Binghamton University (SUNY-Binghamton) Spring 2026
Econ 450, Monetary Economics
Christopher Hanes

Readings

1) The Economy: Crisis and Response (Federal Reserve Bank of San Francisco, 2010)

2) Bagehot's Dictum in Practice: Formulating and Implementing Policies to Combat the Financial Crisis (Brian F. Madigan, Federal Reserve Board, 2009)

3) Reflections on a Year of Crisis (Ben Bernanke, Federal Reserve Board, 2009)

4) Lehman Died, Bagehot Lives: Why Did the Fed and Treasury Let a Major Wall Street Bank Fail? (Willaim R. Cline and Joseph Gagnon, Peterson Institute for International Economics, 2013)

5) Reflections on the TALF and the Federal Reserve's role as liquidity provider (Brian P. Sack, Federal Reserve Bank of New York, 2010)

6) The Federal Reserve's Recent Actions to Support the Flow of Credit to Households and Businesses (Lorie K. Logan, Federal Reserve Bank of New York, 2020)

7) Implementing the Fed's Facilities: Moving at Maximum Speed with Maximum Care (Daleep Singh, Federal Reserve Bank of New York, 2020)

8) Interest Rate Risk, Bank Runs and Silicon Valley Bank. (Christopher J. Neely, Michelle Clark Neely, Federal Reserve Bank of St. Louis, 2023)

9) Bank Failure: the FDIC's Systemic Risk Exception (Marc Labonte, Congressional Research Service, 2023)

10) The Failure of Silicon Valley Bank and the Panic of 2023 (Andrew Metrick, 2023)

11) Understanding Monetary Policy Implementation *excerpts* (Huberto Ennis and Todd Keister, Federal Reserve Bank of Richmond, 2008)

> ***Note:*** *this was written when the Fed was still operating according to the "Fed's pre-2007 system" described in notes. At that time most other central banks had been using the symmetric corridor system for many years. But in America most people, even economists in the Federal Reserve system, were unfamiliar with the corridor system or the floor system. Many people were wedded to the idea that the Fed had to change reserve supply in order to affect the market overnight rate. They did not understand that relationship was specific to the Fed's old system.*

12) Interest Rate Control is More Complicated than You Thought (Stephen D. Williamson, Federal Reserve Bank of St. Louis, 2016)

13) A New Frontier: Monetary Policy with Ample Reserves (Scott A. Wolla, Federal Reserve Bank of St. Louis, 2019)

14) The Fed's "Ample-Reserves" Approach to Implementing Monetary Policy (Jane Ihrig, Zeynep Senyuz, Gretchen C. Weinbach, Federal Reserve Board, 2020)

15) Statement on Longer-Run Goals and Monetary Policy Strategy (Federal Reserve Board, 2012)

16) Statement on Longer-Run Goals and Monetary Policy Strategy (Federal Reserve Board, 2025)

17) Why Are Interest Rates So Low? (Stanley Fischer, Federal Reserve Board of Governors, 2016)

18) Monetary Policy in a Low R-Star World (John Williams, Federal Reserve Bank of San Francisco, 2016)

19) Underlying Trends in the U.S. Neutral Interest Rate (Carlos Carvalho et. al., Federal Reserve Bank of San Francisco, 2025)

20) Supply Chain Disruptions, Inflation, and the Fed (John Mullin, Federal Reserve Bank of Richmond, 2022)

21) What Can We Learn from the Pandemic and the War about Supply Shocks, Inflation, and Monetary Policy (Lael Brainard, Federal Reserve Board of Governors, 2022)

22) Review and Outlook (Jerome H. Powell, Federal Reserve Board of Governors, 2024)

23) The Federal Reserve's Unconventional Policies (John Williams, Federal Reserve Bank of San Francisco, 2012)

24) Economic Outlook and Monetary Policy Implementation (Philip Jefferson, Federal Reserve Board, 2026)

25) What Can History Tell Us About Tariff Shocks? (Regis Barnichon, Aayush Singh, Federal Reserve Bank of San Francisco, 2026)

26) Reflections on Stablecoins and Payments Innovations (Christopher waller, Federal Reserve Board, 2021)

27) Reflections on a Maturing Stablecoin Market (Christopher waller, Federal Reserve Board, 2025)

28) Exploring the Possibilities and Risks of New Payment Technology (Michael Barr, Federal Reserve Board, 2025)

29) A Historical Perspective on Stablecoins (Stephan Luck, Federal Reserve Bank of New York, 2025)

THE ECONOMY: CRISIS & RESPONSE

What ignited the financial crisis?

• Housing boom

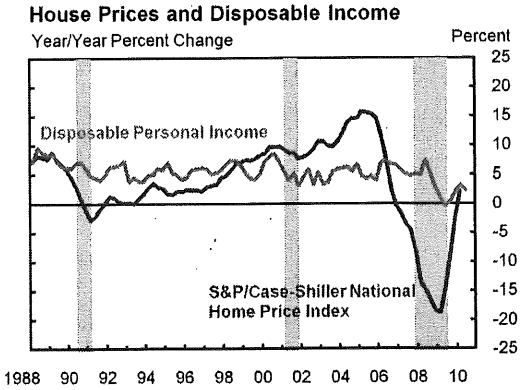
During the early 2000s, low mortgage rates and expanded access to credit made homeownership possible for more people, increasing the demand for housing and driving up house prices. Low mortgage rates were a consequence of low interest rates around the world as well as Federal Reserve policy aimed at stimulating the economy following the 2001 recession. Home prices soared and construction of new houses reached all-time highs. According to one measure, U.S. house prices rose about 10 percent per year on average from 2000 to 2006, well outpacing gains in income. In some areas, the housing boom was even more dramatic, with prices rising by more than 15 percent per year.

References:

Monetary Policy and the Housing Bubble, speech by Ben S. Bernanke, Chairman, Federal Reserve Board of Governors, at the Annual Meeting of the American Economic Association, Atlanta, GA, January 3, 2010.

A View of the Economic Crisis and the Federal Reserve's Response, by Janet L. Yellen, President, Federal Reserve Bank of San Francisco, FRBSF Economic Letter 2009-22, July 6, 2009.

House Prices and Disposable Income



Sources: Standard & Poor's, Fiserv, MacroMarkets LLC, Bureau of Economic Analysis, Haver Analytics; Note: Gray bars reflect NBER recession dating except recent recession end, assumed to be mid 2009.

• Easy credit

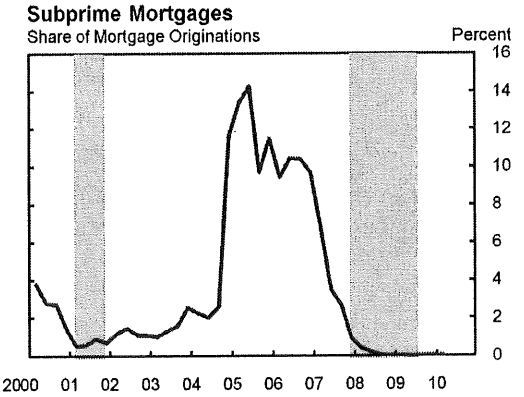
The housing boom got a boost from increased securitization of mortgages—a process in which mortgages were bundled together into securities that were traded in financial markets. Securitization of low-risk mortgages has been around for decades and has helped lower home loan rates by expanding the market of investors that hold mortgages. But, early this decade, securitization of riskier mortgages expanded rapidly, including subprime mortgages made to borrowers with poor credit records. During the boom years, defaults on these mortgages were rare because homeowners could easily refinance or sell their houses. High profits and low defaults made lenders and investors in mortgage-backed securities complacent. Underwriting standards became increasingly lax—including little or no down payment or documentation. Investors were reassured because rating agencies gave even subprime mortgage-backed securities high ratings.

References:

Envisioning a Future for Housing Finance, speech by Elizabeth A. Duke, Governor, Federal Reserve Board of Governors, at the Mortgage Foreclosure Policy Conference, Federal Reserve Bank of Chicago, Chicago, IL, December 10, 2009.

A Minsky Meltdown: Lessons for Central Bankers, by Janet L. Yellen, President, Federal Reserve Bank of San Francisco, FRBSF Economic Letter 2009-15, May 1, 2009.

Subprime Mortgages



Source: LPS Applied Analytics; Note: Gray bars reflect NBER recession dating except recent recession end, assumed to be mid 2009.

• Housing bust and mortgage meltdown

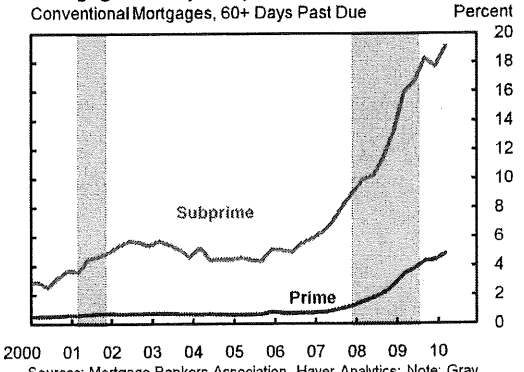
Large numbers of new homes came onto the market and buyers began to realize that home prices could not rise indefinitely. House prices faltered in early 2006 and then started a steep slide. Home sales and construction fell sharply. For many people who had recently bought their homes or had taken equity out when refinancing, falling house prices meant that they owed more on their mortgages than their homes were worth. Starting with subprime mortgages, more and more homeowners fell behind on their payments. Eventually, this spread to prime mortgages as well.

References:

Recent Developments in Mortgage Finance, by John Krainer, Senior Economist, Federal Reserve Bank of San Francisco, FRBSF Economic Letter 2009-33, October 26, 2009.

Housing, Mortgage Markets, and Foreclosures, speech by Ben S. Bernanke, Chairman, Federal Reserve Board of Governors, at the Federal Reserve System Conference on Housing and Mortgage Markets, Washington, DC, December 4, 2008.

Mortgage Delinquency Rates



Sources: Mortgage Bankers Association, Haver Analytics; Note: Gray bars reflect NBER recession dating except recent recession end, assumed to be mid 2009.

Why did the mortgage meltdown threaten the financial system?

• Mortgage-related losses skyrocket

The rising number of delinquencies on subprime mortgages was a wake-up call to lenders and investors that many residential mortgages were not nearly as safe as once believed. As the mortgage meltdown intensified, the magnitude of expected losses rose dramatically. In October 2007, shortly after the onset of the housing bust, the International Monetary Fund estimated that losses of financial institutions related to U.S. residential mortgages would total $240 billion. By April 2009, its estimate was nearly six times larger, exceeding $1.4 trillion. Because millions of U.S. mortgages were repackaged as securities, losses spread across the globe.

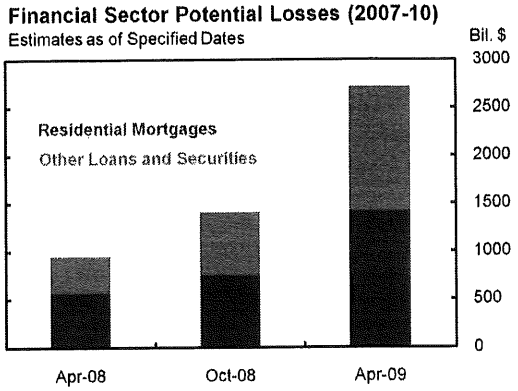
References:

International Perspective on the Crisis and Response, speech by Donald L. Kohn, Vice Chairman, Federal Reserve Board of Governors, at the Federal Reserve Bank of Boston 54th Economic Conference, Chatham, MA, October 23, 2009.

The Mortgage Meltdown, Financial Markets, and the Economy, by Janet L. Yellen, President, Federal Reserve Bank of San Francisco, FRBSF Economic Letter 2008-35-36, November 7, 2008.

Financial Sector Potential Losses (2007-10)

Estimates as of Specified Dates



Source: International Monetary Fund; Note: Data reflect potential losses on U.S. residential mortgages and other U.S. loans and securities held by banks, insurers, and other financial institutions across the globe.

• Confidence erodes

As estimates of the magnitude of mortgage-related losses mounted, investors and financial institutions became increasingly nervous about their own exposure to risk and the financial health of firms with which they did business. In particular, it became very difficult to determine the value of many loans and mortgage-related securities. In addition, the widespread use of complex and exotic financial instruments made it even harder to figure out the vulnerability of financial institutions to losses. Institutions became increasingly reluctant to lend to each other. The situation reached a crisis point in 2007 when these fears about the financial health of other firms led to massive disruptions in the wholesale bank lending market that institutions use to fund their day-to-day needs for cash. As a result, rates on short-term loans rose sharply relative to the overnight federal funds rate.

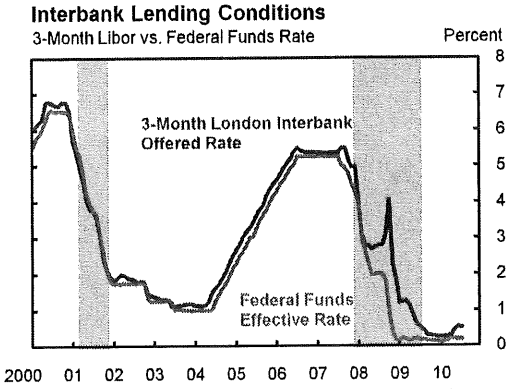
References:

Behavior of Libor in the Current Financial Crisis, by Simon Kwan, Vice President, Federal Reserve Bank of San Francisco, FRBSF Economic Letter 2009-04, January 23, 2009.

The Financial Markets, Housing, and the Economy, by Janet L. Yellen, President, Federal Reserve Bank of San Francisco, FRBSF Economic Letter 2008-13-14, April 18, 2008.

Interbank Lending Conditions

3-Month Libor vs. Federal Funds Rate



Sources: Financial Times, Federal Reserve Board, Haver Analytics; Note: Gray bars reflect NBER recession dating except recent recession end, assumed to be mid 2009.

• Financial markets panic

In the fall of 2008, two large financial institutions failed: the investment bank Lehman Brothers and the savings and loan Washington Mutual. Several others threatened to go under. The extensive web of connections among major financial institutions meant that the failure of one could start a cascade of losses throughout the financial system, threatening many other institutions. Large losses at a big money market mutual fund extended the crisis to a part of the financial system previously regarded as safe, prompting investors to pull their money out. Short-term lending to corporations in the commercial paper market also froze. Confidence in the financial sector collapsed and stock prices of financial institutions around the world plummeted.

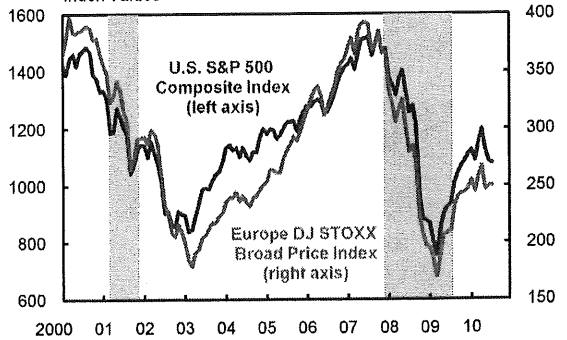
References:

Reflections on a Year of Crisis, speech by Ben S. Bernanke, Chairman, Federal Reserve Board of Governors, at the Federal Reserve Bank of Kansas City's Annual Economic Symposium, Jackson Hole, WY, August 21, 2009.

The Panic of 2008, speech by Kevin Warsh, Governor, Federal Reserve Board of Governors, at the Council of Institutional Investors 2009 Spring Meeting, Washington, DC, April 6, 2009.

Stock Market Indices

Index Values



Sources: Wall Street Journal, Dow Jones, Haver Analytics; Notes: DJ STOXX based in Euro. Gray bars reflect NBER recession dating except recent recession end, assumed to be mid 2009.

How did the financial crisis threaten Main Street?

• Credit crunch

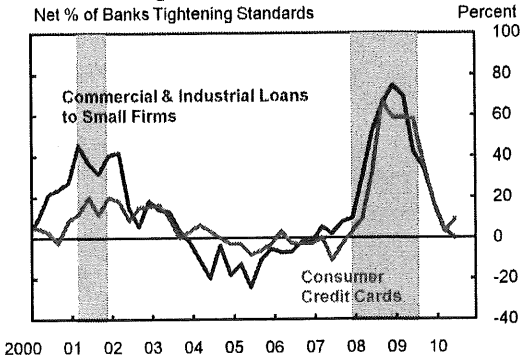
The shock of massive losses in mortgage-related investments made financial institutions and investors much more wary of lending to households and businesses. Bad loans also eroded bank capital, the financial cushion these institutions maintain to cover losses. Moreover, banks were unable to sell most types of loans to investors because securitization markets had stopped working. As a result, banks and investors clamped down on many types of loans by tightening standards and demanding higher interest rates—a classic credit crunch.

References:

Four Questions about the Financial Crisis, speech by Ben S. Bernanke, Chairman, Federal Reserve Board of Governors, at Morehouse College, Atlanta, GA, April 14, 2009.

How Will a Credit Crunch Affect Small Business Finance?, by Gregory F. Udell, Professor, Indiana University, and Visiting Scholar, Federal Reserve Bank of San Francisco, FRBSF Economic Letter 2009-09, March 6, 2009.

Bank Lending Practices



Sources: Federal Reserve Board, Haver Analytics; Note: Gray bars reflect NBER recession dating except recent recession end, assumed to be mid 2009.

• Plummeting wealth

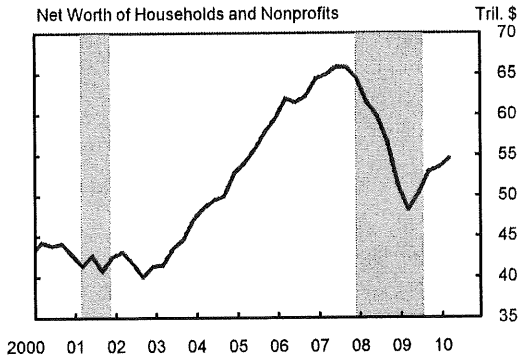
The financial crisis wiped out over 25 percent of Americans' net worth. Plummeting house prices reduced the wealth of Americans by over $7 trillion. Following the panic of late 2008 and the intensifying global recession, stock prices around the world crashed. In the United States, nearly one-half of stock market wealth was lost, a percentage decline that exceeded the 2000-2002 stock market crash. Foreign households didn't fare any better, as stock markets around the world crashed.

References:

Global Household Leverage, House Prices, and Consumption, by Reuven Glick, Group Vice President, and Kevin J. Lansing, Senior Economist, Federal Reserve Bank of San Francisco, FRBSF Economic Letter 2010-01, January 11, 2010.

U.S. Household Deleveraging and Future Consumption Growth, by Reuven Glick, Group Vice President, and Kevin J. Lansing, Senior Economist, Federal Reserve Bank of San Francisco, FRBSF Economic Letter 2009-16, May 15, 2009.

Household Wealth



Sources: Federal Reserve Board. Haver Analytics; Note: Gray bars reflect NBER recession dating except recent recession end, assumed to be mid 2009.

• Recession

The credit crunch and loss of wealth were a one-two punch that sent the United States and many other economies into recession. Tight credit weakened spending on big-ticket items financed by borrowing: houses, cars, and business investment. The hit to household wealth was another factor causing people to cut back on spending as they struggled to rebuild depleted savings. With demand weakening, businesses canceled expansion plans and laid off workers. The U.S. economy entered a recession, a period in which the level of economic activity was shrinking, in December 2007. The recession had been relatively mild until the fall of 2008 when financial panic intensified, causing job losses to soar.

References:

Okun's Law and the Unemployment Surprise of 2009, by Mary Daly, Vice President, and Bart Hobijn, Research Advisor, Federal Reserve Bank of San Francisco, FRBSF Economic Letter 2010-07, March 8, 2010.

Issues Raised by the Credit Crunch and Global Recession, presentation by Janet L. Yellen, President, Federal Reserve Bank of San Francisco, to the Haas Business School, University of California, Berkeley, Berkeley, CA, May 5, 2009.

Unemployment Rate

Sources: Bureau of Labor Statistics, Haver Analytics; Note: Gray bars reflect NBER recession dating except recent recession end, assumed to be mid 2009.

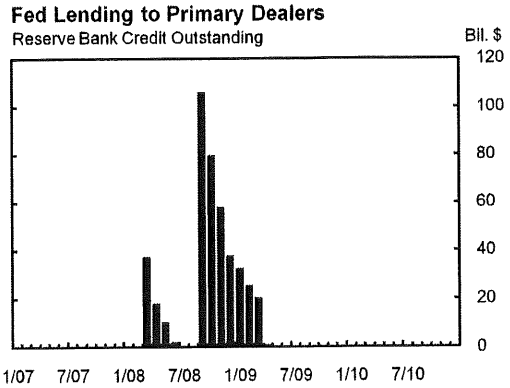
What has the Fed done about the financial crisis?

• Provided liquidity

As short-term markets froze, the Federal Reserve expanded its own collateralized lending to financial institutions to ensure that they had access to the critical funding needed for day-to-day operations. Normally, the Federal Reserve provides loans only to institutions that take deposits, such as commercial banks, a process known as discount-window lending. However, amid a widespread collapse of confidence in early 2008, investment banks, including those that were primary dealers of government securities, also had trouble obtaining short-term funding and became vulnerable to credit cutoffs similar to bank runs. In March 2008, the Federal Reserve created two programs to provide short-term secured loans to primary dealers similar to discount-window loans provided to banks. Conditions in these markets improved considerably in 2009.

Fed Lending to Primary Dealers

Reserve Bank Credit Outstanding



Sources: Federal Reserve Board, Haver Analytics; Note: Reflects credit extended through the Primary Dealer Credit Facility and to certain other broker-dealers.

References:

Monetary Policy in the Crisis: Past, Present, and Future, speech by Donald L. Kohn, Vice Chairman, Federal Reserve Board of Governors, at the Brimmer Policy Forum, American Economic Association Annual Meeting, Atlanta, GA, January 3, 2010.

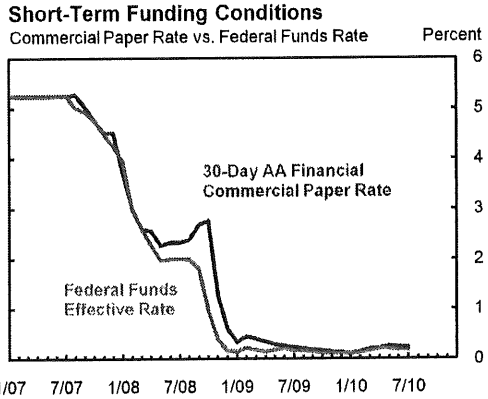
The Federal Reserve's Balance Sheet: An Update, speech by Ben S. Bernanke, Chairman, Federal Reserve Board of Governors, at the Federal Reserve Board Conference on Key Developments in Monetary Policy, Washington, DC, October 8, 2009.

• Supported impaired financial markets

In addition to direct loans to financial institutions, the Federal Reserve acted to improve conditions in two vital markets that broke down during the panic in the fall of 2008: money market mutual funds and short-term lending to businesses. Money market mutual funds collect funds from investors and put money into short-term investments such as Treasury bills and unsecured short-term loans to corporations, known as commercial paper. The commercial paper market is a key funding source for many businesses. But when the investment bank Lehman Brothers declared bankruptcy, investors feared that more failures could make some commercial paper nearly worthless. They began pulling money out of money market mutual funds that held commercial paper. Interest rates on commercial paper skyrocketed. The Federal Reserve provided secured loans to institutions in these markets, ensuring that adequate funding was available. Since then, rates on commercial paper have fallen to low levels and these markets are once again functioning well.

Short-Term Funding Conditions

Commercial Paper Rate vs. Federal Funds Rate



Sources: Federal Reserve Board, Haver Analytics

References:

Gauging Aggregate Credit Market Conditions, by Jose A. Lopez, Research Advisor, Federal Reserve Bank of San Francisco, FRBSF Economic Letter 2009-32, October 19, 2009.

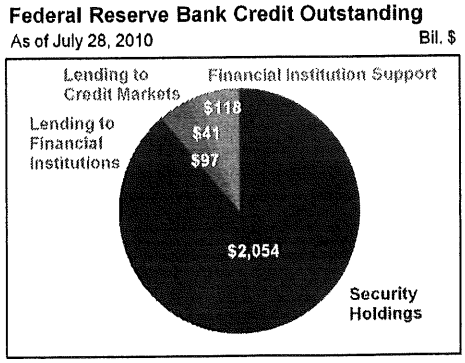
The Federal Reserve's Balance Sheet: An Update, speech by Ben S. Bernanke, Chairman, Federal Reserve Board of Governors, at the Federal Reserve Board Conference on Key Developments in Monetary Policy, Washington, DC, October 8, 2009.

• Supported systemically important financial institutions

The possible failure of the investment bank Bear Stearns early in 2008 carried the risk of a domino effect that would have severely disrupted financial markets. In order to contain the damage, the Federal Reserve provided non-recourse loans to the bank JP Morgan Chase to facilitate its purchase of certain Bear Stearns assets. Following the collapse of the investment bank Lehman Brothers, financial panic threatened to spread to several other key financial institutions, potentially leading to a cascade of failures and a meltdown of the global financial system. The Federal Reserve provided secured loans to the giant insurance company American International Group (AIG) because of its central role guaranteeing financial instruments.

Federal Reserve Bank Credit Outstanding

As of July 28, 2010



Sources: Federal Reserve Board, Haver Analytics; Note: Financial institution support includes support to Bear Stearns through Maiden Lane LLC, and support to AIG through Maiden Lane II LLC, Maiden Lane III LLC, AIA Aurora LLC, ALICO Holdings LLC, and other credit extended.

References:

American International Group, testimony by Ben S. Bernanke, Chairman, Federal Reserve Board of Governors, before the Committee on Financial Services, U.S. House of Representatives, Washington, DC, March 24, 2009.

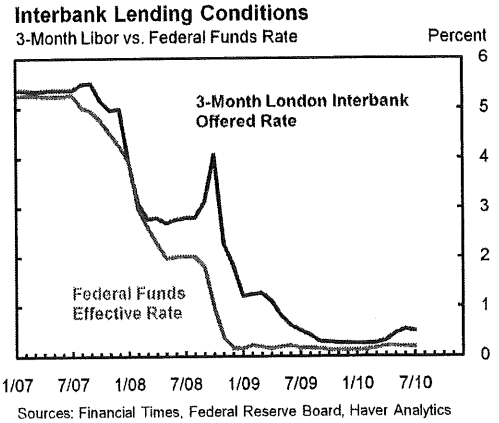
Financial Regulation and Financial Stability, speech by Ben S. Bernanke, Chairman, Federal Reserve Board of Governors, at the Federal Deposit Insurance Corporation's Forum on Mortgage Lending for Low and Moderate Income Households, Arlington, VA, July 8, 2008.

What has the Fed done about banks?

• Added liquidity to the banking system

A basic function of a central bank is to provide emergency cash—liquidity—to the banking system during periods of financial distress. In normal times, banks borrow from each other for terms ranging from overnight to several months. When banks find it difficult to borrow from other banks, they can access what is known as the "discount window," a term referring to Federal Reserve loans secured with collateral. Starting in August 2007, banks became increasingly reluctant to make short-term loans to each other. In response, the Federal Reserve increased the availability of one- and three-month discount-window loans to banks through the creation of the Term Auction Facility. It also created swap lines with foreign central banks to increase the availability of dollar-denominated loans to banks in other countries. In addition, in October 2008, the FDIC launched the Temporary Liquidity Guarantee Program, which provided guarantees on newly issued bank debt and expanded deposit insurance coverage.

Interbank Lending Conditions
3-Month Libor vs. Federal Funds Rate



Sources: Financial Times, Federal Reserve Board, Haver Analytics

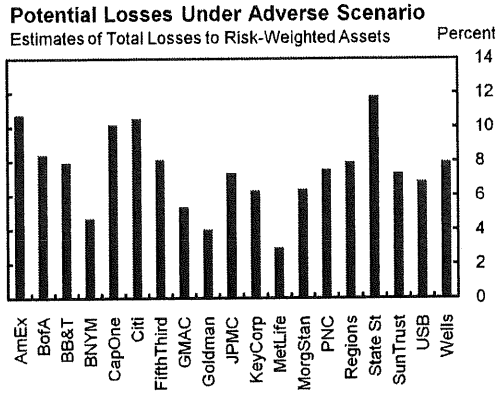
References:
The Federal Reserve's Balance Sheet: An Update, speech by Ben S. Bernanke, Chairman, Federal Reserve Board of Governors, at the Federal Reserve Board Conference on Key Developments in Monetary Policy, Washington, DC, October 8, 2009.

Have the Fed Liquidity Facilities Had an Effect on Libor?, by Jens Christensen, Economist, Federal Reserve Bank of San Francisco, FRBSF Economic Letter 2009-25, August 10, 2009.

• Conducted "stress tests" of major banks

The financial crisis undermined confidence in the banking system. In the spring of 2009, the Federal Reserve, in conjunction with other federal regulatory agencies, conducted an exhaustive and unprecedented review of the financial condition of the 19 largest U.S. banks. This included a "stress test" that measured how well these banks could weather a bad economy over the next two years. Banks that didn't have enough of a capital cushion to protect them from loan losses under the most adverse economic scenario were required to raise new money from the private sector or accept federal government funds from the Troubled Asset Relief Program.

Potential Losses Under Adverse Scenario
Estimates of Total Losses to Risk-Weighted Assets



Source: Federal Reserve Board

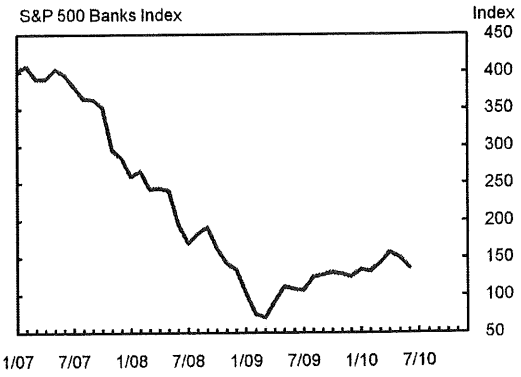
References:
Lessons from the Crisis Stress Tests, speech by Daniel K. Tarullo, Governor, Federal Reserve Board of Governors, at the Federal Reserve Board International Research Forum on Monetary Policy, Washington, DC, March 26, 2010.

Fed Chair Bernanke on the Lessons of SCAP "Stress Tests," Federal Reserve Bank of Atlanta Financial Update, Vol. 22(2), Second Quarter 2009, May 13, 2009.

• Supported systemically important banks

Massive loan losses and the failure of two large financial institutions —Lehman Brothers and Washington Mutual—fueled fears that other large banks could fail. The resulting panic threatened to lead to a full-scale "run" on banks by depositors and lenders, a nightmare scenario that could have caused the entire financial system to break down. That made it essential to support institutions whose failure could lead to such a meltdown. In concert with the Treasury Department and other federal agencies, the Federal Reserve agreed to provide non-recourse loans to two giant banks: Citigroup and Bank of America. Although these loans have not been made, backing from the Federal Reserve and other government agencies helped calm investors.

Bank Stock Prices
S&P 500 Banks Index



Source: Bloomberg

References:
The Economy and Why the Federal Reserve Needs to Supervise Banks, speech by Narayana R. Kocherlakota, President, Federal Reserve Bank of Minneapolis, at the Allied Executives Business & Economic Outlook Symposium, Minneapolis, MN, March 2, 2010.

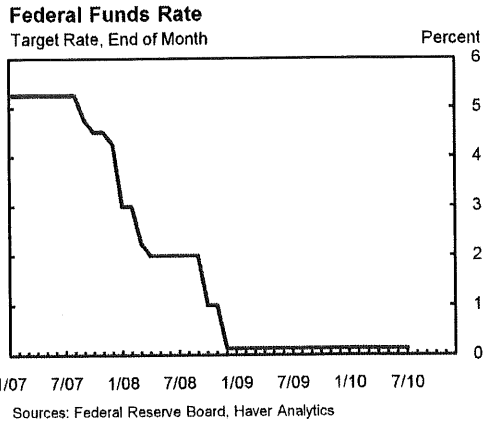
Troubled Asset Relief Program, testimony by Donald L. Kohn, Vice Chairman, Federal Reserve Board of Governors, before the Committee on Financial Services, U.S. House of Representatives, Washington, DC, January 13, 2009.

THE ECONOMY: CRISIS & RESPONSE

What has the Fed done about the economy?

- ### Lowered short-term interest rates to close to zero

In response to the economic crisis, the Federal Reserve's policy making body, the Federal Open Market Committee, slashed its target for the federal funds rate over the course of more than a year, bringing it nearly to zero by December 2008. The federal funds rate—the Federal Reserve's main policy tool—is the interest banks pay for overnight loans and serves as a benchmark for many other short-term interest rates. This is the lowest level for federal funds in over 50 years and effectively is as low as this key rate can go. Cutting the federal funds rate helped lower the cost of borrowing for households and businesses on mortgages and other loans. That helped boost demand, especially for durable goods and housing. Central banks in other major industrial economies also cut interest rates to nearly zero.



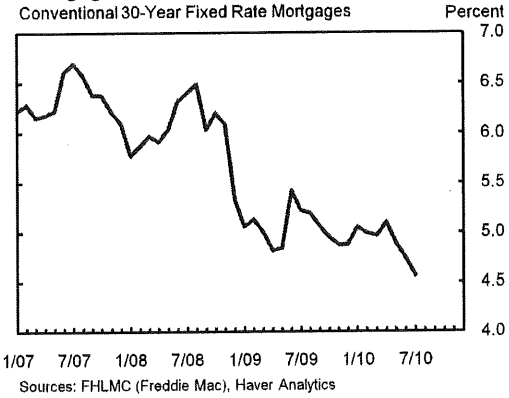
References:

The Fed's Monetary Policy Response to the Current Crisis, by Glenn D. Rudebusch, Senior Vice President and Associate Director of Research, Federal Reserve Bank of San Francisco, FRBSF Economic Letter 2009-17, May 22, 2009.

The Uncertain Economic Outlook and the Policy Responses, presentation by Janet L. Yellen, President, Federal Reserve Bank of San Francisco, to the Forecasters Club of New York, March 25, 2009.

- ### Purchased longer-term securities to lower borrowing costs

By late 2008, the Federal Reserve had pushed the federal funds rate about as low as it could go. To stimulate the economy and further lower borrowing costs, it turned to unconventional policy tools. It purchased $300 billion in longer-term Treasury securities, which are used as benchmarks for a variety of longer-term interest rates, such as corporate bonds and fixed-rate mortgages. To support the housing market, the Federal Reserve authorized the purchase of $1.25 trillion in mortgage-backed securities guaranteed by agencies such as Freddie Mac and Fannie Mae and about $175 billion of mortgage agency longer-term debt. The mortgage meltdown had caused rates on home loans to soar. These Federal Reserve purchases have reduced mortgage interest rates, making home purchases more affordable.



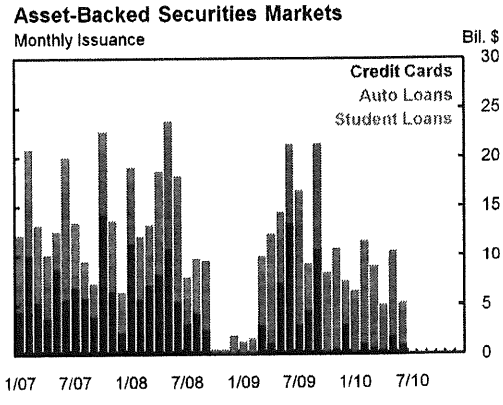
References:

The Federal Reserve's Balance Sheet: An Update, speech by Ben S. Bernanke, Chairman, Federal Reserve Board of Governors, at the Federal Reserve Board Conference on Key Developments in Monetary Policy, Washington, DC, October 8, 2009.

U.S. Monetary Policy Objectives in the Short and Long Run, by Janet L. Yellen, President, Federal Reserve Bank of San Francisco, FRBSF Economic Letter 2009-01-02, January 9, 2009.

- ### Supported securitization of consumer and business loans

The shutdown in securitization of loans—that is, the packaging of loans as securities and their sale to investors—was felt far beyond the mortgage market by late 2008. It affected a wide range of loans, including those for students, credit cards, commercial real estate, and small businesses. Packaging loans into securities had become an important link in the U.S. financial system. By selling loans to investors, banks and other lenders freed up funds that could be used to make more loans. But losses in these markets destroyed investor confidence. In response, the Federal Reserve and the Treasury Department began a program, the Term Asset-Backed Securities Loan Facility, that provides credit to institutions that securitize loans. Since this program started, issuance in these markets has gradually returned and rates on these securities have come down.



References:

Unusual and Exigent: My First Year at the Fed, Elizabeth A. Duke, Governor, Federal Reserve Board of Governors, at the Economics Club of Hampton Roads, Norfolk, VA, February 18, 2010.

Board of Governors of the Federal Reserve System

Speech

Brian F. Madigan, Director, Division of Monetary Affairs
At the Federal Reserve Bank of Kansas City's Annual Economic Symposium, Jackson Hole, Wyoming
August 21, 2009

Bagehot's Dictum in Practice: Formulating and Implementing Policies to Combat the Financial Crisis

As a result of the developments of the past two years, the appropriate scope of central bank policy actions in a crisis is now a matter of significant public discussion, one that is taking place in the context of a wider debate over financial regulatory reform. For central bankers, however, the essential principles guiding their actions are long-standing and well established. In considering the appropriate central bank response to a financial crisis, monetary economists have long appealed to the insights that Walter Bagehot set forth in *Lombard Street*.[1] Paul Tucker, for example, recently summarized Bagehot's dictum as follows: "[T]o avert panic, central banks should lend early and freely (ie without limit), to solvent firms, against good collateral, and at 'high rates.' "[2]

Bagehot's dictum is well founded: By lending freely, the central bank may be able to quell powerful panic-driven demands for liquidity and their potentially untoward effects on the economy. Providing a virtually unlimited source of liquidity to institutions can avert the fire sales that can lead to decreases in asset values, reductions in wealth, and ultimately to a costly contraction in economic activity. And providing liquidity can enable a continuation of the lending by financial institutions that is necessary to support activity at the economy's potential. We might call this the macroeconomic rationale for Bagehot's dictum--promoting the full employment of resources.

At the same time, Bagehot's dictum can be viewed as having a sound foundation in microeconomics--one directed at promoting the efficient allocation of resources. By lending only to solvent firms, by lending only against good collateral, and by charging a penalty rate, central banks can limit the moral hazard and other distortionary effects of government intervention in private financial markets that can impair the efficiency of the economy. Specifically, lending only to sound institutions and lending only against good collateral sharpens firms' incentive to invest prudently in order to remain solvent. And lending only at a penalty rate preserves the incentive for borrowers to obtain market funding when it is available rather than seeking recourse to the central bank.[3] Maintaining these incentives to the greatest extent possible helps promote the efficient allocation of society's resources.

However, these principles need to be interpreted and applied in the real world in which central banks actually operate, one with grey areas and practical considerations. My remarks are intended to articulate some of the challenges that the Federal Reserve has faced in the current crisis as it has struggled to apply established principles of central banking and use its available tools to support economic growth and avoid distortions in the allocation of resources. I also draw lessons from that experience that can be applied toward the formulation of policies relevant to future crises. Of course, the standard disclaimer applies: The views that I am about to express are not necessarily shared by the Board, the Federal Open Market Committee, or other staff members at the Federal Reserve.[4]

Federal Reserve Liquidity Actions during the Crisis: Traditional Central Banking?

One of the key questions that surfaced in the financial crisis is, To whom should central banks lend? According to the quote I cited a minute ago, Paul Tucker's interpretation of Bagehot's view is fairly broad: Central banks are to lend to solvent firms. What is notable about Tucker's formulation is that it is not restricted to banks. In this respect, Tucker's characterization seems to be true to Bagehot. A typically pithy passage from Bagehot makes his perspective quite clear.

> The holders of the cash reserve must be ready not only to keep it for their own liabilities, but to advance it most freely for the liabilities of others. They must lend to merchants, to minor bankers, to 'this man and that man,' whenever the security is good.[5]

Quite evidently, Bagehot saw few limitations on the appropriate counterparties of a central bank in a financial crisis.

In the modern era, central banks in market economies generally do not engage in *routine* lending to institutions that do not have a banking charter. When financial markets and institutions are functioning normally, a central bank has no need to extend credit to nonbank institutions. Extending credit to nonbank firms is held in normal times to be the job of commercial banks and other private lenders. In contrast, the task of a central bank in such circumstances is to ensure that short-term interest rates and the aggregate quantity of money and credit are suitable to promote macroeconomic objectives such as maximum employment and stable prices, primarily using market-based tools like open market operations. Central banks can accomplish this task by restricting their usual lending operations to banks, leaving the allocation of credit across banks and in the broader economy to market mechanisms.

However, the absence of a routine reason for lending to nonbank institutions does not mean that central banks never need the authority to lend to such entities. Bagehot clearly saw this point. His remark that central banks must be prepared to lend to "this man and that man" implies that he drew no sharp distinctions among potential recipients of central bank funding in a panic.

And indeed, from the very beginning of this crisis, events have demonstrated the potential for losses among nonbank firms to lead to systemic disruptions. For example, large redemptions from three funds operated by BNP Paribas, coupled with illiquid conditions in the markets for their assets, prompted the bank to shutter those funds on August 9, 2007, a development that was the immediate cause of intense money market pressures on that first day of the crisis. Over the course of the crisis, many other nonbank entities, including money market funds, conduits, structured investment vehicles, investment banks, and other financial firms experienced what amounted to bank runs. The resulting strains were felt immediately in bank funding markets as well, with rising rate spreads and sharply reduced liquidity, especially for term borrowing, as counterparty credit concerns mounted.

Lending to Commercial Banks and Other Depository Institutions

The Federal Reserve and other central banks initially responded to the panic through the most traditional channels, by stepping up the provision of reserves to banks through open market operations and by increasing the availability and decreasing the cost of liquidity made available to banks through discount mechanisms. However, those steps appeared to have only limited success in stemming the panic, in part because banks were reluctant to use central banks' lending facilities. Indeed, one of the important practical difficulties that confronted the Federal Reserve early in the crisis--and one that appears not to have been anticipated by Bagehot--was the unwillingness of many banks to draw discount window credit because of concerns about stigma.

That unwillingness threatened to undermine the effectiveness of central bank action to combat the crisis. And it was an important motivation behind the decision of the Federal Reserve to establish the Term Auction Facility (TAF) as a means of providing a large volume of term funding to banks through an auction mechanism. The Federal Reserve expected that providing funds through an auction, in which no individual institution can have any assurance of winning funds and where settlement takes place with a lag, would have much less stigma than a standing facility. Other central banks took similar actions in association with the Federal Reserve's establishment of the TAF,

importantly by lending dollars obtained through swap lines arranged with the Federal Reserve. Various researchers have investigated the effectiveness of the TAF, but the econometric results have been diffuse because of thorny econometric identification problems.[6] However, it is difficult to believe that meeting bank demands for more than $1 trillion in dollar funding through the TAF and comparable foreign arrangements, in conjunction with the broad range of other central bank and government interventions, did not play an important role in stabilizing the financial system.[7]

Lending to Primary Dealers and Investment Banks

Although the TAF and related actions were successful in overcoming some banks' concerns about stigma and increasing the availability of term funding to the banking system, particularly over the critical period at year-end 2007, economic conditions continued to weaken, asset prices kept declining, and market volatility stayed elevated. By early 2008, the pressures on financial institutions began to have a distinct adverse effect on primary dealers--highly leveraged firms many of which hold a substantial volume of relatively illiquid, long-term assets financed largely through the market for short-term repurchase (repo) agreements. In the environment of volatile and declining asset values, the required "haircuts" on repo agreements were ratcheting higher, putting pressure on dealers to delever quickly through fire sales of assets; but the fire sales only exacerbated market illiquidity, volatility, and price declines. The failure of a major primary dealer could have meant substantial losses for repo investors, such as money market funds and securities lenders, a development that, in turn, could have led to broader difficulties in the money markets, such as disruption of the commercial paper market, and thus ultimately to serious economic consequences.

In mid-March 2008, Bear Stearns became unable to secure adequate market financing, and some other primary dealers were approaching a similar condition. To address what was rapidly becoming a very unstable situation, the Federal Reserve provided credit to support the acquisition of Bear Stearns by JPMorgan Chase and created two facilities for lending to primary dealers more broadly, the Primary Dealer Credit Facility (PDCF) and the Term Securities Lending Facility (TSLF). Because these facilities involved the extension of credit to nondepository institutions, their establishment required the Federal Reserve Board to invoke its authorities under section 13(3) of the Federal Reserve Act, and in particular to make a determination that "unusual and exigent circumstances" were present--the first time in decades that the section 13(3) authority had been used.[8]

In lending under the PDCF and the TSLF, the Federal Reserve's actions are quite consistent with the principles attributed to Bagehot. The Fed lends to firms that are judged to be solvent; by applying haircuts to the market value of securities, it ensures that it is lending against good collateral; and, particularly under the PDCF, the Fed extends credit at interest rates that would be above-market in more routine circumstances. As under the TAF, TSLF funding is provided through an auction mechanism and at an auction-determined price, a structure that seems to have greatly reduced the problem of stigma.

Rather than lending directly to primary dealers, why couldn't the Federal Reserve maintain its routine lending practices and rely on the usual separation principle under which it lends to commercial banks, and commercial banks in turn lend to nonbank firms such as solvent broker-dealers? After decades of lending only to depository institutions, why did the Federal Reserve suddenly find it necessary in March 2008 to begin lending to broker-dealers?

Very simply, it was because the financial system and the economy experienced a huge--perhaps unprecedented--adverse shock that exposed numerous weaknesses in the financial system. The aggregate value of the housing stock and other assets was in the process of declining by trillions of dollars from peak levels, implying massive losses for financial intermediaries that had lent against such collateral, especially for those that had large exposures to poorly underwritten loans. Given the extent of such losses, and the uncertainty about their exact incidence, concerns about counterparty credit risk and lending firms' own solvency and liquidity increased dramatically. As a result, lending, arbitrage, and, more generally, market functioning broke down across a broad front. Without a

liquidity provider of last resort, that breakdown in market functioning likely would have implied the disorderly failure of a number of primary dealers. Given their large size and interconnections within the financial system, that development would probably have cascaded across markets and institutions, with attendant severe adverse effects on credit availability and the economy. It is also worth recalling that over the first seven months of the crisis, the Federal Reserve responded using essentially its traditional arsenal; but that arsenal eventually proved inadequate given the magnitude of the current shock and the way that it was being transmitted through the entire financial system.

The scope for rapid and unchecked transmission of the shock was increased by changes in financial structure that had developed gradually over preceding years. In particular, investment banks and other primary dealers on the one hand and commercial banks on the other had become more similar. For example, investment banks had moved away from a model under which their assets were primarily an inventory of relatively liquid securities to one in which they held an appreciable amount of relatively illiquid assets such as structured notes and loans they had originated or purchased. At the same time, they continued to finance themselves primarily through deposit-like short-term repo agreements and used substantial amounts of leverage. The model of financing relatively illiquid, longer-term assets with short-term borrowing is, of course, the commercial banking model. Meanwhile, some larger commercial banks had adopted business approaches--more specifically, the originate-to-distribute model--that resembled the operation of investment banks; this business strategy involved relatively less reliance on traditional retail deposit funding and a greater dependence on securitization markets. Moreover, the funding of AAA-rated tranches of securitizations was often provided by conduits that were supported by the originators of the underlying securities. When securitization markets came under increasing strain and ultimately ceased to function altogether, all entities that relied on such markets for funding were exposed. With the relevant economic characteristics of large commercial banks and large investment banks more similar than different, it made little sense to draw sharp distinctions between commercial banks and investment banks in terms of their access to central bank liquidity during the crisis. Still, the Federal Reserve recognized that differences in the supervisory regimes applied to commercial banks and investment banks raised greater issues of moral hazard in lending to investment banks.

As I have noted, the Federal Reserve's initial response to the crisis was consistent with the traditional model of bank-centered intermediation--in effect, it was driven by the Federal Reserve's statutory authority that governs its routine operations and by its established practice. In the wake of a smaller shock, that response might have been sufficient. But the financial system was broadly dysfunctional. And because of their own credit, capital, and liquidity problems, commercial banks simply were unable to act as the channel through which the central bank could provide liquidity sufficient to support the entire financial system. In these circumstances, the choice was stark: Lend to nonbank financial firms, something that had not been undertaken in decades, with the hope and expectation that such action would be sufficient to stave off financial collapse; or refuse to lend and accept almost certain systemic failure.

Terms of Central Bank Lending

Bagehot instructs us to lend at a high rate, and central banks generally seek to lend at a penalty rate in their standing facilities. The motivation that Bagehot had in mind was to avoid unnecessary draws on a limited stock of central bank liquidity, which is not a consideration in modern central banking. But pricing the facilities at a penalty rate has the added virtue of building an "exit strategy" into the structure of the programs. In pricing the PDCF, the Federal Reserve followed Bagehot's instruction by setting the interest rate on PDCF credit at the primary credit rate charged to depository institutions. As financial markets have improved and that rate has come increasingly to represent a penalty relative to rates available in the market, the usage of the PDCF has fallen to zero.

Despite Bagehot's advice to lend broadly, practicability requires that central banks not lend to all firms, or even all financial institutions, either in routine circumstances or in a crisis. Rather, central banks generally need to establish eligibility for their facilities using some sharply defined criteria--for example, a banking charter, designation as a primary dealer, and so on--in order to avoid an untenable situation in which it may appear that individual firms are arbitrarily allowed or denied

access. But because firms are heterogeneous, central banks also have to accept that, as a practical matter, any set of potential borrowers defined on the basis of institutional features will comprise firms with a range of financial characteristics, so that what is a penalty rate for one firm may not be for another.

Partly for this reason, the setting of an above-market rate for a standing facility is not as simple as it might first appear. The heterogeneity of firms, particularly with respect to their size and thus their access to open market sources of funds, implies that either the rate needs to be set a level that represents a stiff penalty for the firms with the lowest marginal cost of funds or that the central bank may need to administratively restrict borrowing by the individual banks that have relatively high marginal costs of funds. A desire to minimize the need for such administrative restrictions is the principal reason that the Federal Reserve has set a relatively wide, 100 basis point spread of the primary credit rate over the target federal funds rate in routine circumstances. With a narrower spread, some banks with relatively high marginal costs of funds would find regular dependence on the discount window to be a cost-minimizing strategy. Over the course of the crisis, the primary credit spread was lowered to 25 basis points in order to encourage institutions to use the window and thus support overall credit availability. When market conditions normalize, a wider spread of the primary credit rate over the funds rate may be needed to provide incentives to all banks to seek market sources of funds.

Actually, the pricing of a collateralized loan is multidimensional, and terms other than the interest rate are relevant. In particular, the terms on which collateral for a discount window loan is taken constitute an important additional dimension, and the haircut applied to the collateral is one of the most salient aspects. In establishing haircuts for the PDCF, the Federal Reserve sought to provide financing on terms that were less onerous than could be obtained in the markets during the crisis but also less attractive than those available in the markets in more routine circumstances. Thus, the haircuts set on the primary dealer facilities represented a generalization of the dictum to "lend at a high rate." This generalization has been applied to the Federal Reserve's other liquidity facilities as well. The fact that usage of the Federal Reserve's liquidity facilities has declined markedly--in several cases to zero--as market conditions have improved suggests that the Federal Reserve has been successful in pricing these programs at terms that represent penalties in more normal circumstances.

Illiquidity and Insolvency

Traditional central banking principles also tell us to lend only to solvent institutions and only against good collateral, but complying with these standards in a crisis is not entirely straightforward. For instance, the difference between solvency and liquidity is not sharp--insolvency can cause illiquidity and vice versa--and the distinction blurs further in a financial panic.[9] Unless markets are quite liquid, any firm that is forced to sell assets in order to obtain liquidity will see some erosion of its economic capital. In a financial panic, when markets for financial assets may be extremely illiquid, enlarged liquidity premiums can absorb so much of a firm's economic capital that its solvency can be called into question if it needs to engage in a fire sale of assets, even though in more placid conditions the solvency of the firm may not be in doubt. Thus, the reduction in market liquidity during a panic can reduce the margin of solvency of financial firms. A key responsibility of central banks is to provide the liquidity to sound banks that is necessary to help them survive bouts of market illiquidity in order to preserve the functioning of the financial system and support economic activity.

However, assessing the solvency of financial firms can be difficult, especially in strained market circumstances. Large financial institutions tend to be opaque, but in routine conditions, given enough time, a central bank can conduct a careful review of the financial condition of the firm seeking liquidity and obtain reliable market quotes for the collateral being tendered to obtain reasonable assurance that the central bank is lending only to sound institutions and with adequate security. In contrast, in a financial crisis, markets may be dysfunctional and price quotes volatile or even unavailable, adding to the uncertainty in assessing firms' solvency. As a result, the decision as to whether to lend to a given firm can entail a significant measure of judgment--judgment both about

the firm's solvency and about the possible market effects of the failure of the firm.

Indeed, the ramifications of a possible default of a large financial firm in conditions of financial stress may be unclear--and, typically, time is short. Consequently, it is essential for a central bank to have the capability to assess the firm's condition and the quality of its collateral, on the basis of incomplete information, rapidly and effectively. It is also essential to be able to make quick and sound judgments as to the likely market effects of the possible failure of such a firm. The experience of the Federal Reserve in this episode illustrated very convincingly that the ability of a central bank to make such determinations in short order is substantially enhanced by the availability of the in-house expertise that comes from having responsibility for conducting bank supervision and from a practice of ongoing monitoring and analysis of a wide range of financial markets and institutions.

Lending to Money Market Mutual Funds and Commercial Paper Issuers

Although the Federal Reserve's lending to primary dealers helped stabilize financial markets over the spring and summer of 2008, the Federal Reserve was again confronted with severe difficulties at nonbank financial firms in the early fall. At that time, money market mutual funds, among many other entities, came under intense liquidity pressures. The U.S. money fund industry is huge; with more than $3-1/2 trillion in assets, it is close to one-third the size of the U.S. commercial banking system. Moreover, money funds are major investors in the large and critical commercial paper and repo markets.

Certain characteristics of money funds make them vulnerable to runs, like banks in the absence of deposit insurance. First, money funds engage in maturity transformation: They offer shares that are payable on demand but hold assets that typically mature in several weeks. Last fall, secondary markets for those assets came under considerable strain, and as a result funds had difficulty disposing of assets to meet redemptions without experiencing capital losses. Second, investors have come to
expect--and demand--an unwavering money fund share price of $1, in part because money funds have regulatory authority to maintain, within limits, a stable price in the face of fluctuating market values of their assets. When the market value of money fund shares is expected to fall below their price, investors have an incentive to run.

But money funds, unlike banks, do not have regular access to the discount window and do not have a permanent share insurance arrangement that would neutralize the incentive to run. Furthermore, the short-term nature of money funds' assets means that any broad-scale disruption to their investment poses an immediate threat to firms whose economic activity depends on access to financing in the money markets--especially when the availability of funding from alternative sources, such as commercial banks, is diminished.

The fact that money funds are subject to runs was a significant contributor to the enormous increase in financial stress that occurred in the fall of 2008. On September 16, the Reserve Primary Fund announced that it "broke the buck" as a result of losses on its holdings of Lehman paper. That announcement was an unpleasant wake-up call for the many investors who had assumed that their investments in money market funds were, for all practical purposes, absolutely safe.

Still, the money fund industry is quite competitive, with hundreds of funds in operation, and even in the highly stressed conditions during the fall of 2008, no single fund was large enough to be critical to the continued functioning of the financial system. Nonetheless, a substantial number of funds--in particular, many of the so-called prime funds that usually invest mainly in private debt securities--were seen by investors as having exposures potentially similar to that of the Reserve Primary Fund. A severe run on much of the industry ensued, with withdrawals totaling hundreds of billions of dollars and more than 100 funds losing a substantial volume of assets in the span of just a few weeks.

As a result, many money funds were forced to dump assets on the market and cease buying new paper. Consequently, the commercial paper market nearly ground to a halt, preventing many

businesses and investment vehicles from rolling over their liabilities beyond very short terms and leaving them potentially unable to finance their operations. In addition, banks had provided lines of credit to many issuers of unsecured paper as well as ABCP programs; as a result, banks faced additional pressures on their balance sheets though their commitments to provide loans under such lines.

Given the direct threat to economic activity and the scope for exacerbating the liquidity crunch, these circumstances were clearly unusual and exigent and warranted extending central bank credit to money funds even though, once again, the entities needing liquidity did not have regular access to the discount window. Had Bagehot been a member of the Federal Reserve Board, he most certainly would have approved such action.

However, several factors potentially impeded the Federal Reserve's ability to lend to such entities. For example, representatives of the money fund industry advised the Federal Reserve that money funds would be unwilling to borrow, partly because investors would recognize that leverage would amplify the effects of any fund losses on remaining shareholders and intensify their incentive to run. Indeed, the Federal Reserve Board approved the establishment of a Direct Money Market Mutual Fund Lending Facility but left it on the shelf after being informed that money funds would be unwilling to use it.[10]

The unwillingness of money funds to borrow led the Federal Reserve to implement several facilities in support of money funds and money markets that did not involve direct lending to money funds. For example, under the Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility (AMLF), the Federal Reserve lends not to money funds, but rather to commercial banking organizations, which can pledge as collateral just one type of asset--top-rated asset-backed commercial paper (ABCP)--that they purchase at amortized cost from the money funds. Tight constraints in designing the program--in particular, the need to lend to banking organizations rather than directly to the money funds--as well as the narrow spread of good quality ABCP over the federal funds rate meant that the credits had to be structured as nonrecourse loans, and also that it was impossible to charge a penalty rate for this facility; thus the design of the facility diverges modestly from Bagehot's principles. Partly to ensure that the absence of a penalty rate does not encourage funds to rely inappropriately on the facility, the Federal Reserve recently imposed certain constraints on use of the program that ensure it is used only for liquidity reasons.

Given the limitations on the AMLF, the Federal Reserve saw some risk that this facility would not provide sufficient support to the money market and economic activity dependent on money market financing. So, even as the AMLF was being launched, the Federal Reserve intensively considered other mechanisms. It is essential to recall the circumstances under which this problem was being addressed. Several large financial institutions had failed or were close to failure. Large banks were extremely concerned about losses, capital adequacy, and continued access to liquidity, and thus were rapidly tightening terms and standards for credit extensions rather than seeking new lending opportunities; indeed, the situation was so serious that the government was designing mechanisms for injecting capital into major banking institutions and cleansing them of troubled assets.

Under these conditions, it was highly unlikely that an effective mechanism could be engineered for increasing the availability of short-term financing through normal channels to nonfinancial businesses and to the conduits and other vehicles that relied on commercial paper. Issuance of paper with terms of more than a few days was nearly impossible, so the volume of paper maturing each day was in the hundreds of billions of dollars and mounting steadily, indicating that addressing the problem quickly was essential. Banking organizations themselves had issued large amounts of commercial paper, and thus the problems in the commercial paper market exacerbated banks' own liquidity problems. The serious impairment of two major sources of funding to the business sector--commercial banks and money funds--implied that prospects were dim for buoying the extension of credit to firms and households by providing additional liquidity to any existing financial intermediary.

In order to support the continued availability of short-term credit to the economy, the Federal Reserve established the Commercial Paper Funding Facility (CPFF). Under the CPFF, the Federal Reserve in effect lends directly to nonfinancial as well as financial issuers of commercial paper.[11] Although the details of the CPFF stand in some contrast to standard central bank liquidity facilities--in particular, its security comes from fees rather than from collateral--in its broad structure, the facility is still in keeping with Bagehot's view of appropriate central bank actions in a crisis. Indeed, as I noted earlier in my remarks, Bagehot exhorted central bankers dealing with a panic to lend even "to merchants."

Ultimately, the AMLF and the CPFF, in combination with a range of other Federal Reserve and government programs and facilities, proved successful in stemming the run on money funds and stabilizing the money markets.[12] Over the course of the fourth quarter of 2008, flows to prime money funds resumed, the runoff of commercial paper slowed, and usage of the AMLF and CPFF began to decline. In retrospect, it is clear that the broad suite of actions taken by central banks and governments in the fall of 2008 was key to arresting the broadening liquidity panic.

Lending to Investors in Asset-Backed Securities

The crisis of fall 2008 disrupted not only the money markets but also other key financial markets. In particular, activity in the asset-backed securities (ABS) markets, in which more than one-third of consumer lending had been financed in recent years, abruptly halted in the fourth quarter. Of the markets providing longer-term credit to the economy, the ABS market was especially hard-hit because leverage was no longer available from the conduits, securities lenders, and other entities to the traditional investors in the higher-rated tranches of ABS who customarily relied heavily on leverage to achieve their desired risk-return combinations.

Without a functioning ABS market as an outlet for originations of loans, the availability of auto, credit card, and student loans, as well as other types of financing, was likely to become even more impaired, further undermining economic activity. In response, the Federal Reserve in late 2008 announced that it was establishing the Term Asset-Backed Securities Loan Facility (TALF). Under the TALF, the Federal Reserve lends on a nonrecourse basis, at interest rates and with haircuts that would ordinarily be less attractive than those available in the market, to investors in the AAA-rated tranches of ABS. Both the significant haircuts on the collateral and backing from the Treasury afford the Federal Reserve substantial protection from credit risk.

At first blush, the TALF appears very different from the traditional discount mechanisms of central banks. The Federal Reserve is intervening in a specific market for longer-term credit. But, in most of its essential elements, the TALF fits neatly into standard central bank approaches for addressing financial crises. Under the TALF, the Federal Reserve lends to investors against collateral--again, with substantial haircuts and additional credit protection provided by the Treasury--and at penalty rates.[13] And the program lends against a broad range of asset-backed collateral to minimize distortions to credit allocation. Encouragingly, activity in the ABS market has picked up so far this year, suggesting that the TALF has been successful in helping to buoy the availability of credit to firms and households and thus in supporting economic activity.

Some Lessons

Let me conclude with several lessons that can be drawn from the Federal Reserve's experience in extending credit in this episode. First, Bagehot's dictum continues to provide a useful framework for designing central bank actions for combating a financial crisis. However, that framework needs to be interpreted in the context of the modern structure of financial markets and institutions and applied in a way that observes both legal constraints and a broad range of practical considerations. The experience of the crisis shows that, in extraordinary circumstances, central banks may well need to take measures to prevent systemic collapse that are unprecedented in their details; but such measures may still be quite congruent with established central banking principles.

Second, the problem of discount window stigma is real and serious. The intense caution that banks

displayed in managing their liquidity beginning in early August 2007 was partly a result of their extreme reluctance to rely on standard discount mechanisms. Absent such reluctance, conditions in interbank funding markets may have been significantly less stressed, with less contagion to financial markets more generally. Central banks eventually were able to take measures to partially circumvent this stigma by designing additional lending facilities for depository institutions; but analyzing the problem, developing these programs, and gathering the evidence to support a conclusion that they were necessary took valuable time. Going forward, central banks and other policymakers need to avoid measures that could further exacerbate the stigma of using central bank lending facilities. And they should consider whether some now-existing arrangements, such as the Term Auction Facility and similar mechanisms, need to be adapted and made permanent, or new facilities established, so that the stigma of using central bank credit is minimized, especially in future crises.

Third, the severe difficulties encountered by primary dealers in this crisis, and the evident consequences for broader effects on the financial system and the economy, illustrate a broader point: Any financial system that includes systemically important nonbank financial firms with significant amounts of illiquid assets and short-term liabilities--in other words, any system that includes important nonbank financial firms subject to bank-like runs--requires a mechanism for lending to such firms at least in crisis situations. Even though those firms may not be banks de jure, they are banks de facto in the risks that they pose to the broader financial system and the economy. Like banks, their interconnectedness with other parts of the financial system, as well as their similarities to one another and to other types of financial institutions, makes contagion possible and, in some circumstances, likely. The experience of this episode underscored once again the severe consequences that can result from the disorderly failure of one or more major financial institutions and the need for liquidity and resolution mechanisms to prevent such failures.

Fourth, the run on money funds implies that individual nonbank "firms" do not necessarily have to be systemically important in themselves to warrant access to centralized liquidity. Rather, if the difficulties of one or a few such firms pose the risk of contagion to similar entities or to other parts of the financial system, a run on an entire set of firms, atomistic in themselves but not in the aggregate, can ensue, potentially disrupting economic activity. Thus, a means of lending in contingency situations even to nonbank firms that may not be systemically critical in themselves would seem necessary to promote a suitable degree of financial stability.

Finally, experience suggests that a workable regulatory system must incorporate a mechanism to extend central bank credit to entities that are not normally eligible to borrow from the central bank; no reasonable system of regulation can draw a bright line that cannot be crossed between banks and nonbanks. Absent very onerous regulation, there will always be a continuum in the degree to which financial firms pose systemic risk. Subjecting systemically risky firms to enhanced supervision and regulation is certainly warranted. But practical considerations will always require that only a well-specified set of institutions subject to a specific supervisory regime have regular access to central bank credit, and that firms outside the boundary do not have such access. Lending to some firms without routine access to central bank credit will occasionally be appropriate to prevent severe systemic disruptions. Thus, it would seem that authority similar to that provided by section 13(3) will continue to be necessary.

In summary, the recent financial crisis provides considerable evidence in support of what Bagehot knew more than 135 years ago from the experience of his era. To cushion the adverse effects of a financial panic on economic activity, a central bank must be ready to lend freely, potentially to a broad range of counterparties, in a crisis. Although the need for a modern central bank to lend in normal times may be quite limited, it is not prudent to severely circumscribe the potential scope for central bank lending in a financial panic. Rather, as Bagehot recommended, we should look to the restrictions of lending only to solvent firms, only against good collateral, and only at high rates to limit distortionary effects on markets and to protect the fisc while allowing central bank credit to prevent financial panics from having excessively adverse effects on economic activity and employment. Bagehot's precepts need to be interpreted and applied in light of practical considerations, and that application is not necessarily straightforward. In a crisis, the solvency of

firms may be uncertain and even dependent on central bank actions; the value of collateral may be depressed to an uncertain degree by liquidity rather than credit premiums; and the extent to which the terms of a central bank facility represent a penalty rate may depend on the circumstances and vary across firms. Nonetheless, Bagehot's dictum effectively addresses key economic objectives of society and thus continues to provide a useful framework for the formulation of central banks' policy actions in a crisis.

Footnotes

1. Walter Bagehot ([1873] 1897), *Lombard Street: A Description of the Money Market* (New York: Charles Scribner's Sons). Return to text

2. Paul Tucker (2009), "The Repertoire of Official Sector Interventions in the Financial System: Last Resort Lending, Market-Making, and Capital (90 KB PDF)," remarks at the Bank of Japan 2009 International Conference on the Financial System and Monetary Policy Implementation, Bank of Japan, Tokyo, May 27-28, p. 5. Return to text

3. Chairman Bernanke has noted that a desire to minimize moral hazard was not Bagehot's principal motivation for recommending that the central bank should lend at a penalty rate; rather, the high rate was intended to discourage unnecessary draws on limited liquidity. (See Ben S. Bernanke (2008), "Liquidity Provision by the Federal Reserve," remarks at the Federal Reserve Bank of Atlanta Financial Markets Conference, Sea Island, Georgia (via satellite), May 13.) Still, reducing moral hazard is one potentially important benefit of following Bagehot's precepts. Prudential supervision and regulation are also important mechanisms to ensure that financial institutions appropriately manage their liquidity. Return to text

4. Nonetheless, I thank, without implicating, members of the Board of Governors and members of the Board's staff for comments and suggestions. Return to text

5. Bagehot, *Lombard Street*, p. 51. Bagehot goes on to say (pp. 51-2), "The way in which the panic of 1825 was stopped by advancing money has been described in so broad and graphic a way that the passage has become classical. 'We lent it,' said Mr. Harman, on behalf of the Bank of England, 'by every possible means and in modes we had never adopted before; we took in stock on security, we purchased Exchequer bills, we made advances on Exchequer bills, we not only discounted outright, but we made advances on the deposit of bills of exchange to an immense amount[,] in short, by every possible means consistent with the safety of the Bank, and we were not on some occasions over-nice....' After a day or two of this treatment, the entire panic subsided, and the 'City' was quite calm." Return to text

6. See, for instance, John B. Taylor and John C. Williams (2008), "A Black Swan in the Money Market (339 KB PDF)," Working Paper 2008-04 (San Francisco: Federal Reserve Bank of San Francisco, February (revised April 2008)); and Tao Wu (2008), "On the Effectiveness of the Federal Reserve's New Liquidity Facilities (300 KB PDF)," Working Paper 0808 (Dallas: Federal Reserve Bank of Dallas, May). Return to text

7. To be sure, the fundamental problems of the banking system stemmed from losses and erosion of capital, and the situation was not adequately stabilized until governments contributed capital and provided guarantees to the banking system. Nonetheless, the TAF and comparable actions surely acted as at least a palliative by addressing panic-driven demands for liquidity. Return to text

8. Although the Federal Reserve found it necessary, in the interest of financial stability, to lend to support the acquisition of Bear Stearns and later to prevent the disorderly failure of AIG--in both cases with the full support of the Treasury Department--the Federal Reserve and the Treasury have both noted that a superior arrangement would be for the Congress to establish by statute a regime for the resolution of systemically important nonbank financial firms. Under such a regime, the central

bank presumably would need to lend to a failing systemically important institution at most only for a brief period before responsibility was assumed by the resolving authority.Return to text

9. See Ben S. Bernanke (2009), "Reflections on a Year of Crisis," speech delivered at a symposium sponsored by the Federal Reserve Bank of Kansas City, held in Jackson Hole, Wyo., August 21-23. Return to text

10. The creation of the Direct Money Market Mutual Fund Lending Facility is reported in *Minutes of Meeting of Federal Reserve Board*, "Financial Markets--Proposal to Provide Liquidity Directly to Money Market Mutual Funds through the Direct Money Market Mutual Fund Lending Facility (103 KB PDF)," October 3, 2008, pp. 11-12, available on the Board's website. Return to text

11. The CPFF purchases commercial paper directly from issuers and finances those purchases through loans from the Federal Reserve. The loans are secured by fees paid by the issuers and by the accumulation of an excess spread in the facility. Return to text

12. Among other key government actions during the fall of 2008, the Treasury established a Temporary Guarantee Program for Money Market Funds, and the FDIC implemented a Temporary Liquidity Guarantee Program to insure certain bank debt, including commercial paper issued by banks. Return to text

13. The fact that credit is extended on a nonrecourse basis means that the third element of Bagehot's dictum--lending only to sound institutions--is of little direct relevance. Return to text

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Board of Governors of the Federal Reserve System

Speech

Chairman Ben S. Bernanke
At the Federal Reserve Bank of Kansas City's Annual Economic Symposium, Jackson Hole, Wyoming

Chairman Bernanke delivered the same remarks at the Brookings Institution, on September 15, 2009

August 21, 2009

Reflections on a Year of Crisis

By the standards of recent decades, the economic environment at the time of this symposium one year ago was quite challenging. A year after the onset of the current crisis in August 2007, financial markets remained stressed, the economy was slowing, and inflation--driven by a global commodity boom--had risen significantly. What we could not fully appreciate when we last gathered here was that the economic and policy environment was about to become vastly more difficult. In the weeks that followed, several systemically critical financial institutions would either fail or come close to failure, activity in some key financial markets would virtually cease, and the global economy would enter a deep recession. My remarks this morning will focus on the extraordinary financial and economic events of the past year, as well as on the policy responses both in the United States and abroad.

One very clear lesson of the past year--no surprise, of course, to any student of economic history, but worth noting nonetheless--is that a full-blown financial crisis can exact an enormous toll in both human and economic terms. A second lesson--once again, familiar to economic historians--is that financial disruptions do not respect borders. The crisis has been global, with no major country having been immune.

History is full of examples in which the policy responses to financial crises have been slow and inadequate, often resulting ultimately in greater economic damage and increased fiscal costs. In this episode, by contrast, policymakers in the United States and around the globe responded with speed and force to arrest a rapidly deteriorating and dangerous situation. Looking forward, we must urgently address structural weaknesses in the financial system, in particular in the regulatory framework, to ensure that the enormous costs of the past two years will not be borne again.

September-October 2008: The Crisis Intensifies

When we met last year, financial markets and the economy were continuing to suffer the effects of the ongoing crisis. We know now that the National Bureau of Economic Research has determined December 2007 as the beginning of the recession. The U.S. unemployment rate had risen to 5-3/4 percent by July, about 1 percentage point above its level at the beginning of the crisis, and household spending was weakening. Ongoing declines in residential construction and house prices and rising mortgage defaults and foreclosures continued to weigh on the U.S. economy, and forecasts of prospective credit losses at financial institutions both here and abroad continued to increase. Indeed, one of the nation's largest thrift institutions, IndyMac, had recently collapsed under the weight of distressed mortgages, and investors continued to harbor doubts about the condition of the government-sponsored enterprises (GSEs) Fannie Mae and Freddie Mac, despite the approval by the Congress of open-ended support for the two firms.

Notwithstanding these significant concerns, however, there was little to suggest that market participants saw the financial situation as about to take a sharp turn for the worse. For example,

although indicators of default risk such as interest rate spreads and quotes on credit default swaps remained well above historical norms, most such measures had declined from earlier peaks, in some cases by substantial amounts. And in early September, when the target for the federal funds rate was 2 percent, investors appeared to see little chance that the federal funds rate would be below 1-3/4 percent six months later. That is, as of this time last year, market participants evidently believed it improbable that significant additional monetary policy stimulus would be needed in the United States.

Nevertheless, shortly after our last convocation, the financial crisis intensified dramatically. Despite the steps that had been taken to support Fannie Mae and Freddie Mac, their condition continued to worsen. In early September, the companies' regulator placed both into conservatorship, and the Treasury used its recently enacted authority to provide the firms with massive financial support.

Shortly thereafter, several additional large U.S. financial firms also came under heavy pressure from creditors, counterparties, and customers. The Federal Reserve has consistently maintained the view that the disorderly failure of one or more systemically important institutions in the context of a broader financial crisis could have extremely adverse consequences for both the financial system and the economy. We have therefore spared no effort, within our legal authorities and in appropriate cooperation with other agencies, to avert such a failure. The case of the investment bank Lehman Brothers proved exceptionally difficult, however. Concerted government attempts to find a buyer for the company or to develop an industry solution proved unavailing, and the company's available collateral fell well short of the amount needed to secure a Federal Reserve loan of sufficient size to meet its funding needs. As the Federal Reserve cannot make an unsecured loan, and as the government as a whole lacked appropriate resolution authority or the ability to inject capital, the firm's failure was, unfortunately, unavoidable. The Federal Reserve and the Treasury were compelled to focus instead on mitigating the fallout from the failure, for example, by taking measures to stabilize the triparty repurchase (repo) market.

In contrast, in the case of the insurance company American International Group (AIG), the Federal Reserve judged that the company's financial and business assets were adequate to secure an $85 billion line of credit, enough to avert its imminent failure. Because AIG was counterparty to many of the world's largest financial firms, a significant borrower in the commercial paper market and other public debt markets, and a provider of insurance products to tens of millions of customers, its abrupt collapse likely would have intensified the crisis substantially further, at a time when the U.S. authorities had not yet obtained the necessary fiscal resources to deal with a massive systemic event.

The failure of Lehman Brothers and the near-failure of AIG were dramatic but hardly isolated events. Many prominent firms struggled to survive as confidence plummeted. The investment bank Merrill Lynch, under pressure in the wake of Lehman's failure, agreed to be acquired by Bank of America; the major thrift institution Washington Mutual was resolved by the Federal Deposit Insurance Corporation (FDIC) in an assisted transaction; and the large commercial bank Wachovia, after experiencing severe liquidity outflows, agreed to be sold. The two largest remaining free-standing investment banks, Morgan Stanley and Goldman Sachs, were stabilized when the Federal Reserve approved, on an emergency basis, their applications to become bank holding companies.

Nor were the extraordinary pressures on financial firms during September and early October confined to the United States: For example, on September 18, the U.K. mortgage lender HBOS, with assets of more than $1 trillion, was forced to merge with Lloyds TSB. On September 29, the governments of Belgium, Luxembourg, and the Netherlands effectively nationalized Fortis, a banking and insurance firm that had assets of around $1 trillion. The same day, German authorities provided assistance to Hypo Real Estate, a large commercial real estate lender, and the British government nationalized another mortgage lender, Bradford and Bingley. On the next day, September 30, the governments of Belgium, France, and Luxembourg injected capital into Dexia, a bank with assets of more than $700 billion, and the Irish government guaranteed the deposits and most other liabilities of six large Irish financial institutions. Soon thereafter, the Icelandic government, lacking the resources to rescue the three largest banks in that country, put them into receivership and requested assistance from the International Monetary Fund (IMF) and from other

Nordic governments. In mid-October, the Swiss authorities announced a rescue package for UBS, one of the world's largest banks, that consisted of a capital injection and a purchase of assets.[1] The growing pressures were not limited to banks with significant exposure to U.S. or U.K real estate or to securitized assets. For example, unsubstantiated rumors circulated in late September that some large Swedish banks were having trouble rolling over wholesale deposits, and on October 13 the Swedish government announced measures to guarantee bank debt and to inject capital into banks.[2]

The rapidly worsening crisis soon spread beyond financial institutions into the money and capital markets more generally. As a result of losses on Lehman's commercial paper, a prominent money market mutual fund announced on September 16 that it had "broken the buck"--that is, its net asset value had fallen below $1 per share. Over the subsequent several weeks, investors withdrew more than $400 billion from so-called prime money funds.[3] Conditions in short-term funding markets, including the interbank market and the commercial paper market, deteriorated sharply. Equity prices fell precipitously, and credit risk spreads jumped. The crisis also began to affect countries that had thus far escaped its worst effects. Notably, financial markets in emerging market economies were whipsawed as a flight from risk led capital inflows to those countries to swing abruptly to outflows.

The Policy Response

Authorities in the United States and around the globe moved quickly to respond to this new phase of the crisis, although the details differed according to the character of financial systems. The financial system of the United States gives a much greater role to financial markets and to nonbank financial institutions than is the case in most other nations, which rely primarily on banks.[4] Thus, in the United States, a wider variety of policy measures was needed than in some other nations.

In the United States, the Federal Reserve established new liquidity facilities with the goal of restoring basic functioning in various critical markets. Notably, on September 19, the Fed announced the creation of a facility aimed at stabilizing money market mutual funds, and the Treasury unveiled a temporary insurance program for those funds. On October 7, the Fed announced the creation of a backstop commercial paper facility, which stood ready to lend against highly rated commercial paper for a term of three months.[5] Together, these steps helped stem the massive outflows from the money market mutual funds and stabilize the commercial paper market.

During this period, foreign commercial banks were a source of heavy demand for U.S. dollar funding, thereby putting additional strain on global bank funding markets, including U.S. markets, and further squeezing credit availability in the United States. To address this problem, the Federal Reserve expanded the temporary swap lines that had been established earlier with the European Central Bank (ECB) and the Swiss National Bank, and established new temporary swap lines with seven other central banks in September and five more in late October, including four in emerging market economies.[6] In further coordinated action, on October 8, the Federal Reserve and five other major central banks simultaneously cut their policy rates by 50 basis points.

The failure of Lehman Brothers demonstrated that liquidity provision by the Federal Reserve would not be sufficient to stop the crisis; substantial fiscal resources were necessary. On October 3, on the recommendation of the Administration and with the strong support of the Federal Reserve, the Congress approved the creation of the Troubled Asset Relief Program, or TARP, with a maximum authorization of $700 billion to support the stabilization of the U.S. financial system.

Markets remained highly volatile and pressure on financial institutions intense through the first weeks of October. On October 10, in what would prove to be a watershed in the global policy response, the Group of Seven (G-7) finance ministers and central bank governors, meeting in Washington, committed in a joint statement to work together to stabilize the global financial system. In particular, they agreed to prevent the failure of systemically important financial institutions; to ensure that financial institutions had adequate access to funding and capital, including public capital if necessary; and to put in place deposit insurance and other guarantees to restore the confidence of depositors.[7] In the following days, many countries around the world announced comprehensive rescue plans for their banking systems that built on the G-7 principles. To stabilize funding, during

October more than 20 countries expanded their deposit insurance programs, and many also guaranteed nondeposit liabilities of banks. In addition, amid mounting concerns about the solvency of the global banking system, by the end of October more than a dozen countries had announced plans to inject public capital into banks, and several announced plans to purchase or guarantee bank assets. The comprehensive U.S. response, announced on October 14, included capital injections into both large and small banks by the Treasury; a program which allowed banks and bank holding companies, for a fee, to issue FDIC-guaranteed senior debt; the extension of deposit insurance to all noninterest-bearing transactions deposits, of any size; and the Federal Reserve's continued commitment to provide liquidity as necessary to stabilize key financial institutions and markets.[8]

This strong and unprecedented international policy response proved broadly effective. Critically, it averted the imminent collapse of the global financial system, an outcome that seemed all too possible to the finance ministers and central bankers that gathered in Washington on October 10. However, although the intensity of the crisis moderated and the risk of systemic collapse declined in the wake of the policy response, financial conditions remained highly stressed. For example, although short-term funding spreads in global markets began to turn down in October, they remained elevated into this year. And, although generalized pressures on financial institutions subsided somewhat, government actions to prevent the disorderly failures of individual, systemically significant institutions continued to be necessary. In the United States, support packages were announced for Citigroup in November and Bank of America in January. Broadly similar support packages were also announced for some large European institutions, including firms in the United Kingdom and the Netherlands.[9]

Although concerted policy actions avoided much worse outcomes, the financial shocks of September and October nevertheless severely damaged the global economy--starkly illustrating the potential effects of financial stress on real economic activity. In the fourth quarter of 2008 and the first quarter of this year, global economic activity recorded its weakest performance in decades. In the United States, real GDP plummeted at nearly a 6 percent average annual pace over those two quarters--an even sharper decline than had occurred in the 1981-82 recession. Economic activity contracted even more precipitously in many foreign economies, with real GDP dropping at double-digit annual rates in some cases. The crisis affected economic activity not only by pushing down asset prices and tightening credit conditions, but also by shattering household and business confidence around the world.

In response to these developments, the Federal Reserve expended the remaining ammunition in the traditional arsenal of monetary policy, bringing the federal funds rate down, in steps, to a target range of 0 to 25 basis points by mid-December of last year. It also took several measures to further supplement its traditional arsenal. In particular, on November 25, the Fed announced that it would purchase up to $100 billion of debt issued by the housing-related GSEs and up to $500 billion of agency-guaranteed mortgage-backed securities, programs that were expanded substantially and augmented by a program of purchases of Treasury securities in March.[10] The goal of these purchases was to provide additional support to private credit markets, particularly the mortgage market. Also on November 25, the Fed announced the creation of the Term Asset-Backed Securities Loan Facility (TALF). This facility aims to improve the availability and affordability of credit for households and small businesses and to help facilitate the financing and refinancing of commercial real estate properties. The TALF has shown early success in reducing risk spreads and stimulating new securitization activity for assets included in the program.

Foreign central banks also cut policy rates to very low levels and implemented unconventional monetary measures. For example, the Bank of Japan began purchasing commercial paper in December and corporate bonds in January. In March, the Bank of England announced that it would purchase government securities, commercial paper, and corporate bonds, and the Swiss National Bank announced that it would purchase corporate bonds and foreign currency. For its part, the ECB injected more than €400 billion of one-year funds in a single auction in late June. In July, the ECB began purchasing covered bonds, which are bonds that are issued by financial institutions and guaranteed by specific asset pools. Actions by central banks augmented large fiscal stimulus packages in the United States, China, and a number of other countries.

On February 10, Treasury Secretary Geithner and the heads of the federal banking agencies unveiled the outlines of a new strategy for ensuring that banking institutions could continue to provide credit to households and businesses during the financial crisis. A central component of that strategy was the exercise that came to be known as the bank stress test.[11] Under this initiative, the banking regulatory agencies undertook a forward-looking, simultaneous evaluation of the capital positions of 19 of the largest bank holding companies in the United States, with the Treasury committing to provide public capital as needed. The goal of this supervisory assessment was to ensure that the equity capital held by these firms was sufficient--in both quantity and quality--to allow those institutions to withstand a worse-than-expected macroeconomic environment over the subsequent two years and yet remain healthy and capable of lending to creditworthy borrowers. This exercise, unprecedented in scale and scope, was led by the Federal Reserve in cooperation with the Office of the Comptroller of the Currency and the FDIC. Importantly, the agencies' report made public considerable information on the projected losses and revenues of the 19 firms, allowing private analysts to judge for themselves the credibility of the exercise. Financial market participants responded favorably to the announcement of the results, and many of the tested banks were subsequently able to tap public capital markets.

Overall, the policy actions implemented in recent months have helped stabilize a number of key financial markets, both in the United States and abroad. Short-term funding markets are functioning more normally, corporate bond issuance has been strong, and activity in some previously moribund securitization markets has picked up. Stock prices have partially recovered, and U.S. mortgage rates have declined markedly since last fall. Critically, fears of financial collapse have receded substantially. After contracting sharply over the past year, economic activity appears to be leveling out, both in the United States and abroad, and the prospects for a return to growth in the near term appear good. Notwithstanding this noteworthy progress, critical challenges remain: Strains persist in many financial markets across the globe, financial institutions face significant additional losses, and many businesses and households continue to experience considerable difficulty gaining access to credit. Because of these and other factors, the economic recovery is likely to be relatively slow at first, with unemployment declining only gradually from high levels.

Interpreting the Crisis: Elements of a Classic Panic

How should we interpret the extraordinary events of the past year, particularly the sharp intensification of the financial crisis in September and October? Certainly, fundamentals played a critical role in triggering those events. As I noted earlier, the economy was already in recession, and it had weakened further over the summer. The continuing dramatic decline in house prices and rising rates of foreclosure raised serious concerns about the values of mortgage-related assets, and thus about large potential losses at financial institutions. More broadly, investors remained distrustful of virtually all forms of private credit, especially structured credit products and other complex or opaque instruments.

At the same time, however, the events of September and October also exhibited some features of a classic panic, of the type described by Bagehot and many others.[12] A panic is a generalized run by providers of short-term funding to a set of financial institutions, possibly resulting in the failure of one or more of those institutions. The historically most familiar type of panic, which involves runs on banks by retail depositors, has been made largely obsolete by deposit insurance or guarantees and the associated government supervision of banks.[13] But a panic is possible in any situation in which longer-term, illiquid assets are financed by short-term, liquid liabilities, and in which suppliers of short-term funding either lose confidence in the borrower or become worried that other short-term lenders may lose confidence.[14,15] Although, in a certain sense, a panic may be collectively irrational, it may be entirely rational at the individual level, as each market participant has a strong incentive to be among the first to the exit.

Panics arose in multiple contexts last year. For example, many financial institutions, notably including the independent investment banks, financed a portion of their assets through short-term repo agreements. In repo agreements, the asset being financed serves as collateral for the loan, and the maximum amount of the loan is the current assessed value of the collateral less a haircut. In a

crisis, haircuts typically rise as short-term lenders attempt to protect themselves from possible declines in asset prices. But this individually rational behavior can set off a run-like dynamic: As high haircuts make financing portfolios more difficult, some borrowers may have no option but to sell assets into illiquid markets. These forced sales drive down asset prices, increase volatility, and weaken the financial positions of all holders of similar assets, which in turn increases the risks borne by repo lenders and thus the haircuts they demand.[16] This unstable dynamic was apparent around the time of the near-failure of Bear Stearns in March 2008, and haircuts rose particularly sharply during the worsening of the crisis in mid-September.[17] As we saw last fall, when a vicious funding spiral of this sort is at work, falling asset prices and the collapse of lender confidence may create financial contagion, even between firms without significant counterparty relationships. In such an environment, the line between insolvency and illiquidity may be quite blurry.

Panic-like phenomena occurred in other contexts as well. Structured investment vehicles and other asset-backed programs that relied heavily on the commercial paper market began to have difficulty rolling over their short-term funding very early in the crisis, forcing them to look to bank sponsors for liquidity or to sell assets.[18] Following the Lehman collapse, panic gripped the money market mutual funds and the commercial paper market, as I have discussed. More generally, during the crisis runs of uninsured creditors have created severe funding problems for a number of financial firms. In some cases, runs by creditors were augmented by other types of "runs"--for example, by prime brokerage customers of investment banks concerned about the funds they held in margin accounts. Overall, the role played by panic helps to explain the remarkably sharp and sudden intensification of the financial crisis last fall, its rapid global spread, and the fact that the abrupt deterioration in financial conditions was largely unforecasted by standard market indicators.

The view that the financial crisis had elements of a classic panic, particularly during its most intense phases, has helped to motivate a number of the Federal Reserve's policy actions.[19] Bagehot instructed central banks--the only institutions that have the power to increase the aggregate liquidity in the system--to respond to panics by lending freely against sound collateral.[20] Following that advice, from the beginning of the crisis the Fed (like other central banks) has provided large amounts of short-term liquidity to financial institutions. As I have discussed, it also provided backstop liquidity support for money market mutual funds and the commercial paper market and added significant liquidity to the system through purchases of longer-term securities. To be sure, the provision of liquidity alone can by no means solve the problems of credit risk and credit losses; but it can reduce liquidity premiums, help restore the confidence of investors, and thus promote stability. It is noteworthy that the use of Fed liquidity facilities has declined sharply since the beginning of the year--a clear market signal that liquidity pressures are easing and market conditions are normalizing.

What does this perspective on the crisis imply for future policies and regulatory reforms? We have seen during the past two years that the complex interrelationships among credit, market, and funding risks of key players in financial markets can have far-reaching implications, particularly during a general crisis of confidence. In particular, the experience has underscored that liquidity risk management is as essential as capital adequacy and credit and market risk management, particularly during times of intense financial stress. Both the Basel Committee on Banking Supervision and the U.S. bank regulatory agencies have recently issued guidelines for strengthening liquidity risk management at financial institutions. Among other objectives, liquidity guidelines must take into account the risks that inadequate liquidity planning by major financial firms pose for the broader financial system, and they must ensure that these firms do not become excessively reliant on liquidity support from the central bank.

But liquidity risk management at the level of the firm, no matter how carefully done, can never fully protect against systemic events. In a sufficiently severe panic, funding problems will almost certainly arise and are likely to spread in unexpected ways. Only central banks are well positioned to offset the ensuing sharp decline in liquidity and credit provision by the private sector. They must be prepared to do so.

The role of liquidity in systemic events provides yet another reason why, in the future, a more systemwide or macroprudential approach to regulation is needed.[21] The hallmark of a macroprudential approach is its emphasis on the interdependencies among firms and markets that have the potential to undermine the stability of the financial system, including the linkages that arise through short-term funding markets and other counterparty relationships, such as over-the-counter derivatives contracts. A comprehensive regulatory approach must examine those interdependencies as well as the financial conditions of individual firms in isolation.

Conclusion

Since we last met here, the world has been through the most severe financial crisis since the Great Depression. The crisis in turn sparked a deep global recession, from which we are only now beginning to emerge.

As severe as the economic impact has been, however, the outcome could have been decidedly worse. Unlike in the 1930s, when policy was largely passive and political divisions made international economic and financial cooperation difficult, during the past year monetary, fiscal, and financial policies around the world have been aggressive and complementary. Without these speedy and forceful actions, last October's panic would likely have continued to intensify, more major financial firms would have failed, and the entire global financial system would have been at serious risk. We cannot know for sure what the economic effects of these events would have been, but what we know about the effects of financial crises suggests that the resulting global downturn could have been extraordinarily deep and protracted.

Although we have avoided the worst, difficult challenges still lie ahead. We must work together to build on the gains already made to secure a sustained economic recovery, as well as to build a new financial regulatory framework that will reflect the lessons of this crisis and prevent a recurrence of the events of the past two years. I hope and expect that, when we meet here a year from now, we will be able to claim substantial progress toward both those objectives.

Footnotes

1. Of course, these interventions were not the first of the crisis. For example, in July and August of 2007, two German banks that had relied heavily on market funding through asset-backed commercial paper (ABCP) conduits--IKB and Sachsen LB--received assistance from public-sector owners to cope with severe funding pressures. In September 2007, Northern Rock, a large mortgage lender that relied heavily on securitizations for funding, was nationalized by U.K. authorities after experiencing a run by retail depositors. In February 2008, West LB--another German bank with large ABCP conduits--received protection against losses from its owners, including the state of North Rhine-Westphalia. And in March 2008, the U.S. Treasury and the Federal Reserve facilitated the acquisition of the investment bank Bear Stearns by JPMorgan Chase & Co. Return to text

2. Throughout these remarks, where examples are given, they represent only a selection of instances, not an exhaustive list of all the relevant cases. Return to text

3. Prime money funds hold a variety of instruments, with commercial paper and bank obligations typically accounting for the majority of their assets. Return to text

4. For example, most financing of automobile purchases was provided through nonbank channels, and such channels began shutting down in September and October of 2008. Return to text

5. More precisely, in the Commercial Paper Funding Facility (CPFF), the Fed lends to a special purpose vehicle that, in turn, purchases highly rated three-month commercial paper directly from eligible issuers. On October 21, the Fed also announced the creation of the Money Market Investor Funding Facility, or MMIFF, which was intended to provide a source of backup liquidity to U.S. money market mutual funds and certain other money market investors. Given the improvement in

short-term markets brought about by the Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility (AMLF), the CPFF, and the Treasury guarantee of money market funds, the MMIFF never had to be tapped. Nonetheless, market participants reported that the facility's existence helped reassure investors that ample liquidity would be available in case of further disruptions in the money markets. Return to text

6. A crucial feature of these lines is that the Federal Reserve's counterparties are the foreign central banks, which are governmental entities, not the private-sector entities to which those central banks might lend in turn. Accordingly, the Fed bears little risk through these arrangements. Return to text

7. Notably, these commitments were reaffirmed on October 11 in communiqués issued by the International Monetary and Financial Committee of the Board of Governors of the IMF and by the Group of Twenty finance ministers and central bank governors. Return to text

8. The FDIC's guarantee program complemented a temporary increase in the deposit insurance limit, from $100,000 to $250,000 per account, passed by the Congress as part of the Emergency Economic Stabilization Act, the bill that created the TARP. Return to text

9. On January 26, the Dutch government announced that it would provide ING Group, a large banking and insurance firm, with loss protection on some of its assets, following up a €10 billion capital injection on October 19. Shortly afterward, the U.K. Treasury announced packages for the Royal Bank of Scotland (RBS) and for Lloyds Banking Group that included loss protection on assets and, in the case of RBS, a capital injection. Return to text

10. In March, the Federal Reserve announced that it would purchase up to $300 billion of longer-term Treasury securities and raised the caps on other purchases to $200 billion for the direct debt of the housing-related GSEs and $1.25 trillion for agency-guaranteed mortgage-backed securities. Return to text

11. Officially, it was called the Supervisory Capital Assessment Program, or SCAP. Return to text

12. See Walter Bagehot ([1873] 1897), *Lombard Street: A Description of the Money Market* (New York: Charles Scribner's Sons). Return to text

13. The Northern Rock episode in the United Kingdom may be seen as a counterexample, but in that case deposit insurance coverage was only partial. Return to text

14. To be sure, there are good economic reasons for a maturity mismatch between assets and liabilities in the financial system, including allowing households flexibility in when to consume (see Douglas W. Diamond and Philip H. Dybvig (1983), "Bank Runs, Deposit Insurance, and Liquidity," Leaving the Board *Journal of Political Economy*, vol. 91 (June), pp. 401-19). Moreover, short-term creditors can help to impose market discipline on financial institutions (see Charles W. Calomiris and Charles M. Kahn (1991), "The Role of Demandable Debt in Structuring Optimal Banking Arrangements," Leaving the Board *American Economic Review*, vol. 81 (June), pp. 497-513; and Douglas W. Diamond and Raghuram G. Rajan (2001), "Liquidity Risk, Liquidity Creation, and Financial Fragility: A Theory of Banking," Leaving the Board *Journal of Political Economy*, vol. 109 (April), pp. 287-327). Return to text

15. Also, during a panic, financial firms concerned about funding are likely to hoard liquidity, further exacerbating the situation. See Douglas W. Diamond and Raghuram G. Rajan (2009), "Fear of Fire Sales and the Credit Freeze," Leaving the Board NBER Working Paper Series 14925 (Cambridge, Mass.: National Bureau of Economic Research, April); and Zhiguo He and Wei Xiong

(2009), "Dynamic Debt Runs (385 KB PDF)," Leaving the Board unpublished paper, June 30, Princeton University, Princeton, N.J. Return to text

16. See Markus K. Brunnermeier (2009), "Deciphering the Liquidity and Credit Crunch 2007-2008," Leaving the Board *Journal of Economic Perspectives*, vol. 23 (Winter), pp. 77-100. This dynamic differed from the standard bank run in that investors did not completely withdraw funding. The reason for the difference lies in the nature of the lending contract. In a standard bank deposit contract, the price of deposits in terms of currency is fixed, and so depositors have no alternative to withdrawal when the value of deposits falls below the value of currency. For similar reasons, many investors in money market mutual funds withdrew all their funds when the redemption value exceeded the value of holding the fund. In contrast, in the case of repo lending, lenders have the alternative to withdrawal of varying the haircut they demand. There is a close analogy to the discounting of bank notes during the U.S. free banking era, as discussed by Gorton (see Gary Gorton (1996), "Reputation Formation in Early Bank Note Markets," Leaving the Board *Journal of Political Economy*, vol. 104 (April), pp. 346-97). In either case, however, variations in the liquidity premium play an important role in the amount of funding that lenders are willing to provide against a given set of assets. Return to text

17. See Gary B. Gorton and Andrew Metrick (2009), "Securitized Banking and the Run on Repo," Leaving the Board Yale International Center for Finance Working Paper No. 14, July. Return to text

18. See Daniel M. Covitz, Nellie Liang, and Gustavo Suarez (2009), "The Evolution of a Financial Crisis: Runs in the Asset-Backed Commercial Paper Market," unpublished paper, Board of Governors of the Federal Reserve System, Division of Research and Statistics, August. Moreover, the scale of these conduits and their vulnerability to runs contributed importantly to the liquidity panics globally as many of these programs were sponsored by non-U.S. banks (see Carlos O. Arteta, Mark Carey, Ricardo Correa, and Jason Kotter (2009), "Revenge of the Steamroller: ABCP as a Window on Risk Choices," unpublished paper, Board of Governors of the Federal Reserve System, Division of International Finance, May). Return to text

19. See Brian F. Madigan (2009), "Bagehot's Dictum in Practice: Formulating and Implementing Policies to Combat the Financial Crisis," speech delivered at this symposium, sponsored by the Federal Reserve Bank of Kansas City, Jackson Hole, Wyo., August 21-23. Return to text

20. See Bagehot, *Lombard Street*. Return to text

21. See Ben S. Bernanke (2009), "Financial Reform to Address Systemic Risk," speech delivered at the Council on Foreign Relations, Washington, March 10. Return to text

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Policy Brief

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Lehman Died, Bagehot Lives: Why Did the Fed and Treasury Let a Major Wall Street Bank Fail?

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To avert panic, central banks should lend early and freely (i.e., without limit), to solvent firms, against good collateral, and at 'high rates.'

—Bagehot's dictum[1]

The firm [Lehman Brothers] could not post sufficient collateral to provide reasonable assurance that a loan from the Federal Reserve would be repaid.

—Ben Bernanke, 2008[2]

Five years after the Federal Reserve and the Treasury allowed the investment bank Lehman Brothers to fail, their actions (or inaction) remain a focus of debate. Some argue that it was an inconsistent policy to have let Lehman fail while making emergency loans to save other large financial institutions in the same time frame. In this Policy Brief we present evidence that the Fed and Treasury had a sound reason to have bailed out other institutions while letting Lehman fail. Simply put, Lehman was insolvent—probably deeply so—whereas the other institutions arguably were solvent. In addition, the other institutions had abundant collateral to pledge, whereas what little collateral Lehman had to pledge was of questionable quality and scattered across many affiliated entities. Thus, federal officials, at least in hindsight, appear to have followed the dictum of Walter Bagehot (cited above), which has guided central banks for almost 150 years.

The Fed and Treasury's adherence to the positive mandate of Bagehot's dictum—providing the lender-of-last-resort function—was extremely important in keeping the Great Recession from being far worse than it was. If Bear Stearns, Fannie Mae and Freddie Mac, and the American International Group (AIG) had all been forced into sudden bankruptcy, the financial crisis and Great Recession almost certainly would have been much more severe than they were. Not everyone recognizes this lesson, and the great public outcry against "bailing out the banks" raises some risk that the central bank may not carry out even this basic Bagehot responsibility in a future crisis. Indeed, the new constraints in the Dodd-Frank legislation curbing the previously nearly complete discretion of the Federal Reserve under the emergency powers that came out of the Great Depression[3] suggest that some risk exists in this regard.[4]

Federal officials, at least in hindsight, appear to have followed the dictum of Walter Bagehot.

1. As summarized by Paul Tucker, deputy governor of the Bank of England, in a 2009 speech, "The Repertoire of Official Sector Interventions in the Financial System—Last Resort Lending, Market-making, and Capital," Bank of Japan 2009 International Conference "Financial System and Monetary Policy: Implementation," Tokyo, May 27–28. For a more detailed presentation, see Bagehot (1873, chapter 7).

2. Ben Bernanke, "Stabilizing the Financial Markets and the Economy," speech at the Economic Club of New York, October 15, 2008.

3. Section 13.3 of the Federal Reserve Act.

4. Emergency loans henceforth must be part of programs with broad-based eligibility and not limited or targeted to individual institutions; they must be approved by the secretary of the Treasury; procedures must be in place to prevent lending to an insolvent institution; and leaders of Congress must be promptly briefed.

Lehman Brothers was so large that it was what has subsequently come to be called a systemically important financial institution (SIFI). The Fed and Treasury nonetheless allowed Lehman to collapse because they adhered to the corresponding negative mandate of Bagehot's dictum: avoid emergency lending to insolvent banks. The ensuing shock to financial markets sent the financial crisis into a new, more acute phase and may have contributed to the severity of the Great Recession. Therefore the lesson from Lehman is not only that Bagehot-type lender-of-last-resort action is as important as ever, if not more so considering the increasing concentration of the financial sector in a few mega-banks, but also that it is critical to ensure an orderly resolution for a SIFI going bankrupt. The Dodd-Frank legislation seeks precisely to provide a structure for such resolution, but we do not yet know whether it will be sufficient. Although in this Policy Brief we limit ourselves to documenting that Lehman was insolvent whereas the other key financial institutions that were rescued were solvent, such that the Bagehot principle was followed, we consider a "Beyond Bagehot" form of SIFI resolution to be crucial unfinished business.

The lesson from Lehman is not only that Bagehot-type lender-of-last-resort action is as important as ever...but also that it is critical to ensure an orderly resolution for a systemically important financial institution going bankrupt.

POLICY CONSISTENCY OR INCONSISTENCY IN THE FOG OF WAR?

In the epilogue to his popular book, *Too Big to Fail*, Andrew Sorkin (2009, 535) lays out the apparent inconsistency of official actions[5]:

> [I]t cannot be denied that federal officials—including [Treasury Secretary Henry] Paulson, [Federal Reserve Board Chairman Ben] Bernanke, and [President of the Federal Reserve Bank of New York Timothy] Geithner—contributed to the market turmoil through a series of inconsistent decisions. They offered a safety net to Bear Stearns and backstopped Fannie Mae and Freddie Mac but allowed Lehman to fall into Chapter 11, only to rescue AIG soon after. What was the pattern? What were the rules? There didn't appear to be any, and when investors grew confused...they not surprisingly began to panic.

In his influential book, *In Fed We Trust*, David Wessel (2009, chapter 1) presents what has become a widely accepted interpretation of the motivations behind this seemingly inconsistent behavior. He says that Fed and Treasury officials wanted to find a buyer to prevent Lehman's collapse but that they were not willing to provide the financial assistance needed to secure a deal. Bernanke and Paulson faced intense criticism of their actions to save Bear Stearns, Fannie Mae, and Freddie Mac, and they feared that there might be a strong political backlash to any further bailouts. According to Wessel, Paulson told Bernanke and Geithner, "I'm being called Mr. Bailout. I can't do it again." In addition,

> Paulson and Bernanke assured each other...that all the companies and traders that did business with Lehman had been given time to protect themselves from a possible Lehman bankruptcy. They comforted themselves that, since the Bear Stearns bailout, the Fed had found new ways to lend to other investment houses that might be hurt by a Lehman collapse. They were wrong. (Wessel 2009, 11)

According to this interpretation, the market turmoil and global condemnation that followed Lehman's demise was so great that Bernanke and Paulson had a change of heart and agreed to bail out AIG just one day later. In Wessel's words, "[i]t was becoming clear that Bernanke had adopted a new mantra: *whatever it takes* [italics in original]."

Wessel notes that, after a few weeks, Bernanke and Paulson began to publically emphasize the legal restrictions on their ability to save Lehman because of its lack of collateral. For example, the opening quote of this Policy Brief about Lehman's lack of collateral is from a speech Bernanke made on October 15, 2008. Geithner also stressed the Fed's lack of authority to lend to Lehman during his Senate confirmation hearings in January 2009. Why did these officials change the way they described their thinking? In an interview with Wessel in January 2009, Paulson said "You're unable to say: 'We let it go down because we were powerless to do anything about it.' You don't want to say 'the emperor has no clothes.'" Wessel presents Paulson's explanation without comment, but

5. The apparent inconsistency of official actions also was a key theme of the written statement of former Lehman CEO Richard Fuld before the Financial Crisis Inquiry Commission, September 1, 2010, and a book by a former Lehman staffer under the pseudonym Joseph Tibman (2009).

the implication seems to be that the emphasis on legal restrictions was a decision taken in hindsight to avoid having to admit a mistake. It is impossible to know what factors were foremost in another person's mind at a point in time, but we find it plausible that in the midst of a financial panic, public officials might not want to admit their impotence. The passage of the Emergency Economic Stabilization Act on October 3, 2008 granted the Treasury the authority to invest in and lend to financial institutions as well as to purchase troubled assets from them via the Troubled Asset Relief Program (TARP). Perhaps only after that point did officials feel free to acknowledge the restrictions on their powers just a few weeks earlier.

Wessel is surely right that officials had other considerations on their minds in addition to the legal restrictions on their powers. There was political pressure against bailouts, and perhaps Bernanke and Paulson were unduly complacent about the market reaction to a Lehman bankruptcy. Arguably, the Fed could have lent enough funds to Lehman to prevent a sudden bankruptcy and claimed to have received satisfactory collateral. But our results, based on data that were not available at the time Sorkin and Wessel wrote their books, suggest that saving Lehman would have required an outright deception on the part of the Fed that was not required for the other emergency loans. Lehman simply was unable to post collateral quickly that would have been worth close to the amount of loan needed. Although Bernanke and Paulson did not stress this point at first, it may have been a decisive factor nonetheless.

A stricture against central bank lending without adequate collateral is an important element of Bagehot's dictum—that in a financial panic a central bank should lend freely but only to solvent institutions with good collateral. Based on our examination of financial statements of all five of the most troubled major financial institutions, Lehman was unique in being deeply insolvent and having relatively few unencumbered assets to pledge as collateral. This finding supports the explanation provided by Chairman Bernanke (see opening quote) and helps to explain why a buyer could not be found for Lehman as had been done for Bear Stearns.

According to the Federal Reserve Act, Fed loans must be "secured to the satisfaction of the Federal Reserve Bank" that makes them. The definition of the word "satisfaction" may be open to question, but one interpretation of this clause is that the Fed cannot lend without collateral that can be plausibly valued at least as highly as the loan. The Treasury's ability to extend credit without congressional approval was even more restricted than the Fed's at the time of these crises, as evidenced by the fact that the Fed—not the Treasury—made the initial loans to Bear and AIG. In contrast, in July 2008, shortly before the rescue of Fannie and Freddie, Congress had granted Treasury expanded authority to lend to these two government-sponsored enterprises with the passage of the Housing and Economic Recovery Act, likely reflecting their political popularity, importance to the key sector of housing, and the past implicit government guarantee of their obligations.

ANALYSIS OF SOLVENCY

We ask whether each of the following institutions was solvent at the time of its emergency loan, conservatorship, or bankruptcy: Bear Stearns, Fannie Mae, Freddie Mac, Lehman Brothers, and AIG.[6] The Fed made an emergency loan to assist with the takeover of Bear by JPMorgan on March 14, 2008. The Treasury put Fannie and Freddie into conservatorship on September 7, 2008. Lehman filed for bankruptcy on September 15, 2008. The Fed gave AIG an emergency loan on September 16, 2008.

If solvency is defined as having a positive net worth in a hypothetical liquidation at current market prices, then all of these institutions and many more were insolvent in late 2008. The essence of banking is the transformation of illiquid assets into liquid deposits and securities. In a panic, investors dump illiquid assets for liquid ones. The central bank's role is to provide liquidity without unduly jeopardizing the taxpayer. This is not to deny that flaws in financial regulation and supervision allowed a panic to develop, but that is a different topic.

We believe a more reasonable definition of solvency for the lender of last resort is whether an institution is expected to have substantially positive net income over the medium term, assuming that it can roll over its short-term liabilities at a normal market rate of return. Under this definition, an insolvent institution is one whose assets and operations are not generating enough revenue to service its liabilities and cover its operating expenses. In other words, future cash flows from assets should be discounted at a rate that is closer to historic norms than what may be implied by market prices of assets during a panic. Correspondingly, an institution is solvent if its assets exceed its liabilities when evaluated at medium-term values, rather than at fire-sale prices in the midst of the crisis.

6. Later in 2008, special assistance packages were designed for Bank of America and Citigroup. Both of these packages were fully repaid with interest above the government's cost of funds by the end of 2010. But in the case of Citigroup, shareholders were largely wiped out. The share price fell from $20 at the end of September 2008 to $1.50 by end-February 2009, reflecting massive dilution under the terms of government support, which led to expansion of the shareholder base from 5.5 billion shares in early 2009 to 28.3 billion by the end of 2009 (Bloomberg).

Our definition of solvency requires a forecast of future revenues and expenses, which in turn depend on many factors, including the state of the economy. To get around this problem, we use actual revenues and expenses between 2008 and 2013 in place of expected revenues and expenses as of five years ago. We believe this approach is conservative because economic growth has been considerably lower than was projected by most forecasters in late 2008, although not as low as implied by some tail-risk scenarios.[7]

An alternative way of measuring solvency under our definition is whether the firm is able to repay the emergency loans in a reasonable period and at a rate of return that is higher than the government's cost of funds.

Our analysis largely omits the intangible value of a firm as a "going concern," which includes the expertise of its staff, its relationships with clients, and its reputation as a brand. Adjusting for the intangible value would strengthen our conclusion that Bear and AIG were solvent, but our evidence presented below shows that the intangible value of Lehman as a going concern was small relative to the size of the hole in its balance sheet and therefore would not have made a difference to its (in)solvent status.

One summary test of our conclusion that Fannie, Freddie, and AIG turned out to be solvent is simply that although their shareholders were nearly wiped out, their shares retained modest positive value. The value of shares of an insolvent firm should be zero. Instead, by mid-December 2010, when the S&P500 index had recovered all of its losses subsequent to early September 2008, the shares of Fannie Mae were worth 4.3 percent of their prior value; those of Freddie Mac, 5.9 percent; and those of AIG, 11.7 percent.[8] (The same test is not available for Bear Stearns because it was taken over by JP Morgan.)

Bear Stearns

Table 1 displays consolidated balance sheets for all entities controlled by Bear Stearns Companies, Inc. the month before the emergency loan (February 2008) and immediately prior to consummation of the merger with JPMorgan Chase & Company (May 2008). After May 2008 it is not possible to track the performance of assets originally held by Bear Stearns.

Bear's assets shrank $110 billion during these three months; its liabilities shrank $99 billion and its net worth shrank $11 billion. Most of the decline in assets reflects a collapse in collateralized borrowing, in which assets and liabilities fell by equal amounts. The decline in net worth almost certainly reflects a markdown of assets closer to market values. As part of the emergency purchase by JPMorgan, Bear sold $30 billion of financial instruments at market values as of March 14, 2008, to Maiden Lane LLC, a company that the Federal Reserve Bank of New York formed in March 2008 to facilitate JPMorgan's merger with Bear Stearns. These assets included $10 billion of agency mortgage-backed securities (MBS), $10 billion of real estate whole loans, $5 billion of private MBS, and $5 billion of derivatives and other structured assets.

Overall, it appears that Bear Stearns was solvent at the time of its emergency loan, but its capital had been eroded by more than 90 percent and its shareholders took a large loss.

Maiden Lane was funded by a $29 billion senior loan from the Federal Reserve Bank of New York and a $1 billion junior loan from JPMorgan. The Fed loan was at the variable primary credit rate of the Fed's discount window, which does not reflect any significant premium for the risk incurred. The JPMorgan loan was at the primary credit rate plus 450 basis points. Both loans were repaid in full, and the Fed retains a moderate residual profit of almost $1.5 billion as of June 2013. Factoring in the profit over the life of the loan, the Fed received about 100 basis points per year above the primary credit rate (and 150 basis points above its cost of funds) on its loan, still not a large premium but not insignificant.

JPMorgan acquired Bear for $1 billion, almost exactly what it reported as Bear's book value immediately prior to the merger. Because Bear was integrated into several of JPMorgan's business lines, it is impossible to calculate a separate profit stream for Bear after the merger. But most observers have assumed that the Bear assets sold to Maiden Lane were among the most troubled of Bear's portfolio.[9] Given that these assets generated cash flows

7. As of 2012, (annual average) US real GDP was more than 7 percent below the mean projection of private-sector forecasters on October 13, 2008, according to Consensus Economics' *Consensus Forecasts*. Consumer prices were about 3 percent lower than projected over the same period, suggesting that nominal GDP was about 10 percent lower than projected. Nominal GDP may be the best indicator of an economy's aggregate ability to service its debts.

8. The S&P500 stood at 1242 on September 5, 2008 and returned to 1242 on December 16, 2010. The stock price comparisons are for the same two dates. Data are from Bloomberg.

9. See, for example, Sorkin (2009, chapter 1); Serena Ng and Carrick Mollenkamp, "Fed Opens the Books on Bear, AIG Toxic Assets," *Wall Street Journal*, April 1, 2010, B1; and Jacob Goldstein, "Meet the Fed's Toxic Assets," Planet Money blog, www.npr.org, April 1, 2010.

Table 1 Consolidated balance sheets of entities controlled by Bear Stearns Companies, Inc. and of Maiden Lane LLC (billions of dollars)

Item	February 29, 2008	March 14, 2008	May 30, 2008	December 31, 2008	December 31, 2009	December 31, 2010	December 31, 2011	December 31, 2012
Bear Stearns								
Assets								
Securities borrowed	129		76					
Financial instruments	171		137					
Other	99		76					
Total	399		289					
Liabilities								
Secured debt and repo	178		55					
Other borrowing	107		107					
Other	102		126					
Total	387		288					
Equity								
Net worth	12		1					
Maiden Lane LLC								
Assets (fair value)		30		26	27	*28*	*8*	1
Liabilities								
Federal Reserve[a]		29		29	29	*26*	*6*	0
JPMorgan[a]		1		1	1	*1*	*1*	0
Other		0		0	0	*1*	*1*	0
Total		30		30	30	*28*	*8*	0
Equity								
Net worth		0		–4	–3	*0*	*0*	1

a. We report the liabilities to Fed and JPMorgan at face value rather than fair value.

Note: Numbers in italics are approximations because of unreported differences between fair value and face value.

Sources: Bear Stearns Form 10-Q filing with the Securities and Exchange Commission; JPMorgan Annual Report 2008 (p. 139); Federal Reserve Bank of New York, www.newyorkfed.org.

sufficient to repay $30 billion in loans at interest rates that were at least slightly above what low-risk borrowers paid, a case can be made that they were worth $30 billion in 2008. And if the worst part of Bear's balance sheet was solvent, it naturally follows that the remainder was solvent.[10]

Overall, it appears that Bear was solvent at the time of its emergency loan, but its capital had been eroded by more than 90 percent and its shareholders took a large loss.

Fannie Mae and Freddie Mac

The US government's treatment of Fannie and Freddie went beyond Bagehot's dictum. In effect, it nationalized the two entities, rather than simply providing classic lender-of-last resort liquidity. Shareholders were largely wiped out and management was replaced. The willingness of the government to act forcefully in this manner reflected the high stakes associated with the pivotal role the firms played in the US housing market, as well as the past implicit government guarantee for obligations of the two "agencies" held by many foreign governments as part of official foreign exchange reserves.

Balance sheets for the federal housing agencies, Fannie Mae and Freddie Mac, continue to show that these institutions would be insolvent without the capital invested by the Treasury. In part this may reflect excessive provisions for loan losses, as the income statements now show loan losses as a posi-

10. At a press conference at the Council on Foreign Relations on October 10, 2012, JPMorgan CEO Jamie Dimon said that there may have been losses of $5 billion to $10 billion from the acquisition of Bear Stearns, noting in particular the lawsuits filed against Bear's subprime mortgage-related activities. We have found no published accounting treatment of the net impact of the Bear acquisition on JPMorgan and it is not clear whether Dimon's estimates net out any offsetting gains from other aspects of Bear's operations, including its value as a going concern.

Table 2 Income, Treasury funding, and repayments by Fannie Mae and Freddie Mac, 2008–20 (billions of dollars)

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2018	2020
Fannie Mae											
Pre-tax income	–45	–73	–14	–17	17	25	25	25	25	25	25
Treasury draw	1	60	28	24	5	0	0	0	0	0	0
Repayment	–17	4	8	10	12	25	25	25	25	25	25
Treasury principal at 5 percent	18	76	99	118	117	98	78	57	35	–13	–66
Treasury principal at 10 percent	18	76	104	129	135	123	110	96	81	45	2
Freddie Mac											
Pre-tax income	–45	–22	15	–6	9	13	13	13	13	13	13
Treasury draw	15	37	13	8	0	0	0	0	0	0	0
Repayment	3	3	5	6	6	13	13	13	13	13	13
Treasury principal at 5 percent	12	46	56	60	58	48	37	26	14	–11	–39
Treasury principal at 10 percent	12	46	59	66	67	61	54	47	38	19	–4

Note: Treasury principal in each year equals the principal in the previous year plus interest at 5 or 10 percent plus the current year's Treasury draw minus the current year's repayment.

Sources: Consolidated statements of Fannie Mae and Freddie Mac and authors' calculations.

tive contribution to net income because they are running lower than had been provisioned for. But loss provisions are not large enough to explain all of the hole in the balance sheet. Moreover, a supplemental balance sheet provided by Fannie shows that the negative equity position even exceeds the value of Treasury's capital if both assets and liabilities are recorded at fair value. Yet both Fannie and Freddie are currently profitable and likely to remain so in the near term. This suggests that the balance sheets are missing the intangible value of their effective government support, which lowers their cost of funds, and their duopoly as providers of mortgage guarantees.

Many people criticized the implicit government support for Fannie and Freddie before the financial crisis, and we are inclined to agree. Without that support and their privileged market positions, the housing agencies probably would have been insolvent prior to the crisis. But we believe that the issue of restructuring the housing agencies should not be confused with the question of whether they were solvent in 2008 under their existing structure.

Because these entities continue to operate as going concerns under the same structure as before, we believe a more useful approach to the solvency question is to look at their income statements. Table 2 shows past and projected future pre-tax income for Fannie and Freddie.[11] We project income for 2013–20 at the average rate of the 18 months from January 2012 through June 2013. This was a period of stability in the housing sector and relatively small adjustments to income from special factors and fair value adjustments. Although it may seem optimistic to assume that income will remain steady for the foreseeable future, an alternative case may be made that it is conservative to assume that there is no further upside to income given how far the economic recovery has to go to reach full employment and how much pent-up demand there may be for housing.

Fannie returned to profitability in 2012 after large losses in the previous four years. Fannie made large draws on Treasury financial support in 2009 through 2011, although it began to service this liability as early as 2009 with a repayment of $4 billion.[12] Beginning in 2013, we assume that all of Fannie's net income is paid to the Treasury, both to service the Treasury's claims in the form of preferred stock and because Treasury has a warrant to acquire common stock for essentially no cost up to an 80 percent ownership position, so that 80 percent of any

11. We use pre-tax income to remove the effect of a large tax benefit booked by Fannie that reflects the carrying forward of past losses on future tax filings. This enabled Fannie to make a large payment to Treasury in 2013 that will presumably be offset by lower tax payments in the future. From Treasury's perspective, pre-tax income is the more relevant concept. For Freddie, the results are essentially identical using either pre-tax or post-tax income as Freddie has paid little in taxes and has not booked any large tax benefit.

12. The negative repayment of $17 billion in 2008 reflects a tax credit for losses, which we include as a net cost to Treasury.

income that does not service Treasury's preferred shares will also go to Treasury. If we assume that Treasury requires a return of 5 percent on its net capital contributions, Fannie is projected to be able to pay back Treasury's capital by 2018, as shown by the negative entry in the line labeled "Treasury principal at 5 percent" in that year. If we assume that Treasury requires a return of 10 percent, the next line shows that the principal will be nearly paid off in 2020. These projections support the proposition that Fannie was and is solvent, even if its capital base was small relative to the fluctuation in its profits.

The bottom half of the table presents similar data for Freddie Mac. Prior to conservatorship, Freddie reported total assets almost identical in size to those of Fannie. However, in 2010, both agencies were required to report all guaranteed mortgages on their balance sheets. Because Fannie had guaranteed a higher volume of mortgages, its balance sheet is now considerably larger than Freddie's. Because of its smaller guarantee pool, total losses at Freddie and the associated capital draw on Treasury were smaller than those of Fannie.

Our overall judgment is that Fannie and Freddie were solvent at the time they were placed under conservatorship, but only with the benefit of their government guarantees.

But Freddie also has less guarantee fee income, and thus the projected payoff dates for Treasury principal are comparable to those for Fannie under both the 5 and 10 percent assumed rates of return.

An alternative method for assessing solvency is to impute a net worth based on sustainable net income and to see if that net worth exceeds the cumulative principal of Treasury's capital contributions. We assume a benchmark pre-tax rate of return on capital of 10 percent per year. Thus, the $25 billion projected annual income at Fannie would imply a net worth of $250 billion, and the $13 billion projected annual income at Freddie would imply a net worth of $130 billion. In each case, the implied net worth is about double the Treasury principal as of December 2012 (also based on a 10 percent rate of return). These calculations support the view that Fannie and Freddie were solvent at the time they were taken into conservatorship, especially in light of the fact that economic outcomes over the past five years have been weaker than most forecasters projected in the fall of 2008.

According to table 2, it will take roughly a decade to repay the capital Treasury has invested in Fannie and Freddie. If the administration and Congress agreed to maintain the current business model of the housing agencies, in which the previously implicit government guarantee is now explicit, Treasury would be able to exercise its warrant to acquire common shares and then sell both its preferred and common shares to the public over a much shorter span of time. Our calculations suggest that Treasury could realize a large profit. The main reason such a sale has not already happened is that the administration and Congress have not decided whether and how to restructure Fannie and Freddie. There is strong opposition to retaining the current government guarantee of the two agencies' obligations, which greatly reduces their cost of funding.

Our overall judgment is that Fannie and Freddie were solvent at the time they were placed under conservatorship, but only with the benefit of their government guarantees.

Lehman Brothers

Among the other firms examined in this Policy Brief, Lehman most closely resembled Bear Stearns. Both were investment banks, which tended to be much more highly leveraged than normal banks (with asset-to-capital ratios of 20 to 30 rather than 10; Cline 2010, 288). Financial market participants anticipated that Lehman could be the next institution to get into trouble after the takeover of Bear Stearns by JPMorgan. In March 2008, Lehman had already sought to establish a "bad bank" subsidiary for $32 billion in troubled commercial real estate assets (named ironically "SpinCo"). The financial environment at the time of the Lehman crisis in early September 2008 was far worse than in early March when the Bear Stearns takeover took place, so presumably less favorable valuations would have been placed on similar assets.

Table 3 displays consolidated balance sheets for all entities controlled by Lehman Brothers Holdings, Inc. On the eve of its bankruptcy filing, Lehman had assets valued at $626 billion and liabilities of $560 billion, leaving a putative net worth of $66 billion. Just three months later, its balance sheet had contracted by half and it had a negative net worth of $29 billion. Much of this decline seems likely to have been associated with the transfer of collateral to collateralized creditors in payment of debt, including the Federal Reserve (which by one account held $63 billion in claims on Lehman through its expanded lending facilities to securities dealers), accompanied by corresponding reduction in outstanding debt.[13] Collateral was also seized by counterparties to derivatives contracts. Asset value declined by more than liability value for five reasons:

13. Jeffrey McCracken, "Lehman's Chaotic Bankruptcy Filing Destroyed Billions in Value." *Wall Street Journal*, December 29, 2008.

Table 3 Consolidated balance sheets of entities controlled by Lehman Brothers Holdings, Inc. (billions of dollars)

Item	September 14, 2008	December 31, 2008	December 31, 2009	December 31, 2010	September 30, 2011	December 31, 2011	December 31, 2012	March 31, 2013
Assets								
Claims on affiliates	455	218	205	191	163	85	66	49
Other	171	78	53	60	60	68	50	50
Total	626	296	258	251	223	153	116	99
Liabilities								
Claims by affiliates	388	189	192	185	180	29	24	22
Other	172	136	124	126	141	369	330	322
Total	560	325	316	311	321	398	354	344
Equity								
Net worth	66	–29	–58	–60	–98	–244	–237	–245

Sources: Balance sheets and operating reports filed by Lehman Brothers in US Bankruptcy Court for the Southern District of New York.

(1) At least some assets were marked down closer to market values; (2) some assets may have been sold at less than book value; (3) market values generally declined over this period; (4) market values of Lehman's assets may have declined more than general market values because of impairments related to default; and (5) collateral seized may have been worth more than the associated liabilities.

It seems likely that few, if any, assets were sold between September 14 and December 31, 2008. Total cash receipts over this period were less than $8 billion, most or all of which probably reflects debt service flows on the assets held. Lehman's CEO in bankruptcy, Bryan Marsal, estimated at the end of December 2008 that value destruction caused by the sudden bankruptcy filing was between $50 billion and $75 billion, mainly arising from termination of derivatives contracts and impairments of asset values due to default.[14] If true, more than half of the decline in Lehman's net worth between September and December 2008 could have been prevented by a more orderly resolution. However, declines in market values of assets and markdowns of assets closer to market values were also likely to have been important.

Net worth declined further in 2009 through 2011, reaching almost –$100 billion in September 2011, as assets declined and liabilities were stable. Most of these declines appear to reflect marking down of assets closer to market values. No record is made of any sales in the first half of 2009. From July 2009 through September 2011, only $20 billion of assets were sold, so sales at depressed prices are not likely to be a major factor in the reported decline in Lehman's net worth.

December 2011 represents a critical date in the resolution of Lehman, as it marks the approval by creditors of the final bankruptcy plan. At this time, a large number of postbankruptcy claims were accepted as liabilities. In addition, many claims and liabilities between affiliates were reduced further in offsetting agreements. On balance, Lehman's net worth took a large step down to nearly –$250 billion. A large part of this decline reflects claims of financial guarantees by Lehman that were not carried on its books, including by investors who purchased asset-backed securities from Lehman before its bankruptcy.[15] Some of it also may reflect claims for damages suffered when Lehman failed to fulfill its obligations beyond the intrinsic value of those obligations. It seems likely that many of the latter claims would not have occurred if Lehman had been able to continue as a going concern. Since December 2011, Lehman's reported net worth has been roughly stable.

How much of the nearly –$250 billion net worth reflects costs and impairments that are unique to a disorderly bankruptcy? As mentioned above, an early estimate of the losses from disorderly bankruptcy was between $50 billion and $75 billion. It is not clear whether this estimate includes loss of value as a going concern and legal fees. But any going concern value would have been an intangible asset that was not included on Lehman's reported assets and thus its loss would not affect reported net worth.[16] And professional fees related

14. McCracken, "Lehman's Chaotic Bankruptcy Filing."

15. Many financial firms have faced a wave of lawsuits from disgruntled investors in structured financial products backed by real estate. JPMorgan noted in its *2012 Annual Report* (p. 321) that there are $170 billion of such claims filed against it with respect to securities sold by JPMorgan, Bear Stearns, and Washington Mutual during the real estate bubble.

16. Lehman's broker-dealer and wealth management operations were sold to Barclays and Nomura for little more than the value of their associated real estate. Since it acquired Lehman's New York office and staff, Barclays' investment banking group has stepped up its net income by just over $1 billion per year. Assuming a rate of return on capital of 10 percent, the operations of Lehman's New York office as a going concern had a property and intangible

to bankruptcy have totaled less than $2 billion over the past five years. At least some of the $150 billion decline in reported net worth in December 2011 reflects lawsuits that would not have been filed if Lehman had not defaulted. On the other hand, the expected low recoveries in the Lehman bankruptcy may have deterred some lawsuits that would have been filed had Lehman remained a going concern. Overall, it appears unlikely that more than half of the negative net worth of $245 billion represents costs that were created by bankruptcy per se.

The negative net worth of $245 billion as of March 31, 2013, represents a 44 percent loss on the initial stock of liabilities of $560 billion. However, the initial liabilities may have been understated in light of the increase in accepted liabilities in December 2011, implying a smaller overall loss than 44 percent. In any event, different classes of creditors are receiving very different payouts. Secured claimholders and some derivatives claimholders received 100 cents on the dollar. Other customers and investors are expected to receive anywhere from 0 cents on the dollar (on subordinated debt) to as much as 100 cents on each dollar of senior claims at affiliates that were fully capitalized. The largest single category is holders of senior unsecured debt of the holding company, with claims of $84 billion at face value. At the time of the final bankruptcy plan, these claimants were expected to receive 21 cents on the dollar. However, estimates of net cash receipts from the resolution rose to $84 billion in the July 2013 report filed with the bankruptcy court, up from $59 billion in the bankruptcy plan. Much of the additional recovery should accrue to the senior unsecured bondholders, since the secured creditors have already been paid off and the junior creditors will still receive essentially nothing. Indeed, senior debt of Lehman Brothers Holdings is currently trading at around 24 cents on the dollar after having already received distributions of 15 cents, implying a final expected payout of 39 cents on the dollar.

An important part of the run-up to bankruptcy was the search for a buyer for Lehman, as had been done with Bear Stearns. The two main targets were Bank of America and Barclays, a large British bank. After examining Lehman's books, Bank of America concluded that the asset quality was too low and it pursued Merrill Lynch instead. Barclays was definitely interested, on the condition that it would not purchase $52 billion in overvalued assets (FDIC 2011, 3). Before any terms could be agreed with the Fed and Treasury, however, the deal was killed by the refusal of the UK Financial Services Authority to waive the requirement of a shareholder vote before Barclays could guarantee Lehman's liabilities. Such a guarantee was essential to allow Lehman to avoid filing for bankruptcy and there was no time to arrange a shareholder vote.

It may be no surprise that a deeply insolvent institution had difficulty in finding a buyer. However, the search for a buyer was also made harder by the heightened market stresses at the time. Despite these stresses, at least one candidate did express an interest before being reined in by its supervisor. We do not take that as significant evidence that Lehman was solvent.[17] Rather, we think that Barclays might have changed its mind if it had had more time to examine Lehman's assets and, to some extent, Barclays' status as too big to fail in the United Kingdom may have created a moral hazard incentive to gamble on expansion. The UK supervisor probably understood these adverse incentives well when it denied Barclays' request.

Overall, our guess of Lehman's true net worth at the time it filed for bankruptcy is somewhere between –$100 billion and –$200 billion. ...In the end, it is this negative net worth and the Fed's unwillingness to lend more than the collateral it received that made it impossible to find a buyer for Lehman.

JPMorgan's takeover of Bear Stearns was facilitated by a loan from the Fed. As we showed above, this loan was secured by assets that in the end proved to be worth more than the loan. The difficulty for Lehman was that any loan from the Fed that was secured by adequate collateral would not have solved the fundamental problem of its deeply negative net worth. In the end, it is this negative net worth and the Fed's unwillingness to lend more than the collateral it received that made it impossible to find a buyer for Lehman.

So what was Lehman's true net worth when it filed for bankruptcy? Overall, our guess of Lehman's true net worth at the time it filed for bankruptcy is somewhere between –$100 billion and –$200 billion. In contrast, an important study by the FDIC conveys the impression that the hole was as small as only $5 billion (FDIC 2011, 18). A close examination of that study, however, shows that the $5 billion does not count $15 billion in subordinated debt that would have to have been

asset value of $12 billion, for which Barclays paid about $2 billion. The Asian and European offices of Lehman (acquired by Nomura) were much smaller and presumably had smaller intangible values.

17. If the $52 billion in assets that Barclays wanted to exclude from the deal were worthless, Lehman would still have had a positive net worth according to the September 14 balance sheet in table 3.

Table 4 Summary of Fed and Treasury assistance to AIG (billions of dollars)

Assistance	Maximum committed	Maximum disbursed (including funding cost)	Date of repayment	Gain or loss (above funding cost)
Fed credit facility	123	90	January 2011	26
Maiden Lane II and III	53	44	June 2012	10
Fed CPFF	21	16	April 2010	0
TARP preferred shares	70	68	December 2012	–13
Total	**198**	**185**		**23**

CPFF = Commercial Paper Funding Facility; TARP = Troubled Asset Relief Program

Source: Baird Webel, *Government Assistance for AIG: Summary and Cost*, Congressional Research Service, August 2013.

wiped out to address losses of $40 billion with a cushion of only $20 billion equity. Moreover, the loss estimate of $40 billion pertained solely to the holding company, whose assets comprised only one-third of consolidated assets including those of subsidiaries (FDIC 2011, 14, 18). If we take –$20 billion as the meaningful net worth for the holding company implied by the FDIC study, and gross up proportionately from the holding company to the consolidated firm, the total net worth would have been –$60 billion. This estimate is not far from the more favorable bound of our range of –$100 billion and –$200 billion. Moreover, the FDIC study was based on the pre-bankruptcy informal estimates of impaired assets by Bank of America and Barclays and did not take into consideration the subsequent large markdowns in asset values by the bankruptcy administrators or the lawsuits that subsequently hit all firms that sold structured financial products backed by real estate during the housing bubble.

To recapitulate, *our overall judgment on Lehman is that it was deeply insolvent at the time of its bankruptcy.* This conclusion applies even if the Fed and Treasury's judgment anticipated none of the subsequent markdowns and lawsuits and was based solely on the range of troubled asset estimates at the time, as summarized in the FDIC study.

American International Group (AIG)

Federal assistance for AIG was more complicated than for the other institutions considered in this Policy Brief (table 4). It consisted of (1) a special Fed credit facility with an initial limit of $85 billion; (2) eligibility for the general Fed backstop for commercial paper known as the Commercial Paper Funding Facility (CPFF); (3) Fed loans to special purpose vehicles (Maiden Lanes II and III) for the purchase of troubled assets from AIG; and (4) Treasury purchases of preferred equity in AIG under the TARP. These programs were restructured on several occasions from late 2008 until September 2010.[18] The last of these programs was terminated in December 2012.

Table 5 shows that between June 2008 and December 2008, AIG's equity (excluding the Treasury purchase of preferred shares) declined by more than $50 billion and its total assets declined by almost $200 billion. This contraction reflected three factors: (1) a reduction in secured liabilities and the associated collateral; (2) sales of assets to Maiden Lanes II and III, which were used to pay down debt; and (3) the markdown of asset values in a falling market. AIG's net worth ticked up a bit in 2009 as federal assistance reached its peak. AIG slimmed down considerably in 2010 and 2011 by selling off subsidiaries. Fed and Treasury equity holdings were converted to common shares in early 2011, at which point Treasury owned 92 percent of outstanding shares. Treasury began to sell its shares in 2011, but most sales were conducted in 2012. By December 2012 Treasury had sold all of its shares of AIG stock.

We find that AIG remained consistently solvent, even though it was on the verge of insolvency in late 2008 and 2009.

On these data, AIG appears to have been solvent throughout the past five years, though it was on the verge of insolvency in late 2008 and 2009, if the value of Fed claims on AIG equity is excluded. Table 4 shows that AIG was able to repay its loans and capital assistance for $23 billion more than the cost of Fed and Treasury funds. Applying this return to the maximum disbursed

18. The initial terms of the Fed assistance were severe. The Fed received an 80 percent claim on AIG common stock that it could keep regardless of whether the loans were repaid. The interest rate on the credit facility was 8.5 percent over the London interbank offered rate (Libor). The interest rate was reduced and other terms were relaxed in subsequent restructurings.

Table 5 Consolidated balance sheets of entities controlled by AIG (billions of dollars)

Item	June 30, 2008	December 31, 2008	December 31, 2009	December 31, 2011	December 31, 2012
Assets					
Fixed income investments	424	404	397	288	295
Equity investments	42	21	18	4	4
Other investments	370	212	187	118	77
Other assets	214	224	246	142	173
Total	1,050	860	848	552	549
Liabilities					
Future policy claims and reserves	265	257	223	149	151
Policyholder funds and deposits	279	240	233	134	129
Long-term debt	164	137	113	75	49
Other (except Fed loans)	264	245	152	83	121
Fed CPFF	0	15	5	0	0
Fed credit facility	0	40	23	0	0
Total	972	798	749	441	450
Equity					
Fed shares	0	0	23	0	0
Treasury shares	0	40	47	87[b]	0
Net worth (excluding Fed and Treasury)	78	21[a]	29[a]	24	99

CPFF = Commercial Paper Funding Facility

a. The Fed credit facility included a warrant to purchase 80 percent of AIG equity, implying that most of the net worth was subject to claim by the Fed.
b. Treasury equity is based on nonvoting shares of $9 billion plus 77 percent ownership of common equity.

Source: AIG Form 10-Q filings with the Securities and Exchange Commission.

amount of $185 billion and assuming the funds were disbursed for the entire five-year period (a conservative assumption) yields a premium for the government of three percentage points above the cost of funds. Some might argue that this is not a large premium given the risks involved, but neither is it inconsequential. As with Bear, AIG's original shareholders lost roughly 90 percent of the value of their equity claims.

In sum, *we find that AIG remained consistently solvent, even though it was on the verge of insolvency in late 2008 and 2009.*

AVAILABLE COLLATERAL

A solvent institution generally has more collateral to post than an insolvent one. But even an insolvent institution may have available collateral provided that its net worth is not too negative and its liabilities are unsecured and have long maturities. Of course, if an insolvent entity posts collateral, its doing so subordinates existing unsecured creditors. At one level, availability of such collateral becomes irrelevant for eligibility for lender-of-last-resort support if the entity is insolvent, because the solvency test is a joint rather than alternative condition for Bagehot's dictum. Nonetheless, because of the difficulty of measuring solvency under stressed market conditions, it is useful to consider the second of the two conditions, sufficient collateral for the loan from the central bank. Did Lehman have sufficient collateral?

First we need to know how large a loan might have been needed. We assume that claims by affiliates and long-term debt are not going to be an immediate source of demand for cash. We focus on the balance sheet of December 2008, immediately after secured claims and associated collateral were run off. According to table 3, liabilities excluding claims by affiliates were $136 billion. Of this, long-term debt was reported to be $82 billion as of September 2008. (No maturity breakdown is available for later dates.) That leaves $54 billion in short-term, nonaffiliate claims on Lehman, a good indicator of the size of emergency loan that might have been needed.

On the asset side, claims on affiliates were $218 billion, but these are not likely to be usable as collateral because liabilities to affiliates were nearly as big as the claims and thus the unencumbered value of these claims is small and uncertain. Other assets are listed with a value of $78 billion, but accuracy

of this valuation is open to doubt, especially given the sharp drop in reported value of this class in the following year.

After allowing for the decline in market valuations and a reasonable haircut for the fraction of market value allowed as collateral, Lehman had barely sufficient collateral to cover short-term nonaffiliated claims, let alone the entirety of obligations. Further complicating factors are that the collateral was mainly held at Lehman's numerous subsidiaries and it spanned a wide range of asset types. The holding company (unconsolidated) listed nonaffiliate claims in December 2008 of only $23 billion, considerably less than was needed for a loan, especially given concerns about asset valuations. It may not have been technically possible to post and value the collateral from a large number of affiliates fast enough to avoid default even if it might have proved sufficient in hindsight.

In the cases of Bear Stearns and AIG, collateral was readily available that proved sufficient to pay off the emergency loans with modest premiums on the cost of funds of the Fed and Treasury. The case of AIG merits further comment. The consolidated balance sheet of AIG shows a huge volume of apparently unencumbered assets that could have been posted as collateral. However, most of these assets were held by insurance subsidiaries whose supervisors would not have allowed them to transfer collateral to the holding company. Effectively the assets and liabilities of these insurance subsidiaries were ring-fenced. Instead, AIG's collateral was the equity value of the subsidiaries themselves. Unlike Lehman's holding company, AIG's holding company did not have large liabilities to its subsidiaries, so its equity claim on those subsidiaries was free and clear to post as collateral for its loan. As of December 2007, the holding company of AIG reported total assets of $136 billion with short-term, secured, and interaffiliate liabilities of only $4 billion. That left $132 billion of assets free and clear to post as collateral, considerably more than the initial $85 billion credit line from the Fed. In addition, its subsidiaries were free to sell their own assets or post them as collateral in order to service or secure their own liabilities, which explains how AIG ultimately was able to draw even more than $132 billion in capital assistance from the Fed and Treasury.

HOW DAMAGING WAS THE LEHMAN COLLAPSE?

A stylized fact, or a relatively widely accepted analytical and empirical view, of the Great Recession is that it has been so severe and protracted because it was caused by a banking and financial crisis rather than by plain vanilla overheating of the economy cured by a harsh but reversible dose of monetary restraint. A companion stylized fact is that the signal event of the financial crisis was the collapse of Lehman and that this event plunged the US and international economies into much deeper financial turmoil.

It is not difficult to find indicators that support the importance of the Lehman event. One standard measure of financial stress is the spread between the London interbank offered rate (Libor) and the corresponding risk-free overnight interest swap for US treasury obligations (OIS). This Libor-OIS spread soared from 50 basis points on September 2, 2008, to a peak of 350 basis points by October 9, 2008 (Cline 2010, 241). For its part, the US stock market, as gauged by the S&P500 index, fell by 10 percent from the end of August to September 17, two days after the announcement of the Lehman bankruptcy. Perhaps the clearest "smoking gun" on Lehman's impact was the announcement by the large money market fund Reserve Primary that it had "broken the buck" because of losses on Lehman's commercial paper, an event that triggered withdrawals of 15 percent of total assets of US money market funds and forced the US Treasury to issue a temporary guarantee of the money market funds (FDIC 2011, 3). Examples of the lasting image of Lehman as the hallmark of the banking crisis can be found in such recent references as the International Monetary Fund's use of "a catastrophic event like the collapse of Lehman Brothers" to calibrate an adverse scenario for the impact of an exit from the euro by Greece (IMF 2013, 78). One of us judges that the stylized fact is broadly right and that it would have been a socially profitable public investment to spend a few billion dollars of public money to avoid the chaotic collapse of Lehman. Doing so in the right way, however, would have required fast-track application of SIFI-type resolution, with the Fed (or FDIC) informing different classes of creditors what ranges of recovery they could likely expect and announcing a timetable for recovery payments. It was not good for the system for Lehman to collapse chaotically, but it would have been even worse for the US government simply to assume all of Lehman's obligations (analogously to what happened in Ireland soon thereafter), and the appropriate alternative of orderly resolution was extremely difficult at a point in time that preceded not only Dodd-Frank but also the TARP.

It was not good for the system for Lehman to collapse chaotically...[but] the appropriate alternative of orderly resolution was extremely difficult at a point in time that preceded not only Dodd-Frank but also the TARP.

The other author notes that there is little agreement as to how much better the economy would have performed if Lehman had been saved, especially if the cost of saving Lehman meant that the subsequent fiscal stimulus would have been proportionally smaller. Lehman's failure caused measures of financial market stress to spike, but the subsequent actions and statements of officials that no other SIFI would be allowed to fail caused these stress indicators to return to near normal levels by January 2009.[19] There is no way to tell how much lasting damage the temporary panic caused. The collapse of the housing bubble meant that households would have been forced to spend less and banks would have been forced to tighten credit to repair their balance sheets regardless of whether or not Lehman was saved. On the other hand, the all-out actions to prevent another disruptive failure after Lehman probably nullified any benefit from the Lehman bankruptcy on moral hazard at financial institutions.

Whether or not the Lehman collapse was a major or minor factor in worsening the Great Recession, we agree that there is a need for an orderly workout alternative to sudden bankruptcy for SIFIs.

CONCLUSIONS

Four of the five major US financial institutions we examined—Bear Stearns, Fannie Mae, Freddie Mac, and AIG—were arguably solvent and received emergency loans and capital that they have already paid off, or are on track to pay off, fully and with a premium over the government's cost of funds. Lehman Brothers, on the other hand, was deeply insolvent and did not receive emergency funding. In retrospect, the decision to let Lehman fail and to bail out the others appears to be consistent with Bagehot's dictum.

What little collateral Lehman had was marginally sufficient at best, and it had very limited time to organize and value the collateral for posting from all the subsidiaries that held it. Again, on this dimension, the other four institutions were fundamentally different from Lehman in that they had lots of available collateral.

Although Bagehot clearly supported aggressive actions to calm financial panics, he drew the line at actions that would likely cost taxpayers' money. Is that the correct place to draw the line? A thorough answer is beyond the scope of this Policy Brief, and we doubt it is possible to answer it even in hindsight. The benefit of a bailout is less disruption of economic activity and the costs are possible taxpayer losses and adverse incentives (moral hazard) for financial institutions and their customers, who may expect to be bailed out in the future.

One point is incontrovertible: The case for adherence to the negative mandate of Bagehot's dictum—lend only to solvent firms and in the presence of collateral—would be greatly enhanced if it were possible to resolve a failing large and complex financial institution in a rapid and nondisruptive manner. This is the objective of the "living will" provision of the Dodd-Frank Act. The efficacy of these living wills has yet to be tested, and no agreement has been reached among regulators of different countries concerning the living wills of internationally active financial institutions. In summary, in modern financial markets the Bagehot principle of providing lender-of-last-resort support remains necessary but is no longer sufficient. Some Beyond Bagehot form of orderly resolution is essential to deal with insolvent SIFIs.

19. See the Plan of Action of G-7 finance ministers and central bank governors on October 10, 2008, www.treasury.gov/press-center/press-releases/Pages/hp1195.aspx. Stress measures are Libor-OIS spreads and bank credit default swap (CDS) spreads.

REFERENCES

Bagehot, Walter. 1873. *Lombard Street: A Description of the Money Market.* Available at www.gutenberg.org.

Cline, William R. 2010. *Financial Globalization, Economic Growth, and the Crisis of 2007-09.* Washington: Peterson Institute for International Economics.

FDIC (Federal Deposit Insurance Corporation). 2011. The Orderly Liquidation of Lehman Brothers Holdings Inc. under the Dodd-Frank Act. *FDIC Quarterly* 5, no. 2: 31–49.

IMF (International Monetary Fund). 2013. *Greece: First and Second Reviews Under the Extended Arrangement Under the Extended Fund Facility.* IMF Country Report no. 13/20 (January). Washington.

Sorkin, Andrew. 2009. *Too Big to Fail.* New York: Viking Penguin.

Tibman, Joseph. 2009. *The Murder of Lehman Brothers: An Insider's Look at the Global Meltdown.* New York: Brick Tower Press.

Wessel, David. 2009. *In Fed We Trust.* New York: Crown Business.

Brian P Sack: Reflections on the TALF and the Federal Reserve's role as liquidity provider

Remarks by Mr Brian P Sack, Executive Vice President of Markets Group of the Federal Reserve Bank of New York, at the New York Association for Business Economics, New York, 9 June 2010.

* * *

In my remarks today, I had intended to focus on the Federal Reserve's experience with the Term Asset-Backed Securities Loan Facility, or the TALF. This facility, which is scheduled to end later this month, was the last of the Federal Reserve's special liquidity programs, and those programs were then expected to enter a period of inactivity. It had therefore seemed to be a good time to reflect on our experiences with the TALF, and more broadly on the role of the central bank as a liquidity provider.

However, the context for this talk has shifted importantly with recent developments in financial markets. In particular, investors' concerns about sovereign risk in some European countries, with the attendant pressures on financial firms with exposures in those areas, have put renewed emphasis on liquidity provision and led the Federal Reserve and five foreign central banks to reestablish dollar liquidity swap lines.

Accordingly, I will begin today with some remarks on recent financial market developments and the role of the liquidity swap lines. I will then turn to the TALF program, providing a review of its performance and assessing the benefits that it provided. Both of these programs provide important insights into the role of the central bank as a provider of liquidity, leading to a few observations and to a few questions that I believe warrant further exploration in considering future policy actions.[1]

Liquidity swaps with foreign central banks

The second half of 2009 and the early part of 2010 were marked by substantial improvements in financial markets, ranging from short-term funding to longer term risk assets. There was good reason for those improvements: Efforts by the government to stabilize markets and support financial institutions were successful, and a virtuous circle appeared to be under way in which increasing optimism about the economic outlook and improving conditions in financial markets fed upon one another. The gains in asset prices were dramatic, with broad equity indexes reversing most of the declines experienced in late-2008 and early 2009 and with some measures of short-term funding spreads returning to pre-crisis levels.

However, more recent developments have demonstrated that conditions in financial markets can change abruptly. These developments have been widely discussed at this point, and I will not go through them in detail, except to highlight the two broad themes in play.

First, investors have become concerned about the fiscal positions of some European countries, leading them to re-price sovereign risk for those countries and to question whether austerity measures and other supporting efforts will prove sufficient to restore market confidence. Second, investors have increasingly worried about the exposures of European financial institutions to these countries and to European growth prospects more broadly. These uncertainties have led to sharp declines in the share prices of those financial

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[1] The views and opinions expressed are mine alone and do not necessarily represent the views of the Federal Open Market Committee or the Federal Reserve System.

institutions and have affected the ability of many of them to fund themselves in short-term credit markets.

The successful resolution of these problems ultimately rests on European policy actions. Those actions will determine the degree of fiscal adjustment that is required over time, the amount of fiscal support and risk sharing among European countries that is appropriate, and the extent to which European financial institutions are supported. The Federal Reserve had only a limited and supportive role in the policy response, taking steps to allow the European Central Bank and other foreign central banks to respond more fully to emerging liquidity pressures.

The liquidity pressures that have emerged stem from the balance sheets of European financial institutions. Those institutions still hold large amounts of dollar-denominated assets and finance a sizable portion of those holdings in short-term dollar-denominated funding markets. In the presence of concerns about the status of these institutions, investors have become more reluctant to extend term funding to many of them, putting upward pressure on term funding rates and forcing the firms to change their funding patterns.

To help prevent strains in dollar funding markets from intensifying and spreading, and hence creating more widespread pressure on financial markets, the Federal Reserve established liquidity swap arrangements with the Bank of Canada, the Bank of England, the European Central Bank, the Swiss National Bank and the Bank of Japan. These arrangements provide foreign central banks with the capacity to deliver US dollar funding to institutions in their jurisdictions. The credit is extended by the foreign central bank against the collateral that each accepts, and the interest generated from those transactions is returned to the Federal Reserve.

From the perspective of the Federal Reserve, the liquidity swap arrangements are safe. After all, the Federal Reserve is extending credit to the foreign central bank and not to the financial institutions that obtain dollar funding. The credit we extend to the foreign central bank is collateralized by foreign currency deposited with the Federal Reserve. Moreover, the operations do not involve any exchange rate risk for the Federal Reserve, because the swap transactions are unwound at the same exchange rate at which they are established.

There is currently only a very small amount of outstanding credit extended through the liquidity swap arrangements, in contrast to the dramatic usage that was observed during the financial crisis. The reason is that the circumstances surrounding the recent establishment of the swap lines differed from those in the middle of the financial crisis. During that earlier period, the need for dollar funding was more severe, and funding markets had become completely dysfunctional. The swaps were priced at rates that were well below those available in the market at that time, causing usage of the swap lines to rise dramatically to a peak of nearly $600 billion in December 2008.

In the current circumstances, although the swaps have been priced in the same manner as during the crisis, this pricing is less advantageous relative to the funding rates available in the market, limiting the usage of the swap lines at this time. The swaps were essentially put in place in a preemptive manner, under the view that their presence would provide a backstop for dollar funding markets and help to bolster market confidence.

Reflections on the TALF

I am now going to switch gears and discuss the TALF, which is a liquidity program of a very different nature. Later this month, we will be holding our final subscription for the TALF. However, because no deals have been presented for review for the final subscription, we know that the extension of new credit under the TALF has effectively come to an end.

Although the structure of the TALF differed considerably from the other liquidity programs initiated by the Federal Reserve, its basic role was similar in many ways to the traditional

central bank function of providing liquidity to the financial system and encouraging the flow of credit. In this case, however, the program was geared toward providing support for market-based credit intermediation, as opposed to the traditional banking sector. More specifically, the TALF was designed to support the market for securitized credit.

Overall, the TALF performed impressively in meeting that objective. The program contributed to a substantial improvement in conditions in the securitized credit market, facilitating an increase in the availability of credit to households and businesses. Moreover, it achieved this outcome with limited risk to the Federal Reserve's balance sheet.

Let me begin with some general background information on securitized credit markets. Securitization is an important funding source for bank and nonbank lenders. When a lender extends credit, it makes the decision of whether to keep loans on its books or to securitize and sell them to other investors. If kept on the lender's books, the holdings have to be financed, either by borrowing or by using funds that could be deployed for other purposes, including making other loans. Thus, in many circumstances the lender finds it advantageous to sell assets through the securitization channel, allowing other investors to ultimately hold the assets and hence bear the risk. The amount of credit financed through securitization rivals that provided directly by banks. Indeed, even excluding the sizable securitization markets for mortgage credit, approximately $2 trillion in loans to consumers, students, and businesses were securitized over the past decade.[2]

The securitization market became significantly disrupted during the financial crisis in 2008 and 2009 in all areas outside of conforming agency mortgage-backed securities. Liquidity for securitized products deteriorated, leading to an unprecedented widening of spreads. Issuance virtually ground to a halt, resulting in significant funding concerns for a variety of lenders who relied on securitization. These funding strains prompted some lenders to dramatically tighten underwriting standards, thus reducing overall credit to consumers and businesses. A prolonged shutdown of the securitization market could have compounded the credit crunch and increased the risk of an even more severe contraction of the economy than we experienced.

In response, the TALF was created to provide liquidity in the form of term loans to investors in the least risky part—the AAA tranches—of particular types of asset-backed securities, including those backed by consumer loans, student loans, small business loans, and commercial real estate loans. The hope was that, by providing loans directly to investors against asset-backed collateral, the TALF would help stabilize and improve the prices at which those securities could be sold, thus reducing lenders' costs of funds. With lenders' funding strains alleviated, the extension of credit to consumers and other borrowers could occur on more favorable terms.

While the TALF is essentially similar to other programs in its basic objective of providing liquidity and encouraging the extension of credit, it is worth highlighting that the TALF has several features that are not common in other liquidity facilities.

First, TALF loans are non-recourse, meaning that the borrower can put the collateral to the Federal Reserve rather than repay the loan if the collateral value falls sufficiently below the amount owed. The provision of non-recourse loans helped to encourage investor participation. In late 2008, when secondary market spreads had spiked and risk aversion was high, investors were uncertain as to when and how the market would stabilize. Non-recourse lending helped place a floor on investor losses, thus increasing market confidence broadly and facilitating the return of structured product investors.

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[2] Source: Morgan Markets. Note: This includes securitizations of auto loans and leases, credit card account balances, student loans, dealer floorplan loans, and business equipment loans and leases.

Second, TALF loans have considerably longer maturities than the lending from the Federal Reserve's discount window and its other temporary liquidity facilities. The term of the loans, which were either three or five years, was intended to more closely match the maturity of the underlying securities, as needed to encourage investors to return to the market. In addition, loans with longer terms were viewed as more effective, as financing would extend well beyond the expected end of the recession.

The combination of these two elements – non-recourse loans and long maturities – was critical to the success of program. Without one or the other, investors would have had exposure to short-term swings in risk premiums in a time of extreme volatility, which would have likely limited participation and thus reduced the program's effectiveness.

A third notable feature of the TALF was that it was available to a wide set of market participants beyond the Federal Reserve's traditional bank counterparties. This feature reflected the program's broad focus on a financial market rather than a particular set of financial firms. Given the wide array of market participants, the program's broad reach was necessary to effectively support the entire market.

Let me turn to the program's achievements. By providing liquidity and a backstop to limit losses to investors, the TALF contributed importantly to the revival of securitized credit markets. Secondary spreads narrowed significantly, and volatility moderated. Moreover, the improvements in the secondary market helped re-start the new-issue market. Issuance of non-mortgage asset-backed securities jumped to $35 billion in the first three months of TALF lending in 2009, after having slowed to less than $1 billion per month in late 2008. During those initial months that the TALF was in operation, about half of the issuance in the market was financed by the facility, with this degree of support then gradually declining as market function improved.[3]

While each of the Federal Reserve's liquidity facilities was ultimately aimed at encouraging the flow of credit to the economy, the TALF may be distinctive in offering a more direct impact to the consumer. In fact, nearly all of the auto lenders supported by the TALF reported that the facility enabled them to offer more credit to consumers at lower rates. Lenders attributed this impact to the program's success in re-opening the securitization channel through which roughly half of consumer loans are financed.

The TALF also facilitated the first issuance of commercial mortgage-backed securities since mid-2008, which provided an important benchmark for pricing and helped establish the higher credit standards now seen in the market. These developments paved the way for subsequent commercial mortgage-backed deals to come to the market without TALF support.

The TALF accomplished these benefits while exposing the Federal Reserve to a limited amount of risk, as its design provides considerable protection. As I mentioned earlier, loans were made only against the highest rated asset-backed collateral.[4] Moreover, TALF borrowers contributed significant capital in the form of a risk-based haircut, which means that the market value of collateral pledged exceeded the principal amount of the TALF loan. The prices of securities pledged to the facility have risen, giving the Federal Reserve an even larger cushion against loss, and no securities have been put to the facility to date. In addition, Treasury backstopped the facility by committing up to $20 billion to absorb any losses associated with the loans before the Federal Reserve would be at risk. And lastly, the interest earned on our loans is accruing, with about $400 million earned to date, and serves as a buffer against loss.

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[3] Sources: Morgan Markets; Bloomberg L.P.; Federal Reserve Bank of New York.

[4] Importantly, the Federal Reserve performed due diligence on each of the bonds pledged to the facility as a part of a detailed risk assessment process.

The risk to the Federal Reserve is also limited by the amount of balance sheet employed, which has been considerably less than envisioned at the height of the crisis. While $200 billion was authorized for the program, only approximately $70 billion in total was lent. Moreover, because loans were paid back as private credit markets improved, the maximum amount of credit extended under the program was about $50 billion. Today, there is about $44 billion of TALF credit outstanding.

It is worth considering why the program was able to achieve such significant market improvements with a limited amount of balance sheet. The success of the TALF may reflect that it targeted a market under severe stress, one characterized by extreme liquidity premiums that had caused asset prices to become detached from the underlying credit quality of the securities. Under those conditions, our involvement was able to have a substantial effect, in part by pushing those markets back toward more normal functioning and pricing.

To be sure, improvements in funding markets broadly and in the macroeconomic outlook during the course of the program clearly influenced the recovery of securitized credit markets. That said, the TALF lending mechanism has been widely credited with helping to jumpstart those markets.

As markets have improved and the liquidity premium on securitized credit has shrunk, the TALF has become a less appealing source of funding. Indeed, borrowers have been prepaying their loans as spreads have narrowed below the TALF lending rate. At this point, those asset-backed securities markets that were supported by TALF appear to be standing on their own. Going forward, the securitized credit markets will be shaped importantly by regulatory efforts, with some potential changes such as risk retention and transparency requirements still undecided.

Defining the Central Bank's role as liquidity provider

Let me now turn to the broader issue of the appropriate role of the central bank as a provider of liquidity during periods of market strain. In effect, both of the programs I have just discussed expand the reach of the Federal Reserve's liquidity policies to a broader set of firms than those with access to our traditional discount window program. Moreover, the Federal Reserve launched a number of other facilities during the financial crisis that reached other types of firms and markets.

The scope and process for launching similar liquidity facilities in the future will be guided by the legislative efforts currently under way. Still, it is important for the Federal Reserve to reflect on what we have learned through our experiences so that we may better judge the actions that should be taken in the future within that legislative structure.

The liquidity programs that were launched by the Federal Reserve shared some common characteristics. In all cases, the programs provided credit in stressed markets, and for those facilities that offered credit at a predetermined interest rate, the rate was set at a penalty relative to normal market functioning. This approach yields several benefits.

First, by acting in markets that are under stress, such programs have the scope to produce substantial improvements in market conditions. If they are seen as credible backstops, these programs can increase confidence and move financial conditions back toward normal levels. This feature was discussed earlier in the context of the TALF, in terms of the sizable market impact relative to the amount of risk taken.

Second, liquidity programs designed in this manner have a good chance of generating positive income for the central bank. The reason is that financing is offered at a time when market risk premiums are very high. The central bank therefore captures a high expected return relative to the actual risk it is assuming, especially when the lending is adequately collateralized to limit such risk. Indeed, the Federal Reserve is likely to make substantial

returns from the liquidity facilities launched during the financial crisis.[5] Achieving these returns, of course, was not an objective of the programs, but it does suggest that the Federal Reserve was prudent in the way in which it established these programs.

Third, this approach gives the facilities a self-liquidating property. Loan rates are set at penalty levels that are not attractive in normally functioning markets. Given the scarcity of liquidity and the extreme movements of risk premiums during a crisis, the penalty rates are readily accepted by market participants in those circumstances. However, as the market gains confidence and returns to normal functioning, users of the facility have an incentive to stop borrowing from the central bank and to pursue better rates in private funding markets. In essence, pricing at penalty rates incorporates an exit strategy into the design of the programs.

But while the various liquidity programs shared these features, they differed in other dimensions, and it is these differences that prompt questions about the future scope and design of liquidity facilities.

A primary question is whether liquidity support during times of stress should be offered only to banks or to a wider set of financial institutions. We have a financial system in the United States that is heavily dependent on nonbank institutions in the extension of credit to firms and households. Indeed, as noted earlier, the amount of credit provided by the securitization market has rivaled that provided by banks. Moreover, nonbank firms in many cases are just as vulnerable to liquidity pressures and run-like dynamics as are banks. Accordingly, there may be benefits to having the central bank extend credit to both banks and nonbank financial intermediaries during periods of financial stress. The experience with the TALF suggests that nonbank lending efforts can be successful at restoring market functioning and the flow of credit to firms and households.

A second issue is the extent to which the Federal Reserve should be flexible in setting the structure of its liquidity programs to meet the needs of the market. As noted earlier, the TALF did this in several ways, including its extension of the duration of the loans beyond the short-term nature of most other liquidity facilities. That decision clearly improved the appeal of the program, suggesting that having some flexibility in structure can be beneficial. However, policymakers will have to decide the appropriate degree of flexibility to exercise in the future.

Of course, both of those dimensions—having a wide range of counterparties and using a more flexible lending structure—have the potential to increase risk to the central bank. The TALF was able to offer credit on these terms without compromising the safety of the Federal Reserve's balance sheet by requiring sufficient collateralization of the loans and by relying on the loss buffer provided by the Treasury. Without the Treasury's contribution to the program, it would have been more challenging to design a program that was both appealing to the markets and safe for the Federal Reserve. Thus, a third open issue for future policies is determining the circumstances under which such cooperation between the monetary and fiscal authorities is appropriate.

A final issue is that, if the central bank provides a back-up source of liquidity to the markets, whether through its traditional discount window function or these other facilities, it should consider the effects on the risk taking behavior of market participants. Efforts should be taken to ensure that expectations of the availability of Federal Reserve lending facilities do not lead to excessive risk taking on the part of financial institutions. In the case of banking institutions, this moral hazard is offset by appropriate supervision and regulation. Measures may be warranted for nonbank financial institutions if they expect Federal Reserve credit to be made available to them during times of stress.

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[5] The interest income and fees that accrue to the Federal Reserve from these facilities are ultimately remitted to the US Treasury.

Conclusion

Overall, recent financial market developments serve as a reminder that the central bank's role as a liquidity provider can be critical during periods of financial stress.

In this speech, I discussed the reintroduction of the liquidity swap lines with foreign central banks and reviewed our experience involving the TALF—two programs that provide dollar liquidity to a broad set of counterparties. Our experiences with these two programs, and with the other facilities launched during the financial crisis, suggest that liquidity programs can be quite effective at restoring market functioning and facilitating the flow of credit to households and businesses. However, because these facilities differ from traditional discount window activity, they raise questions about the appropriate scope and structure of the Federal Reserve's role as liquidity provider.

We should continue to evaluate our experience with these facilities and with other liquidity programs to more clearly define an appropriate framework for providing liquidity to the markets in the future.

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SPEECH

The Federal Reserve's Recent Actions to Support the Flow of Credit to Households and Businesses

April 14, 2020

Lorie K. Logan, Executive Vice President

Remarks before the Foreign Exchange Committee, Federal Reserve Bank of New York, New York City
As prepared for delivery

Good afternoon. As members of the Foreign Exchange Committee, you are all well aware of the importance of well-functioning financial markets. I would like to thank you for the commitment you have shown to supporting the smooth functioning of the foreign exchange market. Your continued leadership is especially important in these challenging times. And we are all grateful to those who are putting themselves in harm's way on the front lines to take care of others during this unprecedented public health emergency.

In early to mid-March, amid extreme volatility across financial markets triggered by the coronavirus pandemic, several markets at the center of the U.S. financial system were severely disrupted. In short-term funding markets, it was difficult to borrow for longer than overnight. In the usually very liquid markets for Treasury securities and agency mortgage-backed securities (MBS), trading became impaired. In investment-grade credit markets, even healthy borrowers found that credit was unavailable or very expensive.

These markets matter not only for those who participate in them, but also—because of their central role in the financial system—for workers and families throughout the United States. Continued disruptions could quickly make it more difficult for families to obtain mortgages at reasonable interest rates, for businesses to fund their operations and pay their workers, and for local, state, and federal governments to pay for essential services. Such a credit crunch would exacerbate the hardships many are experiencing in this period of economic constraint necessary to fight the spread of the coronavirus, and reduce the odds of a strong recovery afterward.

Therefore, it was important for the Federal Reserve to act quickly and decisively to support market functioning and the flow of credit. Over a period of a few weeks, the Federal Open Market Committee (FOMC) lowered the target range for the federal funds rate to near zero. The Federal Reserve also announced a sequence of strong actions to support the flow of funding in short-term markets, the functioning of Treasury and MBS markets, and the availability of credit to households, businesses, and state and local governments.

Today, I will provide an overview of these actions to date from my perspective as manager of the System Open Market Account and head of the New York Fed's Open Market Trading Desk. The Fed's recent actions have involved an unprecedented array of tools—from standard open market operations conducted by the Desk and deployed on a larger scale than ever before, to new facilities that use the Federal Reserve's emergency powers with the consent of the Treasury Secretary and financial backing from the Treasury and Congress. Some actions targeted problems in a single market, while others worked to support functioning across many markets. In addition, because they were deployed in close succession, the actions reinforced each other, with improvements in each market supporting the functioning of other markets and the financial system overall. I will speak about recent actions to support liquidity and the flow of credit in four areas: domestic short-term funding markets, international dollar funding markets, markets for Treasuries and MBS, and credit markets.

Before I proceed, let me note that the views I express are my own and do not necessarily reflect those of the Federal Reserve Bank of New York or the Federal Reserve System.[1]

Domestic Short-Term Funding Markets

Funding markets transfer funds from households and businesses that seek safe, easily accessible short-term investments to firms that have short-term borrowing needs. For example, a manufacturing company with a temporary surplus of cash might invest in a money market mutual fund, planning to take the money back out in a few weeks to invest in new equipment. In turn, the money market fund might buy commercial paper issued by another company that needs to cover its payroll, or it might use a repurchase agreement (or "repo") to lend to a broker-dealer that needs to finance an inventory of Treasury securities. The smooth flow of funds in these markets allows businesses to readily finance their operations and investors to engage in vibrant trading that keeps a wide range of other markets working well.

In mid-March, short-term funding markets became severely impaired. In repo and commercial paper markets, there was little term funding available. Even for overnight borrowing, some market participants paid much higher rates than usual. Figure 1 shows the Secured Overnight Financing Rate (SOFR), which is the median rate on certain overnight repos against Treasury collateral, as well as the 75th and 95th percentiles of the distribution of these Treasury repo rates. Ordinarily, this distribution of rates is very tight. However, in the second and third weeks of March, it widened notably, with some borrowers paying dozens of basis points above the median, and well above the FOMC's target range for the federal funds rate.

The initial pressures in funding markets led to further strains. Investors became reluctant to buy the commercial paper of healthy issuers, for fear that when the paper came due, the issuers would have difficulty rolling it over into new paper. Prime money market funds—which invest in commercial paper—saw outflows of about $150 billion over the month of March as some investors worried that difficulty selling holdings would eventually prevent the funds from satisfying withdrawals.

Starting March 9, the Federal Reserve launched a series of actions to stabilize funding markets. The first two actions involved expanding the use of standard tools: repo operations by the Desk and discount window lending by all 12 Reserve Banks.

- The Desk increased daily offerings of overnight repos from $100 billion to $150 billion, then to $175 billion, and ultimately to even larger amounts.[2] The Desk also began offerings of one-month and three-month term repos, each for $500 billion.[3] These offerings allow dealers to access ample funding for Treasury and MBS collateral.
- The Federal Reserve Board lowered the primary credit rate by 150 basis points, to 0.25 percent, and announced that banks could borrow from the discount window for up to 90 days.[4] These steps provide banks with ready access to funding that they can use to provide credit to households and businesses.

Shortly thereafter, several additional actions used emergency tools, based on the Board's authority to act in unusual and exigent circumstances with consent of the Treasury Secretary and, in some cases, funding as well:

- The Primary Dealer Credit Facility (PDCF) allows the New York Fed's primary dealers to obtain funding against a wide range of collateral at the same rate as the discount rate. By increasing dealers' access to funding, this facility helps them to provide credit across numerous markets.[5]
- The Money Market Mutual Fund Liquidity Facility (MMLF) lends against assets that banks acquire from money market funds. By helping to ensure that money market funds will be able to meet demands for redemptions, this facility encourages investors to leave cash in these funds, which then provide credit that flows to the broader economy.[6]
- The Commercial Paper Funding Facility (CPFF) purchases commercial paper directly from highly rated companies and municipal governments. The availability of this facility reduces the risk that eligible commercial paper issuers will be unable to roll over their debts at maturity. In turn, the reduction in risk encourages investors to buy commercial paper from businesses that use the funds to pay employees and invest in operations, and from municipalities that use credit to provide public services. Furthermore, because this facility purchases newly issued commercial paper, it not only enhances liquidity but also directly supports the flow of credit to eligible issuers.[7]

International Dollar Funding Markets

As the world's preeminent reserve currency, the dollar plays a leading role in trade and investment far beyond our country's borders. Banks around the world borrow dollars in international markets to finance these activities. In addition, global banks borrow dollars to finance investments in the United States—lending, that is, to American families, companies, and the U.S. government. As members of the FX Committee, you are well versed in the importance of international dollar funding markets.

These markets, too, came under severe strain in March. Shown in Figure 2, the yen-dollar swap basis spread—a measure of the premium paid to borrow dollars using yen in the foreign exchange market—soared by roughly 200 basis points. Other foreign exchange swap basis spreads also rose sharply, and foreign exchange swap trading volumes declined. These pressures had the potential to spill over to domestic funding markets, as international banks can compete to borrow dollars in the U.S., as well as the potential to disrupt the flow of credit from international financial institutions to domestic borrowers.

To ease strains in global U.S. dollar funding markets, the Federal Reserve and other central banks took coordinated actions in March to enhance the provision of U.S. dollar liquidity through central bank swap lines around the world. These swap lines are designed to improve liquidity conditions in the United States and abroad by providing foreign central banks with the capacity to deliver dollar funding to institutions in their jurisdictions during times of global funding market stress. This supports activities that rely on access to U.S. dollar funding, including supplying credit to U.S. borrowers. The Federal Reserve and the central banks of Canada, the United Kingdom, Japan, Switzerland, and the euro area agreed to lower the pricing on the standing swap lines, to

supply dollars at longer tenors in addition to regular one-week operations, and to increase the frequency of one-week operations. The Federal Reserve also established temporary swap lines, limited in size, with nine other central banks around the world.

In addition to the swap lines, the Federal Reserve established a temporary repo facility to allow foreign and international monetary authorities to temporarily exchange U.S. Treasury securities held in their accounts with the New York Fed for U.S. dollars. This facility provides those central banks with an alternative source of dollar funding that they can then lend to institutions in their jurisdictions. The facility also helps to support the smooth functioning of the market for U.S. Treasury securities by reducing foreign central banks' need to sell these securities outright when private cash and repo markets become stressed.

Markets for Treasury and Mortgage-Backed Securities

The market for U.S. Treasury securities is commonly described as the deepest and most liquid in the world. Ordinarily, it is easy for investors to sell Treasuries quickly and at low cost. This liquidity adds significantly to the value of Treasury securities, helping the U.S. government to borrow at low interest rates. As many other interest rates are priced relative to the safe interest rate on Treasuries, the liquidity of the Treasury market ultimately reduces financing costs for families and firms throughout the economy.

Although not as liquid as the Treasury market, the market for agency MBS—pools of residential mortgages backed by Ginnie Mae, Fannie Mae, and Freddie Mac—is also ordinarily very liquid. This liquidity makes MBS a more attractive investment, supporting low mortgage rates and the flow of mortgage financing to American households.

However, in mid-March, liquidity in Treasuries and MBS dried up. The Desk's market monitoring and data analysis suggest that two key factors were at work. First, amid large moves in asset prices and uncertainty about access to liquidity, many investors sought to sell bond holdings. Some of these investors, such as asset managers that might need to meet redemptions, were seeking to raise cash. Others were rebalancing their portfolios after the sharp fall in equity prices, or exiting positions that were no longer viable in the highly volatile market conditions. These large sales of bonds drove up dealers' inventories of Treasuries and MBS; facing balance sheet constraints and internal risk limits amid the elevated volatility, dealers had to cut back on intermediation. Second, volatile market conditions led some trading firms to step back from the market, further reducing liquidity. Figure 3 shows the consequences: The average bid-ask spread for Treasury securities, a measure of transactions costs, rose by a factor of about 13 over the first few weeks of March. Many other measures of functioning in the Treasury and MBS markets also deteriorated.

In response, the Desk, at the direction of the FOMC, is undertaking extensive purchases of Treasuries and MBS to support the functioning of these critical markets. Although asset purchases are a standard Desk tool, the scale of these purchases has been unparalleled, totaling about $1.6 trillion in the past four weeks. Also, we are now buying agency commercial mortgage-backed securities (CMBS), which are pools of mortgages on apartment buildings and other commercial properties that are backed by Fannie Mae, Freddie Mac, and Ginnie Mae. As important as the volume of purchases is the FOMC's commitment, announced March 23, to purchase whatever amounts are needed to support smooth market functioning and effective transmission of monetary policy.[8] Extending a strong commitment to support market functioning has calmed trading conditions and allayed the potentially self-fulfilling fear that conditions might deteriorate further.

I should note that supporting smooth market functioning does not mean restoring every aspect of market functioning to its level before the coronavirus crisis. Some aspects of liquidity—especially aspects related to transactions costs and market depth—are importantly affected by fundamental factors such as how the current extraordinary uncertainty about the economic outlook influences trading behavior. These aspects of market functioning may not return all the way to pre-crisis levels for some time, even as our purchases slow.

Nor does supporting smooth market functioning mean eliminating all volatility. In well-functioning markets, prices will respond rapidly and efficiently to new information. During the unprecedented disruption caused by the coronavirus pandemic, a great deal of new information arrives every day about the outlook for specific markets, such as housing, and for the economy as a whole. These changes in the outlook should move the Treasury and agency MBS markets irrespective of the Federal Reserve's purchases.

Credit Markets

In normal times, credit markets allow households and businesses to finance a vast array of activities: buying a car or a house, attending college, covering a short-term gap between revenue and expenses, or making a long-term investment in new products or factories. In this time of economic stress, credit markets are all the more critical, helping families to borrow rather than forgo necessities, and helping businesses to keep going, cover their payrolls, and, eventually, make the investments needed for a strong recovery.

Yet credit markets have come under substantial pressure in recent weeks. For example, the spread of interest rates on investment-grade corporate bonds relative to Treasury securities widened by about 250 basis points from late February to mid-March, as illustrated in Figure 4.

Much of that pressure results from significant changes in the economic outlook: With many businesses temporarily closed and millions of people losing their jobs, lenders see a greater likelihood that some borrowers will be unable to repay. But impaired

market functioning has also contributed to the pressures. For example, borrowers often repay their debts by borrowing anew, but rolling over debt is difficult in a stressed market, so lenders may conclude that market dysfunction will lead to defaults even by financially sound borrowers and respond by reducing lending or seeking higher interest rates. We saw several signs that poor market conditions were contributing to credit stress in March, including a drop-off in corporate and municipal bond issuance and large outflows from bond mutual funds.

Many of the Federal Reserve actions in funding and asset markets that I described earlier are also helping to support credit markets. For example, the PDCF, CPFF, and MMLF can all provide funding for loans to creditworthy borrowers such as households, businesses, or local governments, while MBS purchases support a key market for credit to households.

In addition, the Federal Reserve Board, with the consent of the Treasury Secretary and backing provided by the Treasury and Congress under the CARES Act, has used its emergency authority to announce numerous steps targeted at other major credit markets. The Primary Market Corporate Credit Facility (PMCCF) will buy newly issued corporate bonds and syndicated loans, while the Secondary Market Corporate Credit Facility (SMCCF) will give investors an outlet to sell corporate bonds—in both cases supporting a key market for credit to large employers.[9] The Board has also announced a Main Street Lending Program that will purchase up to $600 billion in loans to small and midsize businesses, as well as a facility that will support the Small Business Administration's Paycheck Protection Program (PPP) by supplying liquidity to financial institutions that make PPP loans to small businesses.[10] In addition, the Term Asset-Backed Securities Loan Facility (TALF) will support the issuance of securities backed by student loans, auto loans, credit card loans, small business loans, and other debt, while the Municipal Liquidity Facility (MLF) will lend up to $500 billion to state and local governments.[11] All of these steps will help keep credit markets working and credit flowing to qualified borrowers in response to the coronavirus pandemic.

Conclusion

Modern financial markets are closely connected to one another. Stresses in one market can easily lead to stresses in others, raising the risk that the financial system as a whole becomes significantly impaired. For example, if short-term funding markets are disrupted, otherwise creditworthy borrowers may have difficulty rolling over their debts—which can make the borrowers more risky and create pressures in credit markets. The Global Financial Crisis of 2007-'08 showed how rapidly problems can spread across financial markets and ultimately damage the economy.

Today's crisis is different, having originated outside the financial system, in an enormous challenge to public health. Yet the lesson of the previous crisis still applies, and the Federal Reserve has taken it to heart in responding to the recent stresses in funding markets, Treasury and MBS markets, and credit markets. By acting quickly and forcefully to support all of these markets at once, we have been able to stabilize market conditions. Many challenges surely lie ahead for the economy and financial markets. But the past month demonstrates that the Federal Reserve will use its tools aggressively to keep markets working so that credit can flow to households, businesses, and state and local governments throughout our economy.

Thank you.

Figures PDF

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[1] I would like to thank Sam Schulhofer-Wohl for his assistance in preparing these remarks, Ashley Rhodes for her assistance with data, and colleagues in the Federal Reserve System for valuable comments and suggestions.

[2] See Statement Regarding Repurchase Operations (March 9, 2020), Statement Regarding Repurchase Operations (March 11, 2020), and Statement Regarding Repurchase Operations (March 17, 2020).

[3] See Statement Regarding Treasury Reserve Management Purchases and Repurchase Operations (March 12, 2020).

[4] See Federal Reserve Actions to Support the Flow of Credit to Households and Businesses, Board of Governors of the Federal Reserve System (March 15, 2020).

[5] See Primary Dealer Credit Facility, Board of Governors of the Federal Reserve System.

[6] See Money Market Mutual Fund Liquidity Facility, Board of Governors of the Federal Reserve System.

[7] See Commercial Paper Funding Facility, Board of Governors of the Federal Reserve System.

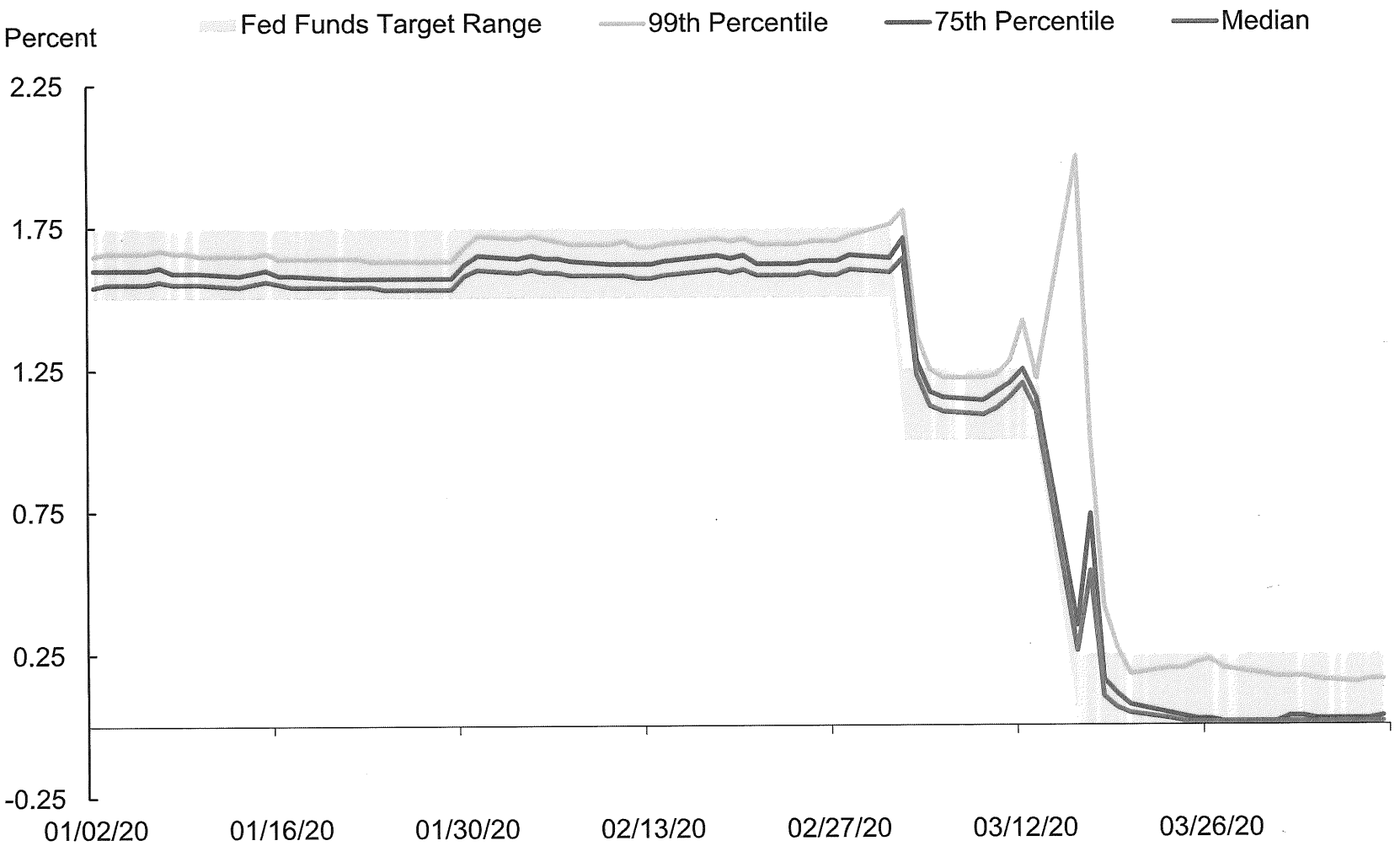
[8] See Federal Reserve issues FOMC statement (March 23, 2020).

[9] See Primary Market Corporate Credit Facility and Secondary Market Corporate Credit Facility, Board of Governors of the Federal Reserve System.

[10] See Main Street Lending Program and Paycheck Protection Program Liquidity Facility, Board of Governors of the Federal Reserve System.

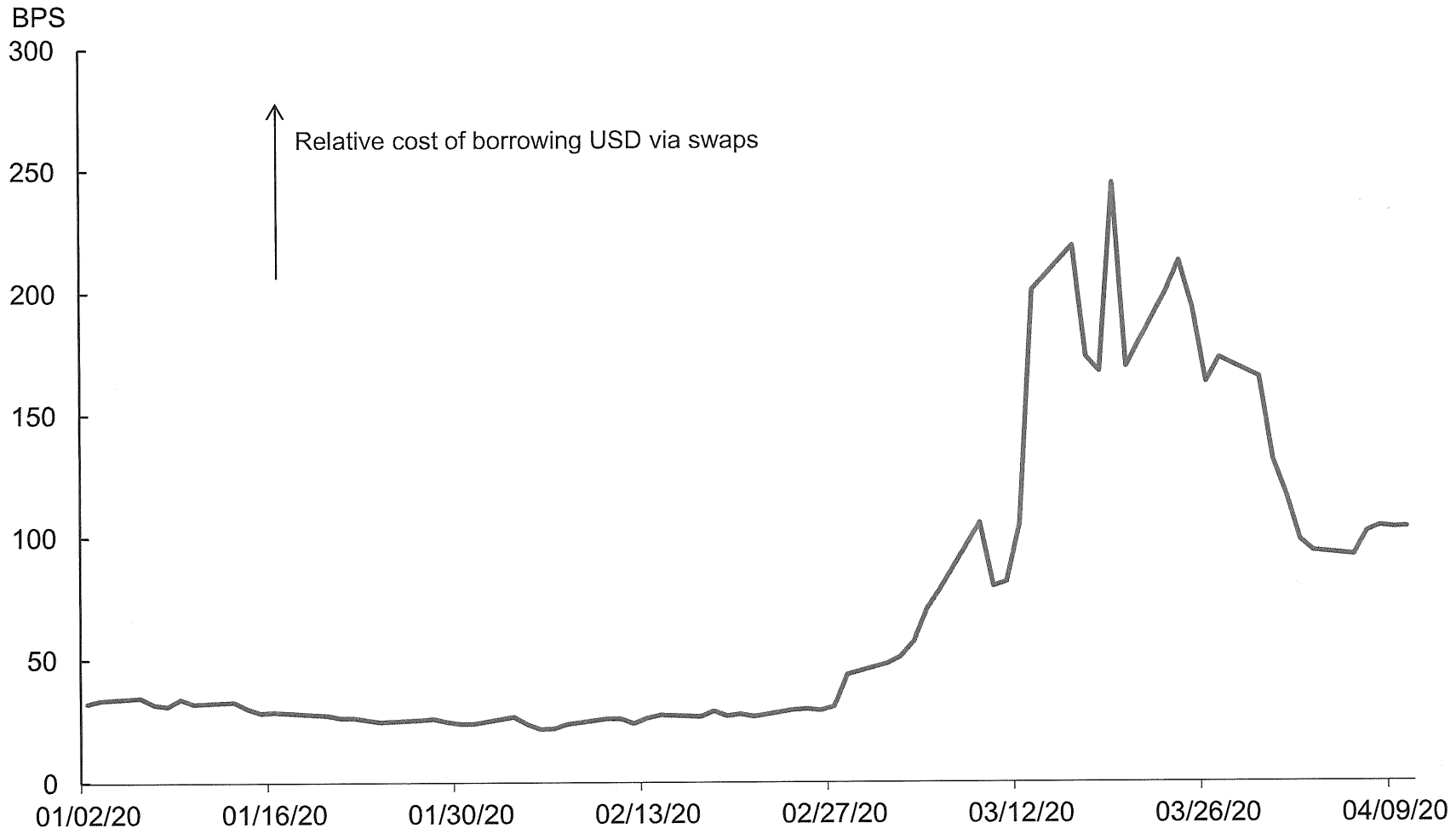
[11] See Term Asset-Backed Securities Loan Facility and Municipal Liquidity Facility, Board of Governors of the Federal Reserve System.

Figure 1: Secured Overnight Financing Rate



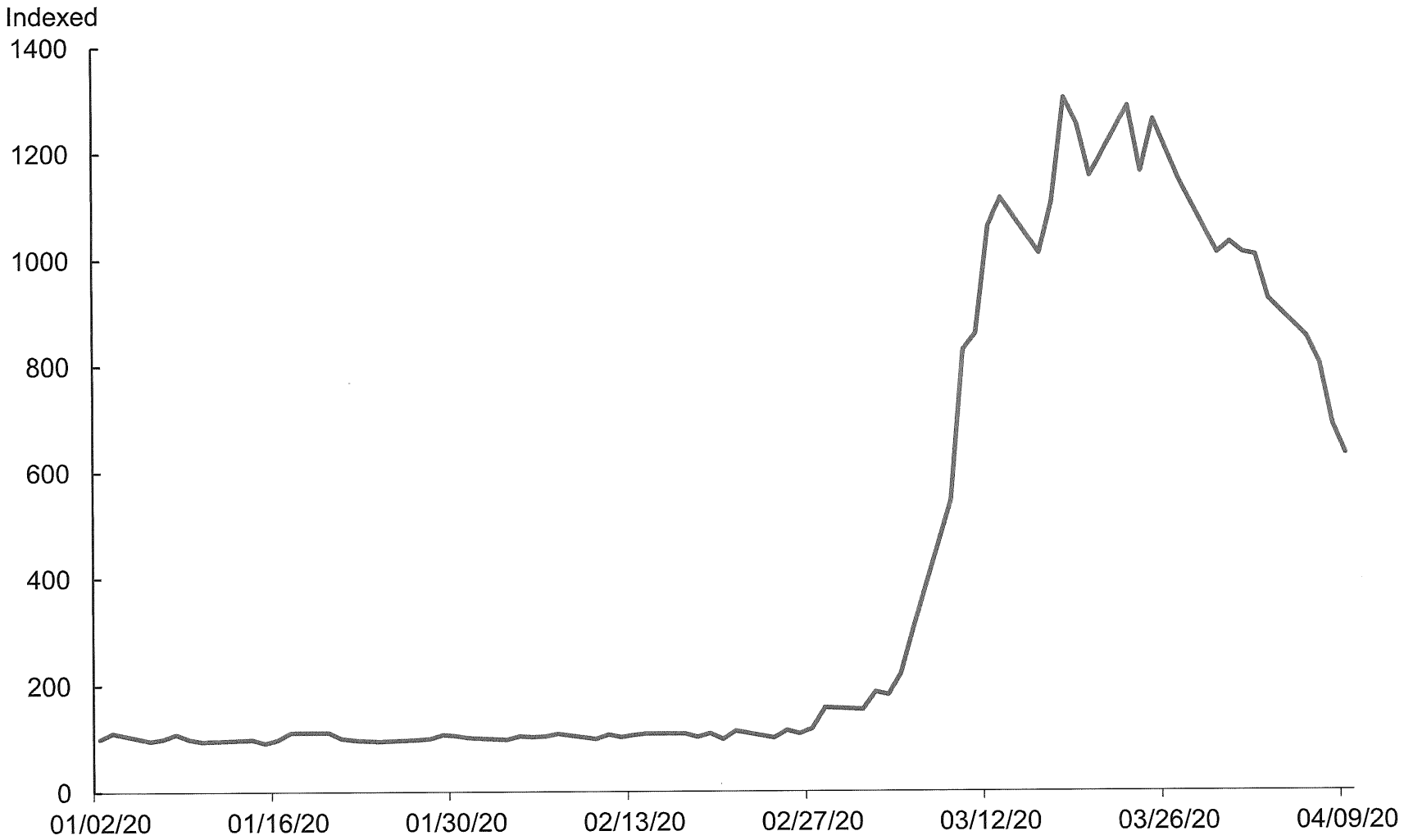
Source: Federal Reserve Bank of New York

Figure 2: Three-Month Japanese Yen-U.S. Dollar FX-Swap Implied Basis



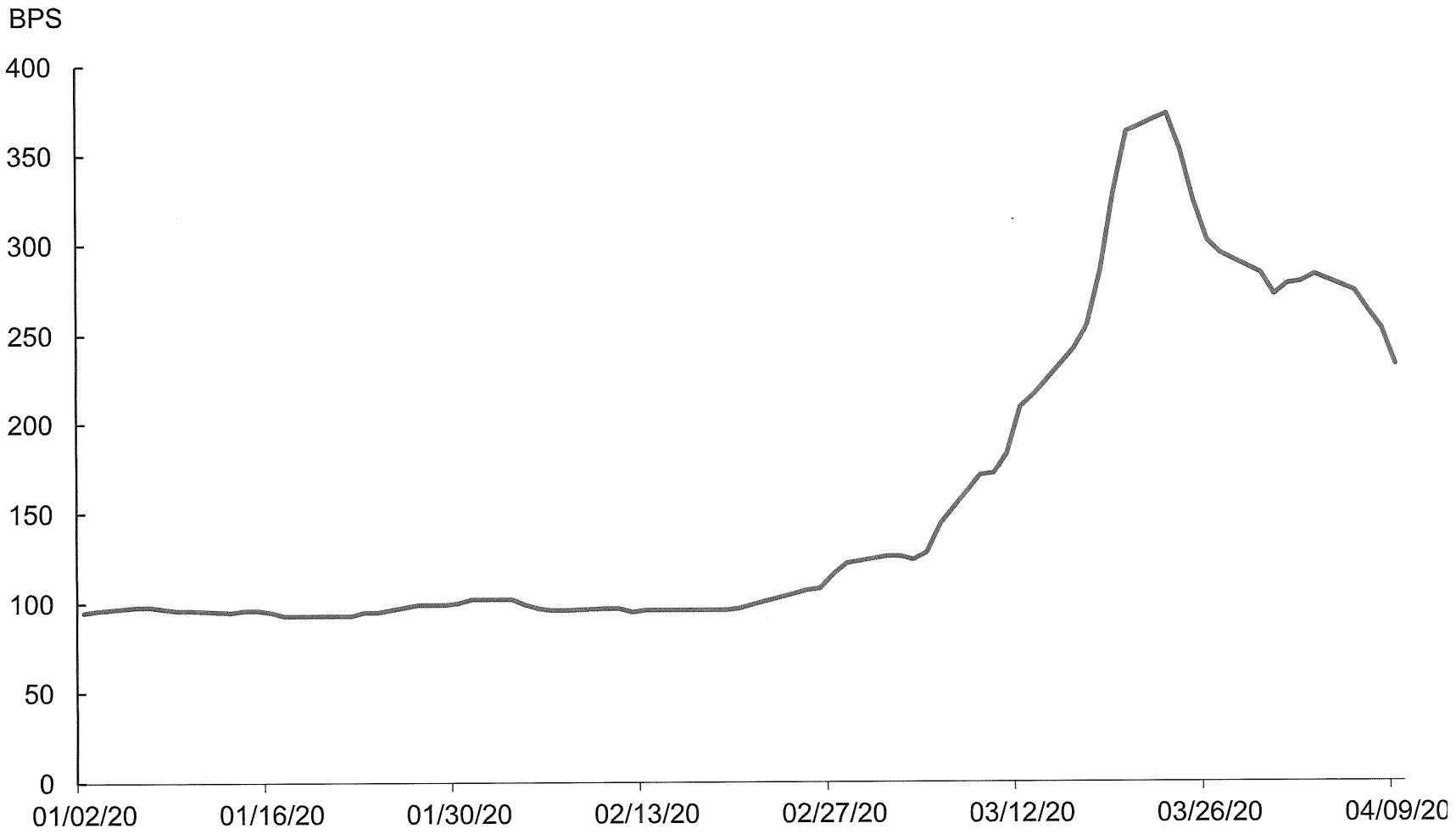
Note: Based off of OIS.
Source: Bloomberg Finance L.P.

Figure 3: Treasury Bid-Ask Spreads



Note: Average Bid-Ask Spreads indexed to 100 as of 01/02/2020.
Source: Bloomberg Finance L.P.

Figure 4: Investment-Grade Credit Spreads



Source: Bloomberg Finance L.P.

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SPEECH

Implementing the Fed's Facilities: Moving at Maximum Speed with Maximum Care

April 17, 2020

Daleep Singh, Executive Vice President

Remarks before the Money Marketeers of New York University (delivered via audio webinar)
As prepared for delivery

Good morning everyone. Thanks for being here, and let me begin by offering best wishes for everyone's health under these difficult circumstances. I should also make clear at the outset that the views I express are my own and do not necessarily reflect those of the Federal Reserve Bank of New York or the Federal Reserve System.

In my remarks today I'd like to review the context in which the Federal Reserve launched an unprecedented set of policy actions, and I will then describe our approach to standing up emergency facilities at maximum speed with maximum care as we execute our mission.

Context in Mid-March

As you will no doubt recall, financial markets in mid-March were seized by the uncertainty caused by virus outbreak, both in terms of the speed and scale of impact on the economic outlook, and for society as a whole. Extreme uncertainty triggered unprecedented market volatility across asset classes, escalating into a system-wide deleveraging event that appeared to overwhelm the capacity of financial intermediaries to absorb and transfer risk in an orderly manner. Liquidity dried up across markets, including in U.S. Treasuries, the benchmark upon which virtually every other asset is priced or hedged, the foundation for the dollar's primacy as a reserve currency, and the source of funding for our federal government.

As uncertainty rose and liquidity deteriorated, demand for cash and safe assets rose and demand for assets with any form of credit or liquidity risk plummeted. For a few weeks in March, even Treasury yields began to rise, especially in longer maturities, and so did the cost for almost all forms of household and corporate borrowing. Access to financing beyond overnight tenors became severely impaired, causing acute dislocation across short-term funding markets and triggering outflows across prime money market funds.

In the race to safety, dollars became increasingly scarce, intensifying the stress across global markets. Emerging market economies experienced an unprecedented outflow of capital from non-residents. Sovereign yields surged in the most indebted European countries. The ominous reality was that a synchronized global selloff had taken on a life of its own, with little prospect for self-correction.

Moving with Maximum Speed

Against this backdrop, policymakers at the Federal Reserve acted swiftly and unreservedly in an effort to break the damaging psychology that was taking hold. The series of policy actions announced over the past month – both conventional and unconventional – reflected a full recognition that the current shock is qualitatively different from the financial crisis of 2008, without a culprit other than the virus itself. Unconstrained by a diagnosis of who was to blame – and considering the mounting downside risks – the speed and scale of the policy response was free to match the dimensions of the unfolding shock.

I won't review all of the actions that the Fed has taken over the past month – they are well documented elsewhere - but I would like to note of the breadth of activity to stabilize the financial system and to support the flow of credit, both within and outside banking system.

To that end, I'll describe a few of the lending and credit facilities that the New York Fed is charged with standing up to supply credit for households, businesses, and state and local governments:

Commercial Paper Funding Facility

By the middle of March, unusually high funding needs and pullbacks by key lenders of short-term funds led to surging rates in the market for commercial paper, or short-term IOUs issued by businesses and municipalities. Interest rates on longer-term commercial paper, in particular, rose to levels not seen since the financial crisis of 2008. Many issuers were reportedly unable to place commercial paper with a term of longer than a week, leading to increased risk that companies would not be able to fund basic operational needs, such as meeting payrolls or financing inventories.

With backing from the U.S. Treasury, the Federal Reserve established the commercial paper funding facility as a funding vehicle that can purchase new issuance of commercial paper from highly rated businesses and municipalities, and certain issuers that were downgraded after the virus shock. By providing assurances to issuers and investors that retiring commercial paper can be replaced with new issuance, the facility will promote confidence in the market and support the flow of credit to businesses and municipalities.

Corporate Credit Facilities (CCFs)

At the same time that short-term commercial paper markets were nearly frozen, so too were markets for longer-term corporate borrowing – at precisely the moment when companies most needed a financing buffer. Borrowing rates for investment-grade corporate issuers relative to Treasury securities increased by about 2.5 percentage points in the first half of March, while issuance for companies rated below investment grade came to a halt.

In this context, the primary market corporate credit facility (PMCCF) was designed to provide funding for highly rated companies that need access to financing in order to maintain business operations during this period of dislocation. Again with backing from the U.S. Treasury, the Federal Reserve will create a funding vehicle to backstop eligible corporate borrowers for up to four years, at an interest rate that is better aligned with corporates' underlying credit risk than was available through market-based financing during March. This funding can be provided by the PMCCF either through purchases of eligible corporate bonds as the sole investor at issuance, or from purchases of portions of syndications at issuance.

The secondary market corporate credit facility (SMCCF), also backed by the U.S. Treasury with funding from the Federal Reserve, will play an important complementary role to the PMCCF. Here again, there will be two mechanisms at work: the SMCCF may either purchase eligible corporate bonds with a remaining maturity of 5 years or less, or it can purchase U.S.-listed ETFs. For ETFs, the preponderance of holdings will be of ETFs whose primary investment objective is exposure to U.S. investment-grade corporate bonds, and the remainder will be in ETFs whose primary investment objective is exposure to U.S. high-yield corporate bonds.

Taken together, the corporate credit facilities will have three main objectives when we go live in the coming weeks: first, to provide broad support for market functioning in secondary markets to allow for orderly and timely risk transfer in corporate credit; second, to support primary issuance for businesses at funding costs that better reflect normal liquidity conditions; and third, to reduce the incidence and severity of fire sales and/or indiscriminate liquidation.

Municipal Liquidity Facility

The last facility I'll mention today is the municipal liquidity facility, which was designed to help provide states, cities and counties with the funding needed to provide essential public services to their citizens. Due to the virus outbreak, the municipal securities market has recently been under considerable strain as investors have become reluctant to purchase municipal securities. As a result, interest rates on municipal securities have increased significantly. At the same time, states, cities, and counties are facing severe liquidity constraints resulting from the increase in state and local government expenditures related to the COVID-19 pandemic and the decrease and delay of certain tax revenue. By ensuring the smooth functioning of this market, particularly in times of strain, the Federal Reserve is providing credit that will support families, businesses, and jobs in communities, large and small, across the economy.

The immediate purpose of the Municipal Liquidity Facility is to enhance the liquidity of the municipal securities market by increasing the availability of funding to eligible States, Cities and Counties through Tax Anticipation Notes ("TANs"), Tax and Revenue Anticipation Notes ("TRANs"), Bond Anticipation Notes ("BANs"), and other similar short-term notes from eligible issuers (collectively, "Notes"). The eligible issuer's proceeds from its notes sales can in turn be used to support its political subdivisions and instrumentalities, among other uses. This facility will provide a form of bridge financing to eligible issuers, and by addressing the cash management needs of eligible issuers, the facility will also encourage investors to once again engage in the municipal securities market.

Of course what I've just covered is not an exhaustive list. The Federal Reserve Board has also announced a number of other programs designed to supply credit directly to households, businesses, and municipalities. These include:

- The Paycheck Protection Program Liquidity Facility will bolster the effectiveness of the Small Business Administration's Paycheck Protection Program by supplying liquidity to participating financial institutions through two-year loans backed by PPP loans as collateral.
- The Main Street Lending Program will enhance support for small and mid-sized businesses that were in good financial standing before the crisis by purchasing up to $600 billion in four-year loans to small and mid-size businesses.
- The Term Asset-Backed Securities Loan Facility (TALF) will support issuance of securities backed by student loans, auto loans, credit card loans, small business loans, and other debt.

Moving with Maximum Care

Considering the speed and scale of damage caused by the virus outbreak, we are making all efforts to implement these facilities at maximum speed. At the same time, though, we are moving with maximum care, drawing upon all of the lessons learned since 2008.

First and foremost, we know that transparency will be key to sustaining public confidence in our efforts. What does this mean in practice? It means that when we work with outside vendors, we explain why we're doing so, who we're working with, and how much we're paying for their services. It requires if we accelerate the vendor selection process to minimize time to market, we operate under a short-term contract and then open up the process to a competitive range of bidders, looking beyond the largest and most established players and providing broad access to a diverse range of smaller players. It means putting on our website the eligibility of borrowers and laying out the terms and conditions of the facilities as clearly as possible, along with posting FAQs and providing opportunities to ask questions. And it means that we actively explore ways to go beyond what's required by legislation and proactively report on the usage of the facilities as much as possible, subject to meeting our policy objectives.

In terms of governance, we will embed the facilities into our existing infrastructure for controls, management, and oversight. We will proactively identify and address conflicts of interest – real or perceived - for anyone working on the facilities. Personal investment guidelines will be refined as needed, and rules will be clear on the gathering of market intelligence and handling sensitive information related to the facilities. Good governance will also require balancing loss protection with financial stability goals, which requires integration of our risk management team into the full life-cycle of the facilities, from policy design to the eventual wind-down.

As a concluding thought, we know the ultimate definition of success is accomplishing what we set out to do in support of the American economy. In pursuing this goal, we've been entrusted with a great responsibility to deploy large sums of public resources, and we have an obligation to the public to be accountable for all our actions. We look forward to engaging with our oversight bodies and those appointed under the CARES Act to ensure that the American people understand the steps we are taking on their behalf as faithful stewards of the public trust.

FEDERAL RESERVE BANK of ST. LOUIS

Interest Rate Risk, Bank Runs and Silicon Valley Bank

By Christopher J. Neely, Michelle Clark Neely

May 11, 2023

KEY TAKEAWAYS

- When commercial banks borrow—from depositors and other sources—over the short term and lend for long periods, it creates the risk that rising interest rates will reduce the value of their long-term assets.
- Bad news or a large drop in asset values may worry depositors and trigger a bank run, which could put a bank out of business if it cannot quickly liquidate assets to meet demands for withdrawals.
- Bank runs can hurt the broader economy by disrupting business relationships.
- Two types of policies have greatly reduced the incidence of bank runs: emergency lending facilities—i.e., lenders of last resort, like central banks—and deposit insurance.

At any given time, some people are saving money, perhaps for emergencies or for college or retirement, while others want to borrow money to buy a house or a car or invest in a business. The largest borrowers—such as governments or large corporations—can sell bonds to raise capital, while smaller borrowers—e.g., smaller companies or individuals—tend to borrow from banks because it would be expensive and risky for savers to evaluate the creditworthiness of smaller borrowers. Banks specialize in evaluating the creditworthiness of borrowers, intermediating between borrowers and lenders.

To obtain funds to make loans, banks borrow from individuals and firms over the short term in the form of deposits. Savers like quick access to their money in case of emergency—such as a job loss—so banks commonly offer demand or savings deposits, which allow depositors to get their money back immediately, or certificates of deposit (CDs), which typically mature in a few months to a few years. In contrast, many firms and individuals want to borrow over the long term for projects, such as building a factory, or major purchases, such as buying a house.

Banks perform a *maturity transformation* when they borrow over the short term and lend for long periods. This transformation creates a potential problem, though: Depositors might demand their money from banks before borrowers repay their loans. Banks keep funds in reserve for the depositors who want to get their money out, with some extra for insurance, but can't pay off all their depositors at once.[1]

Interest Rate Risk in Maturity Transformation

Borrowing over short periods and lending for long periods generally allows banks to make money, because long-term interest rates are usually higher than short-term interest rates. But this strategy carries the risk that interest rates will rise, reducing the value of a bank's long-term fixed-rate assets—usually loans or bonds—because higher interest rates reduce

the present value of the payoffs to those loans or bonds.[2] Potential decline in asset values because of an increase in interest rates is known as *interest rate risk* or *duration risk*, and it can reduce a bank's net worth (assets minus liabilities).

Banks can mitigate interest rate risk in several ways, but most are costly and involve reducing the bank's net amount of maturity transformation. For example, a bank wishing to hedge (reduce) interest rate risk might lock in longer-term deposits in the form of CDs or time deposits, or make more short-term loans instead of long-term loans. Properly managing interest rate risk is a critically important task for banks.[3]

Characteristics of Bank Runs

If depositors learn of such a decline in their bank's net worth, they might fear for the bank's solvency and the safety of their deposits and transfer their money to a safer bank. An attempt by many depositors to simultaneously withdraw their money is called a *bank run*, and such an episode can put a bank out of business. Even if the value of the bank's assets (loans and securities) exceeds that of its liabilities (deposits and borrowings), a bank cannot quickly liquidate its assets to immediately pay off all its liabilities.

A curious thing about bank runs is that they can be self-fulfilling prophecies. If many depositors seek to simultaneously withdraw their money, the attempt puts the bank at risk, and so it makes sense for other depositors to withdraw their money, too, whether or not the bank run is actually justified by fundamentals. Economists Douglas W. Diamond and Philip H. Dybvig formalized this possibility in a well-known paper (PDF), for which they shared the 2022 Nobel Prize in economics with Ben Bernanke.

Bank runs can damage the economy because they disrupt relationships between borrowers and lenders, and uninsured depositors can lose their money. Removing banks from their role of mediating between savers and borrowers is called *disintermediation*. During the early part of the Great Depression, thousands of banks failed. Many economists consider this to be one of the Great Depression's principal causes (PDF).

Policies to Mitigate Bank Runs

Two types of policies have greatly reduced the incidence of bank runs: emergency lending facilities, i.e., a lender of last resort, and deposit insurance.

A fundamentally sound bank whose assets are greater than its liabilities might still fail if it is unable to satisfy its depositors' demands for funds during a bank run. One solution to this problem is to borrow against the bank's illiquid assets, such as business or commercial real estate loans. But bank runs often occur during a financial crisis, when it is difficult or impossible to borrow, even against good collateral. A solution to this problem is to create an emergency lender —a lender of last resort—with very deep pockets that can provide loans during the worst times. Central banks have long had the duty to lend to illiquid but solvent financial institutions in such times of crisis. Indeed, a major purpose for which the Federal Reserve was created was to be a lender of last resort.

Deposit insurance also helps reduce the frequency of bank runs by reducing the incentives for depositors to withdraw their money at the first sign of trouble. The Federal Deposit Insurance Corp. (FDIC) guarantees bank deposits up to $250,000 per depositor, per bank, meaning that no depositor with deposits less than or equal to this figure will lose money.[4] Banks may still be subject to runs, however, if uninsured depositors fear that they will lose their money in the event of a bank failure.

Deposit Insurance Alters Incentives

While deposit insurance helps guard against bank runs, it has a disadvantage in that it removes a source of *market discipline* on banks: Insured depositors no longer have an incentive to track and evaluate banks' financial health.[5] Federal

deposit insurance hasn't automatically covered all deposits partly because larger depositors are thought to be sophisticated enough to evaluate banks' financial health, thereby providing banks an incentive to behave prudently. Extending deposit insurance to larger depositors would remove this incentive and increase the fees banks must pay the FDIC for insurance coverage. Because deposit insurance greatly reduces depositors' incentives to withdraw their funds at the first sign of trouble, insured deposits tend to be much more stable than uninsured deposits.

The Run on Silicon Valley Bank

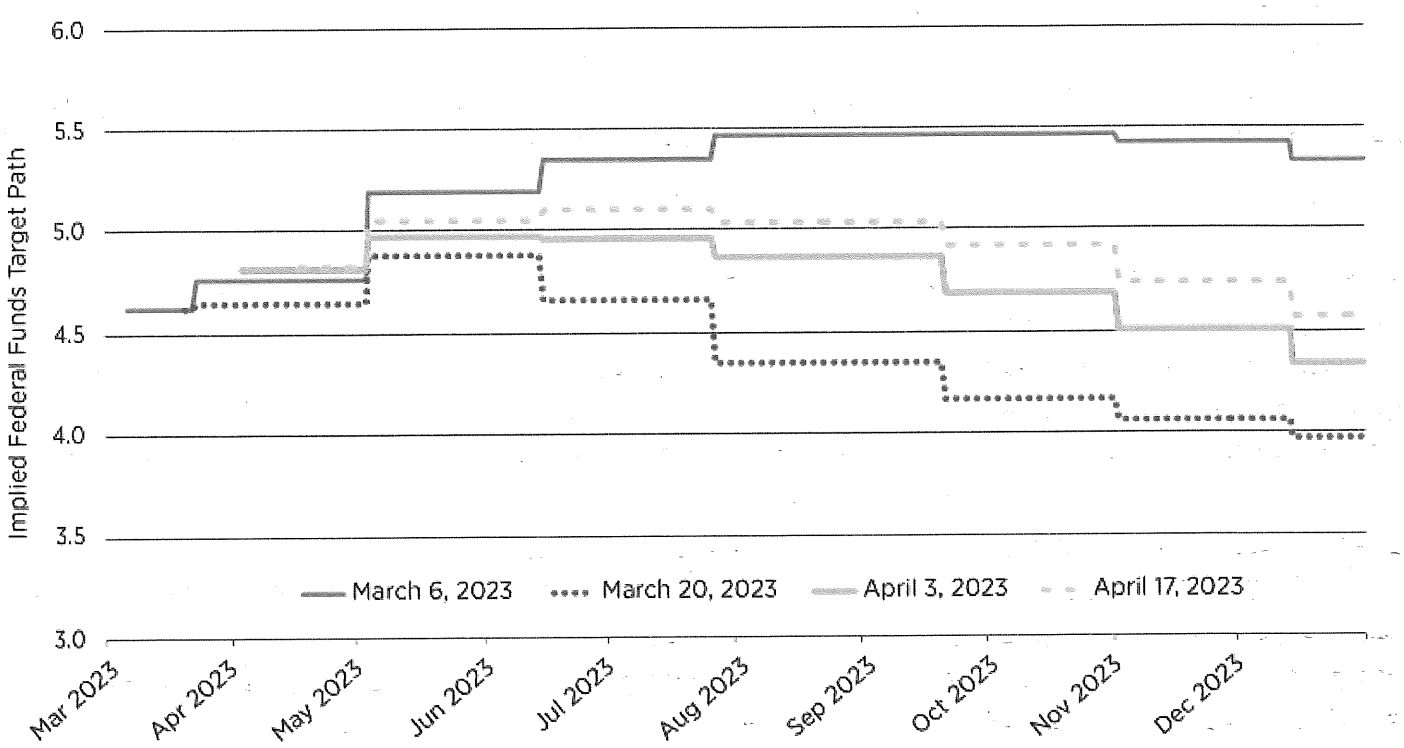
Silicon Valley Bank had several risk factors for a run. This $200 billion bank catered to, and was thus dependent on, the tech sector. When tech was booming, the bank grew very quickly, thanks to a large influx of uninsured deposits from venture capital and tech firms, which were used to meet payroll and operating expenses. Silicon Valley Bank largely invested these deposits in long-term bonds, especially mortgage-backed securities, in an effort to increase yield and bank earnings at a time when interest rates were very low. But the values of these bonds were highly sensitive to interest rate increases.

The 2021-22 surge in inflation prompted the Federal Open Market Committee (FOMC) to raise the federal funds rate target range from 0%-0.25% on March 16, 2022, to 4.75%-5% by March 23, 2023. On March 8, 2023, Silicon Valley Bank posted a $1.8 billion loss on the sale of $21 billion of these securities and announced a plan to raise capital. Uninsured depositors saw these moves as signs of bank distress, word started circulating on social media, and the next day customers withdrew more than $40 billion from the bank. It was a modern twist on a classic bank run in that the deposits could be quickly withdrawn electronically. Silicon Valley Bank could not sell or borrow enough against its assets to meet the demands for deposits. The California Department of Financial Protection and Innovation seized the bank on March 10, 2023.[6]

The run on Silicon Valley Bank kicked off fears that there would be runs against banks in similar situations. Signature Bank in New York, a $100 billion institution, ran into similar problems with uninsured depositors pulling their funds, leading the New York State Department of Financial Services to close the institution on March 12, 2023.

In response to the failures of Silicon Valley Bank and Signature Bank, market expectations of near-term interest rate increases declined in mid-to-late March, and banks further tightened terms on loans, making credit harder to get.[7] The following figure shows that market expectations of the middle of the federal funds target range declined substantially between March 6 and March 20, before partially recovering by the middle of April.

Futures-Implied Expected Paths for the Middle of the Federal Funds Target Range



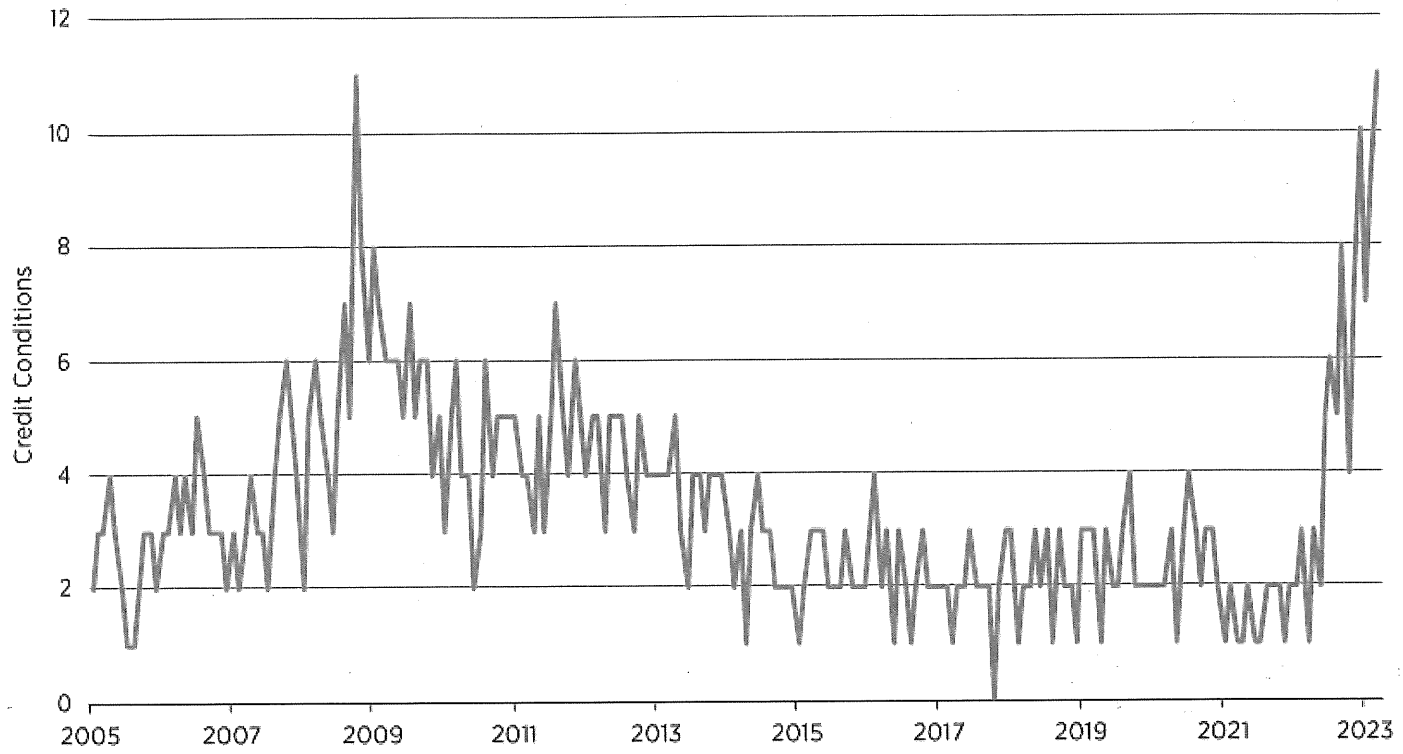
■ FEDERAL RESERVE BANK OF ST. LOUIS

SOURCE: Chicago Board of Trade via Haver.

NOTES: The figure displays the expected paths of the middle of the federal funds target range implied by federal funds futures prices as of March 6, 2023, March 20, 2023, April 3, 2023, and April 17, 2023, assuming target changes occur only at scheduled FOMC meetings and that the average federal funds rate is in the middle of the target range.

The figure below shows that credit conditions for households in March 2023 were tighter than at any time since October 2008. In addition, capital markets temporarily froze up, with corporations issuing very few bonds in the weeks following Silicon Valley Bank's failure.

Credit Conditions for Buying Large Household Goods



SOURCE: University of Michigan Surveys of Consumers via Haver.

NOTE: Higher numbers indicate tighter credit conditions for purchasing large household goods.

The financial stress associated with the failures of Silicon Valley Bank, Signature Bank and, more recently, First Republic Bank remind us that modern economies still depend on traditional financial institutions. And even with mitigating policies such as central bank emergency lending programs and deposit insurance, bank survival depends on bank executives properly managing assets and liabilities.

Notes

1. Banks use a number of liabilities other than deposits to fund loans, including federal funds purchased, brokered deposits and borrowings from Federal Home Loan Banks. These all tend to be more expensive than deposits.
2. Another channel of interest rate risk occurs when a general rise in interest rates forces banks to pay higher interest on deposits but produces only slow increases in bank revenue as new long-term loans are made at higher interest rates. In practice, however, deposit rates typically rise much more slowly than other short-term interest rates.
3. For more on this issue, see the Feb. 9, 2023, blog post "Rising Interest Rates Complicate Banks' Investment Portfolios" by St. Louis Fed Senior Vice President Carl White.
4. Similarly, the National Credit Union Share Insurance Fund insures credit union accounts.
5. Commercial banks must submit quarterly balance sheet and income statements, known as Call Reports. To review a bank's Call Report, one can access the Federal Financial Institutions Examination Council's Central Data Repository.
6. In late April, the Federal Reserve released a review of its supervision of Silicon Valley Bank. The report analyzed the actions of bank management and Fed supervisors that preceded the failure. See the full report (PDF).
7. The Fed's January 2023 Senior Loan Officer Opinion Survey on Bank Lending Practices noted tightening credit conditions before the March bank failures.

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IN FOCUS

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Bank Failures: The FDIC's Systemic Risk Exception

When Silicon Valley Bank (SVB) and Signature Bank failed, the Treasury Secretary, the Federal Deposit Insurance Corporation (FDIC), and the Federal Reserve (Fed) announced on March 12, 2023, that the FDIC would guarantee uninsured deposits at those banks under the statutory systemic risk exception to least-cost resolution (LCR; 12 U.S.C. §1823(c)(4)(G)). The FDIC insures deposits up to a statutory limit of $250,000. Currently, the FDIC projects that guaranteeing the uninsured deposits will cost the FDIC $16.3 billion. Under LCR, losses equal to that amount would have been borne by uninsured depositors. The two banks' combined estimated uninsured deposits were $231.1 billion in 2022. H.R. 4116, as ordered to be reported in the nature of a substitute in April 2024, would require the failed banks' regulator to report to Congress on supervision of the banks and would expand the scope of review by the Government Accountability Office (GAO) when the systemic risk exception is invoked.

FDIC Least-Cost Resolution

When a bank fails, it does not enter the bankruptcy process like other businesses to resolve creditors' claims. Instead, it is taken into receivership by the FDIC, which takes control of the bank and resolves it through an administrative process. Costs to the FDIC associated with a resolution are funded by drawing on the FDIC's Deposit Insurance Fund, which is funded through assessments on banks and backed by the U.S. Treasury.

A banking crisis in the 1980s was more costly to the FDIC, and ultimately the taxpayer, because of the frequent use of regulatory forbearance—allowing troubled banks to stay open—which in many cases increased the losses that they suffered before they were ultimately shut down. In some cases, the FDIC used open bank assistance to provide funds or guarantees to troubled banks to keep them going rather than taking them into receivership.

Following the crisis, Congress reformed how the FDIC resolves banks in 1991 (P.L. 102-242). This act introduced prompt corrective action and LCR requirements as cornerstones of resolution. These two principles are intended to minimize resolution costs by ensuring that banks are resolved as quickly and inexpensively as possible. As such, uninsured depositors and other creditors can be repaid in a resolution only insofar as it is consistent with LCR, unless the systemic risk exception is invoked.

What Is the Systemic Risk Exception?

Systemic risk is financial market risk that poses a threat to financial stability. In the case of SVB and Signature, policymakers were concerned that a run by uninsured depositors would spread to other banks, causing a broader financial crisis detrimental to the real economy.

Under the 1991 law, LCR can be waived under the systemic risk exception with five statutory requirements: (1) The Treasury Secretary, in consultation with the President and upon a written recommendation of at least two-thirds of the boards of the FDIC and Fed, determines LCR "would have serious adverse effects on economic conditions or financial stability" and the FDIC's actions would avoid or mitigate those effects. (2) Any loss to the FDIC must be repaid through a special assessment on banks by the FDIC. In levying this assessment, the FDIC need not follow normal deposit insurance assessment rates and may consider who benefited from the action and the effects on the banking industry (as amended by P.L. 111-22). (In this case, the FDIC levied the assessment on the 114 banks with over $5 billion in uninsured deposits.) (3) The Treasury Secretary must document the decision. (4) GAO must review the incident. (GAO released its review in April 2023.) (5) The Treasury Secretary must notify the congressional committees of jurisdiction within three days.

Before 1991, the FDIC considered several goals, including cost, in determining how to deal with a troubled bank. As such, LCR, even with the exception, represents a constraint on its pre-1991 authority. The FDIC can take a number of actions under the exception, but it can be used only in an FDIC receivership.

Previous Uses of the Exception

Before 2023, GAO reported five planned uses of the systemic risk exception since 1991, all occurring between September 2008 (in the depths of the financial crisis) and March 2009.

1. **Wachovia.** The FDIC sought a buyer to prevent the imminent failure of Wachovia, the fourth-largest U.S. bank. Citigroup made an offer to acquire Wachovia under which the FDIC would partially guarantee $312 billion of Wachovia's assets using the systemic risk exception. The FDIC initially accepted this offer but subsequently rejected it in favor of a competing offer from Wells Fargo that required no FDIC assistance.
2. **Citigroup.** Concerned that Citigroup, the third-largest U.S. bank, would fail and exacerbate the financial crisis, policymakers decided to provide an assistance package involving the Fed, the FDIC, and the Troubled Asset Relief Program (TARP). As part of this package, the FDIC used its systemic risk exception to provide open bank assistance in the form of a partial asset guarantee for $306 billion of Citigroup's assets. This guarantee (joint with the Fed and TARP) never paid out, and the government received compensation in the form of stock and warrants.
3. **Bank of America.** A similar partial asset guarantee for $118 billion of assets was offered to Bank of America,

the second-largest bank, for similar reasons but was never finalized. Bank of America paid the government a termination fee to cancel the guarantee when financial market conditions stabilized. Unlike with Wachovia and Citigroup, the exception was invoked in anticipation of market pressure on Bank of America before it occurred.

4. **FDIC's Temporary Liquidity Guarantee Program.** To help banks remain liquid during the financial crisis, the FDIC created this two-part temporary program—the Debt Guarantee Program (DGP) and the Transaction Account Guarantee Program (TAG). Both programs were voluntary but automatic unless banks opted out. Under DGP, the FDIC guaranteed certain debt issued by banks between October 2008 and October 2009. Under TAG, the FDIC guaranteed non-interest-bearing deposit accounts (primarily owned by businesses and local governments) above the deposit limit. Both programs charged participating banks fees to cover potential costs.
5. **Public Private Investment Program (PPIP).** Treasury created the Legacy Loan Program within TARP's PPIP. Under this program, the FDIC would have partially guaranteed "legacy loans" acquired by PPIP. The program never progressed beyond a pilot phase.

Of the five cases, only the TAG program resulted in net costs to the FDIC. Assistance to Citigroup, Bank of America, and the DGP resulted in positive net income to the FDIC or the government as a whole. (A special assessment was not levied for TAG because its net income was considered jointly with the DGP.) In the cases of Wachovia, Bank of America, and PPIP, the proposed action never occurred. (See CRS Report R43413, *Costs of Government Interventions in Response to the Financial Crisis: A Retrospective*.)

None of these five episodes involved a bank in FDIC receivership. (Wachovia would have been an FDIC-assisted open bank transaction.) Although the exception was clearly intended to be a bank resolution tool, policymakers used the authority at the time to justify two crisis programs that were open to all banks, including healthy ones. In 2010, the Dodd-Frank Act (P.L. 111-203) limited the systemic risk exception to receiverships to rule out its future use for broadly based programs. It provided separate authority for future debt guarantee programs and temporary authority for a TAG program that was not renewed when it expired.

Policy Issues

The systemic risk exception is a recognition by Congress that financial stability concerns sometimes trump the desire to minimize potential costs to the taxpayer. Financial crises impose economic costs that can far exceed resolution costs to the FDIC. Because systemic risk is unpredictable and fast moving, emergency tools such as the systemic risk exception have been crafted to give policymakers broad, discretionary powers to respond quickly to a range of potential risks. This way, financial conditions can be stabilized before a crisis spirals out of control. In this case, guaranteeing uninsured deposits may have prevented a broader deposit run that could have caused other banks to fail. Broad, discretionary powers come at a cost, however. Policymakers may have "itchy trigger fingers" and intervene before the need has been proven. In this case, the failure of two mid-sized banks, in isolation, posed little risk to the economy or financial system. It may be that other banks could have fended off the pressure of withdrawals on their own and conditions could have stabilized.

The downside to intervening is the cost to the government and moral hazard—the concept that when individuals or businesses are protected from losses they will act more recklessly. In this case, SVB and Signature and their leadership and shareholders were not "bailed out," as the banks were closed, but uninsured depositors were. Congress set a deposit insurance limit in part because there is an expectation that depositors above the limit should be financially sophisticated enough to monitor their banks' riskiness (i.e., impose market discipline). By using the systemic risk exception, policymakers have signaled that banks and their uninsured depositors need be less concerned about risk taking going forward. (The systemic risk exception was not used to protect the banks' debtholders or shareholders, so debtholders at other banks arguably still have an incentive to monitor risk taking.)

Guaranteeing uninsured depositors also shifts the costs of the resolution to banks that did not fail. In a counterfactual where all deposits had been insured, banks including SVB and Signature would have pre-funded the deposit insurance fund ex ante to a size sufficient to absorb the costs of guaranteeing all deposits. Instead, those costs must be recouped ex post. But the FDIC is required to consider who benefited from the intervention when levying assessments.

A long-standing moral hazard concern is that some banks are "too big to fail," meaning that their failure could result in financial instability, which would result in government bailouts to prevent them. Although SVB and Signature were taken into receivership, the use of the systemic risk exception at two institutions that few previously believed were TBTF supports those concerns. In addition to moral hazard concerns, TBTF could potentially put small banks at a competitive disadvantage if uninsured depositors believe their deposits are safer at large banks because the systemic risk exception would be invoked only for a large bank.

The first use of the systemic risk exception since it was last amended in 2010 raises questions about whether additional legislative changes are warranted. Policymakers' discretion could be narrowed, but it might impede their ability to quickly and flexibly respond to a crisis. Nevertheless, the Dodd-Frank Act added more parameters to the Fed's emergency lending authority (12 U.S.C. §343) concerning when and how that authority should be used—and what should be reported to Congress—compared to the FDIC's exception. Those changes did not prevent the Fed from responding aggressively to the COVID-19 pandemic or from creating a new emergency program following the failures of SVB and Signature. Legislative changes to bank regulation or deposit insurance could also change the likelihood of the systemic risk exception being used again.

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Disclaimer

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The Failure of Silicon Valley Bank and the Panic of 2023

Andrew Metrick

On Thursday, March 9, 2023, depositors withdrew almost 25 percent of the total deposits at Silicon Valley Bank (SVB). On the morning of Friday, March 10, early evidence suggested that virtually all of the remaining deposits would be withdrawn. Regulators were forced to close the bank in the middle of the day, unable to even "get to the weekend" as had been done for every other bank failure since the Great Depression. Silicon Valley Bank, with $209 billion of assets, the sixteenth-largest bank in the United States, became the second-largest bank failure in nominal terms in US history, ranking in size only behind the failure of Washington Mutual Bank during the Great Recession of 2007–2009.

Since the founding of the Federal Deposit Insurance Corporation (FDIC) in 1934, no US bank depositor has lost any insured funds. As a result, US bank runs have been rare, because depositors see no need to rush to the exits, even if a bank failure is imminent. However, US deposit insurance has a limit on the amount insured of $250,000 per account. Silicon Valley Bank was highly unusual in that about 94 percent of its deposits are large enough to be *uninsured.* This makes SVB a throwback, almost as though it was from the bank-panic frenzies of the late nineteenth century, before the modern safety net for banks was in place. It also makes the failure of SVB an illustrative model for the economics of banking—how things work can often become most clear when they break.

After the failure of Silicon Valley Bank, commentary focused on several possible causes: poor risk management by the bank; changes in bank regulation

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in 2019 that had recently relaxed the rules for banks like SVB; weak oversight by supervisors for the rules that remained; a customer base highly concentrated in one industry (technology, particularly startups) and region (Silicon Valley, of course); and the interaction of modern social media with the tech-savvy customer base of SVB in accelerating the run. From this long list, one might conclude that SVB was a special case, an outlier that reveals little about bank stress in general. This would not, however, be correct, because the underlying problem was systemic, and when SVB was shut down, the Panic of 2023 had begun.

On Sunday, March 12, the Federal Deposit Insurance Corporation took control of another failed institution, Signature Bank, which then became the third-largest bank failure in the history of the United States. This failure convinced authorities that the US banking system faced the possibility of widespread runs. In response, the FDIC and the Federal Reserve each invoked emergency provisions available under the law. The "systemic-risk exception" included in a 1991 law allows the FDIC to act immediately without taking time to seek out a least-cost method of resolving a bank failure: in this case, the FDIC announced that even uninsured depositors would be fully covered at both Silicon Valley Bank and Signature. In turn, the Federal Reserve invoked its power to take action during "unusual and exigent circumstances" that was included in a 1935 revision of the Federal Reserve Act and created a novel emergency-lending program with generous terms. Together, these policy actions succeeded in slowing the deposit outflows, which delayed but did not prevent the eventual failure of First Republic Bank in May. At $213 billion in assets, First Republic was even larger than SVB, thus leapfrogging to become the "new" second-largest bank failure ever in the United States. Panic in the US banking sector also spread to Europe, providing the final nail in the coffin for the long-troubled Credit Suisse, which in April 2023 became the single largest bank failure in the world, ever.

Each of these failures had their own idiosyncratic reasons. But the US examples all shared two things: a very high percentage of uninsured deposits and significant "unrealized" losses on assets. That combination is a dangerous mix, and variations on it lie at the core of most financial panics. In most modern examples, such as the global financial crisis of 2008–2009, this dangerous mix is shrouded in layers of complexity, making it much harder to uncover its dynamics. But the special case of Silicon Valley Bank turns out to be a remarkably clean example, and thus can teach us a lot about the general case.

To elicit these lessons, we focus on underlying economics of the Silicon Valley Bank failure, leaving most of the discussion of government regulation until after the basic story is told. In the next section, we examine the balance sheet of SVB at the end of 2019 and thus before the pandemic, focusing on the largest categories of assets and liabilities. Like most banks, SVB's profits are driven mostly by "net interest margin"—the difference in interest earned and paid for via its assets and liabilities—and this business model has come under pressure since the onset of the pandemic. In the following section, we illustrate this pressure using diagrams showing the components of net interest margin and show how those components changed during the pandemic. With this background of SVB's balance sheet and

business model, we can then make sense of what happened at SVB and the ensuing Panic of 2023. In the penultimate section of the paper, we turn to the role of government bank regulation and oversight in the lead up to the crisis. The final section concludes with a discussion of the policy challenge in preventing future panics of this type.

Silicon Valley Bank before COVID-19

The top panel of Figure 1 shows the balance sheet for Silicon Valley Bank on December 31, 2019. At this time, the bank had a total of $70 billion of assets. The single largest item on the balance sheet was $63 billion of deposits, which comprised the vast majority of the bank's funding. SVB was unusual in that almost all of these deposits—about 94 percent—were not covered by federal deposit insurance.

In the United States, individual bank accounts are insured by the Federal Deposit Insurance Corporation up to a limit of $250,000. Balances below $250,000 are "insured," while all balances above $250,000 are "uninsured." This limit is high enough that the vast majority of all *accounts* are fully insured, but on a *dollar* basis, about 42 percent of the total deposits in the United States were above this limit, and thus uninsured (FDIC 2023c, p. 10). The specific choice of $250,000 as the legal threshold is an attempt to balance the benefits (financial stability) and costs (excess risk-taking by banks) of insurance. The Panic of 2023 has reopened the debate on this threshold—a topic we discuss in the conclusion of the paper.

FDIC insurance is backed by a standing fund financed by insurance premiums charged to banks, with a credit line from the US Treasury and the full faith and credit of the United States standing as additional lines of defense. For insured depositors, the typical bank failure is seamless. Uninsured deposits do not have this explicit protection. Nevertheless, in most bank failures the FDIC has been able to transfer the entire deposit base to another bank, allowing the uninsured depositors to be made whole. Indeed, the *total* losses by uninsured depositors in the last 30 years has been less than $300 million (FDIC 2023c, p. 22). With this history, it would be reasonable for uninsured bank depositors to feel relatively safe, even if that safety has not been legally guaranteed. This implicit safety supports the significant level of uninsured deposits in the US banking system. Most of these uninsured deposits are concentrated in the largest banks. Even among this group, however, Silicon Valley Bank stood out for having the highest percentage of uninsured deposits among all banks with assets of $50 billion or more.

On the asset side of the Silicon Valley Bank balance sheet in 2019, the largest line item was "loans" at $33 billion, followed by "securities" at $28 billion. Most of the loans were in the form of credit lines to SVB customers, instead of more traditional term loans for specific projects; the startup firms served by SVB often have lumpy inflows and outflows and rely on credit lines to smooth those lumps. Very few of the loans were residential or commercial mortgages. The securities holdings were almost exclusively government or agency-backed bonds. With securities holdings at

Figure 1
SVB Balance Sheet, 2019 and 2022

Dec. 31, 2019 ($billions)

Assets		Liabilities + equity	
Cash	6	Deposits	63
Securities	28	Other debt	2
Loans	33		
Other	3	Total liabilities	65
		Equity	5
Total	70	Total	70

Dec. 31, 2022 ($billions)

Assets		Liabilities + equity	
Cash	13	Deposits	175
Securities	117	Other debt	19
Mark-to-market	*99*		
Loans	74		
Other	5	Total liabilities	194
		Equity	15
		Mark-to-market	*-3*
Total	209	Total	209
Mark-to-market	*191*	*Mark-to-market*	*191*

Source: SVB (2019, 2022).
Note: Mark-to-market equity represents author's calculations of adjusted (mark-to-market) assets less book liabilities.

40 percent of all assets, SVB was above the national average of 25 percent, but was not an extreme outlier. Banks hold securities for two main reasons: (1) as a higher-yielding (compared to cash) way to store funds that they plan to later loan out; and (2) as a source of liquidity, because safe government securities can easily be sold for cash to meet deposit withdrawals. Plain "cash" was only at $6 billion.

Bank assets face two main risks: "credit risk" and "interest-rate risk." Credit risk is that a borrower will not make timely payments of interest or principal; this risk is what usually gets banks into trouble, but was not a problem for Silicon Valley Bank. Their loan portfolio was concentrated in the ecosystem of startup technology firms, the venture capital firms that fund them, and the employees of both. Although this portfolio was not well-diversified, SVB never faced serious concerns about the quality of its loans. Furthermore, SVB's securities portfolio was almost exclusively

comprised of government or agency-backed bonds, and thus had effectively zero credit risk.

The main problem at Silicon Valley Bank turned out to be interest-rate risk: in general, when interest rates change, the value of most assets and liabilities change as well, and this risk must be managed. Even risk-free securities like US government bonds are subject to interest-rate risk. For example, imagine that all interest rates are exactly zero, and you own a government security that will pay off in one year for exactly $1, without making any other payments along the way. In this zero-rate world, the market value of this government security today should also be $1. Next, imagine that all interest rates increase to be 1 percent. Now, if you wanted to sell that government security, any buyer will want to earn a return of 1 percent. For a bond that will ultimately pay $1 in one year, the price today would need to be (approximately) 99 cents. Even though the payment of $1 in one year is known for certain, the price of the security must still fall today to make the return (99 cents today turning into $1 in one year) competitive with newly issued securities that offer a 1 percent return.

Interest-rate risk tends to grow with the maturity of a security. Consider a bond that has a single payment of $1 in five years, with no other payments before that. In a zero-interest-rate world, the price of this bond today would still be $1. But now, if interest rates increase to 1 percent, an investor today would only be willing to pay about 95 cents for that bond, because the investor would require a return of 1 percent per year (95 cents today turning into $1 in five years) over the full five-year holding period. For the five-year bond, a 1 percentage point increase in interest rates leads to approximately a 5 percent decrease in the price. For the one-year bond example considered above, the decrease was only 1 percent.

With more complex bonds, the arithmetic gets messier, but the underlying intuition stays the same: when interest rates go up, the value of long-term assets is hurt more than short-term assets. If a bank wants to protect itself against interest-rate risk, it can try to match the maturity structure of its assets and liabilities, so that any change in interest rates would have an offsetting effect on both sides of the balance sheet. If this offset is perfect, then we would say that the bank has "perfectly hedged" its interest-rate risk.

Perfect hedges are difficult to achieve in banking. For most banks, the vast majority of their liabilities are customer deposits, most of which can be withdrawn upon demand. The legal maturity of such deposits is effectively zero. It is not feasible for traditional banks to get their assets down to zero maturity, so banks use a variety of other techniques to manage their interest-rate risk. The failure of Silicon Valley Bank to hedge its interest-rate risk properly was the proximate cause of its failure, but the story is more complicated than simple negligence. We return to this topic in the next section of the paper.

On a bank's balance sheet, the difference between assets and liabilities is mechanically equal to "equity," which in Silicon Valley Bank in 2019 stood at $5 billion, yielding an equity-to-assets ratio of about 7 percent. For the purposes of this paper, we will consider equity to be a synonym for "capital"—that is, the

cushion that protects depositors and other debtholders from variations in the value of the assets. To the extent that assets are completely riskless in all respects, any positive level of capital would be sufficient to provide safety for all depositors, insured and uninsured. But once any uncertainty arises about the value of assets, a rational depositor (or insurer) would require more capital to feel safe.

One useful way to conceptualize the necessary capital cushion for a bank is to think of it as an input in the production of money. To satisfy the value of bank deposits (like checking accounts) as a transactions medium, it must be possible to use these deposits in exchange *at par value* with "no questions asked" (Holmstrom 2015). If an agent has to worry that the money they are receiving is not actually worth the number written on the check, then it will lose its usefulness as money. Having a sufficient capital buffer is the most important step a bank can take to ensure this monetary use. Conversely, if equity levels fall too low, then it would be reasonable for counterparties to be concerned about the quality of the liabilities, and the bank's checks and deposits would lose their no-questions-asked property.

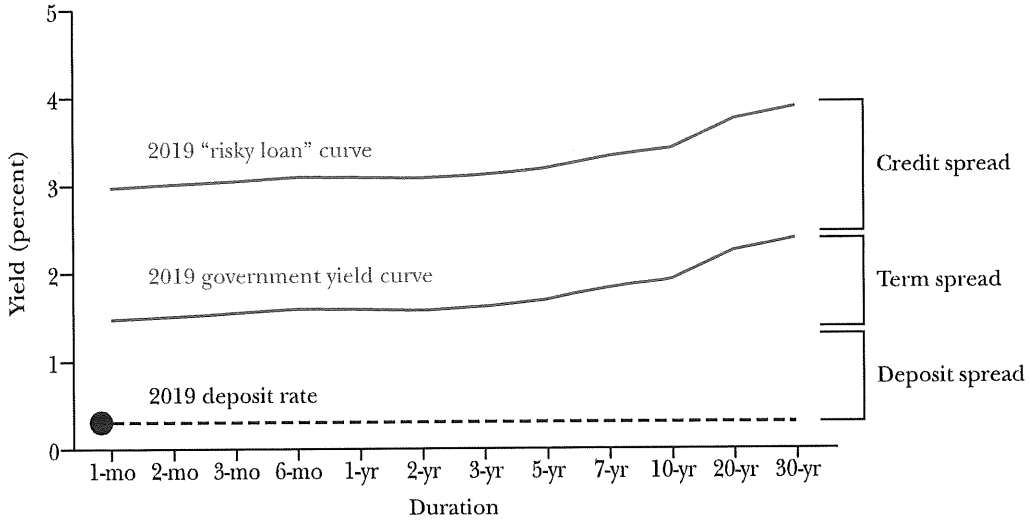
The link between the potential solvency of a bank (through its equity levels) and the liquidity of the bank (through the risk of bank runs) is driven by the connection of both to the no-questions-asked property of deposits. When bank money loses its no-questions-asked property, the rational response for (uninsured) depositors is to take their money out of the bank and put it someplace safer. Bank balance sheets contain many components that are costly to evaluate. No depositor earning a small (or zero) interest rate on their deposits should do a deep analysis of their bank to determine whether or not it was still safe—withdrawing deposits is much easier.

Silicon Valley Bank and the Business Model of Banking

At its core, banking is a simple business. Almost all of a bank's assets and liabilities are essentially just digital equivalents of pieces of paper: mortgages, commercial loans, checking accounts, cash reserves, and so on. The profitability of a bank is driven by earning higher interest on the assets than is paid on the liabilities, with this difference known as the "net interest margin." Indeed, one can think of a bank of producing a consumer good ("deposit services") that is itself just a liability, using the rest of its balance sheet as the factory floor for this production.[1]

[1] US banks earn about two-thirds of their revenue from net interest. The remaining noninterest revenue comes from fees and service charges on deposit accounts and credit cards, investment banking, asset management, and other activities. See Haubrich and Young (2019) for an analysis of these components over time. The Silicon Valley Bank business model focused mainly on net interest: "Net interest income accounts for the major portion of our earnings. It is comprised primarily of income generated from interest rate spread differences between the interest rates received on interest-earning assets, such as loans extended to clients and securities held in our fixed income securities portfolio, and the interest rates paid by us on interest-bearing liabilities, such as deposits and borrowings" (Silicon Valley Bank Financial Group 2023, p. 7).

Figure 2
Silicon Valley Bank and the Business Model of Banking



Source: US Department of the Treasury (2023); SVB (2020a); author's calculations.
Notes: The 2019 deposit rate is a year-end estimate based on SVB presentations. The 2019 government yield curve represents the government's cost of borrowing at different maturities. The 2019 "risky loan" curve represents a 150–basis point premium on the government yield curve as an estimate of a premium on risky lending.

Figure 2 illustrates the three main sources of net interest margin for Silicon Valley Bank as of December 31, 2019. The y-axis shows interest rates (= "yield") measured as an annualized percentage; the x-axis shows time. Starting in the middle of the figure, the solid blue line shows the term structure of government debt: the market interest rates paid by the government to borrow at various maturities, ranging from one month to 30 years. (As is standard in these kinds of figures, the x-axis is not drawn to scale, instead showing many observations for short-term maturities before getting sparser at the long end.) The graph of these government interest rates, represented by the blue line, is called the "yield curve." The curve begins at approximately 1.5 percent for Treasury bills with one month remaining on their term, rising to about 2 percent for 10-year bonds and 2.5 percent for 30-year bonds. The "term spread" shown on the right side of the figure represents the difference between the yields on the shortest- and longest-horizon government debt. This term spread is positive, which is the usual condition. To the extent that SVB—like most banks—will be borrowing at the short end of the curve and lending at the long end of the curve, a bank will capture some component of this term spread as part of its net interest margin.

If all the bank did was to borrow short-term at the government rate and then lend long-term back to the government, the net interest margin would be exactly equal to the term spread. But banks can improve upon the seemingly risk-free

borrowing rates of the government. At the bottom left of the figure, the solid circle at 0.4 percent represents the average interest rate paid by Silicon Valley Bank on deposits at the end of 2019. Because these deposits can be demanded at any time, their *legal* term-to-maturity is close to zero, and thus the solid circle lies right next to the y-axis. The vertical difference between this solid circle and the leftmost point on the blue government yield curve is the "deposit spread" earned by SVB. Effectively, SVB's customers are willing to accept an even lower return than they would get in government T-bills because of the transaction services and other perquisites provided by their demand deposits at the bank. Unlike Treasury bills, bank deposits can be used to facilitate transactions; many components of the legal ability to provide these services are unique to banks.

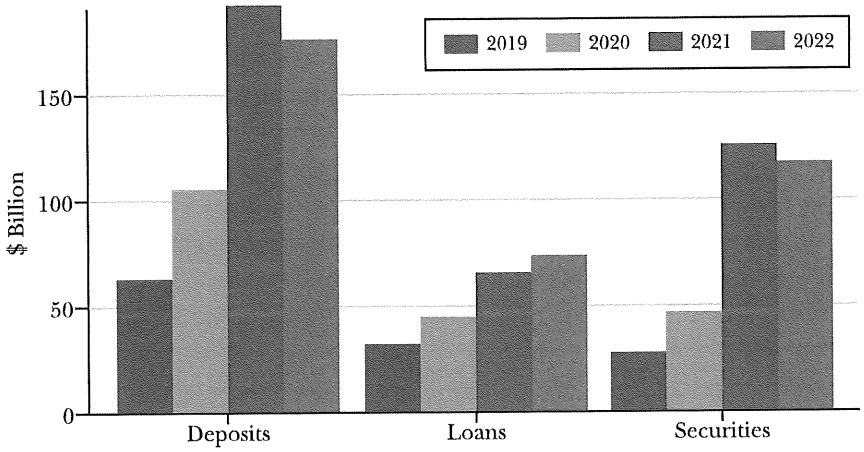
Figure 2 also includes a dotted line extended from the solid circle. This dotted line represents the expectation that deposits are "sticky" in the sense that depositors do not switch banks in the short run. In the limit, if we make an extreme (counterfactual) assumption that most depositors make a lifetime commitment to their bank at current dotted-line rates, then any further increase in the blue line would effectively be a windfall for the bank.

Of course, in normal times we do not expect banks to invest all of their deposits in government securities. As seen in the Silicon Valley Bank balance sheet in Figure 1, approximately half of the assets at SVB were in securities at the end of 2019, with the other half in more traditional loans to businesses and individuals. Unlike government securities, these traditional loans are risky and would be expected to earn a premium over the government yield curve. This "risky-loan" curve is shown in red, with the difference between the red and blue curves shown on the right as the "credit spread." The risky-loan curve represents an estimate of expected yields on the loans, drawn just for expositional purposes: no public data is available to show the rates on the SVB loan book, so we just use a fixed premium here of 1.5 percent. Note that if a bank turns out to have chosen its loans poorly, the *realized* return on risky loans could easily lie beneath the government yield curve.

Taken together, the net interest margin in any given period would be the sum of these three components: the term spread, the deposit spread, and the credit spread. In ordinary times, when a bank is able to pay deposit rates below the government borrowing rate (positive deposit spread), when the government yield curve slopes up (positive term spread), and when risky loans are being paid back (positive realized credit spread), banks will have healthy net interest margins. For 2019, Silicon Valley Bank realized a net interest margin above 3 percent.

But the monetary policy response to COVID-19 led to major changes. Figure 3 traces the evolution of the government yield curve for the next three years. The blue line gives the starting point at the end of 2019, with the same curve as shown in the same color on Figure 2. Even though this curve was already low by historical standards, the response of the Federal Reserve to the pandemic drove rates even lower. The orange line shows the government yield curve at the end of 2020. Short-term rates were effectively zero, and Silicon Valley Bank—like all banks—was no longer earning a positive deposit spread.

Figure 4
SVB: Loans, Deposits, and Securities, 2019–2022



Source: SVB (2019, 2020b, 2021, 2022).
Note: This figure illustrates the main changes to Silicon Valley Bank's end-of-year balance sheet from 2019 to 2022, using the same color scheme as for interest rates in Figure 3.

The bank's growth in 2020 and 2021 took place in a low-interest-rate environment. When the Federal Reserve aggressively raised its target interest rate in 2022, the balance sheet at Silicon Valley Bank stopped growing. Towards the end of the year, tighter credit conditions and the need for operating funds led some of SVB's customers both to withdraw deposits and to tap their credit lines. To hold on to customers, SVB did begin to raise the interest rates paid on deposits, slightly, but even at the end of 2022, about half of all its deposits paid no interest.

For Silicon Valley Bank, the greatest damage of the interest-rate changes came from the effect on the balance sheet, as the increase in long-term interest rates reduced the value of all of the long-maturity assets. The bottom panel of Figure 1, showing the balance sheet on December 31, 2022, allows us to assess the damage. At this time, the book value (or original cost) of assets and liabilities was $209 billion and $194 billion respectively, leaving $15 billion left over as an equity cushion. From this book-value accounting perspective, SVB was solvent and had an equity-to-assets ratio of approximately 7 percent, the same ratio as it had at the end of 2019.

But things look different once we "mark-to-market" the assets—that is, when we look not at the value of the assets at the time they were purchased, but at what they are worth at current market prices. For securities held by Silicon Valley Bank, most of which were purchased when interest rates were much lower in 2020 and 2021, the rise in long-term rates caused a reduction in mark-to-market value of about $17 billion, with this newly mark-to-market value shown in red as $103 billion. Note that these mark-to-market values are not based on realized or expected credit losses; rather, all of the reduction in value comes only from the fact that the value of a bond that pays a certain fixed interest rate will fall when market interest rates rise.

There is no mystery about this mechanical relationship, and it was well understood by management, bank supervisors, and market analysts. Indeed, most of these losses had already been incurred by the end of the third quarter of 2022, and the information about these losses was available in public filings by the bank well before the end of 2022. By this measure, Silicon Valley Bank was already insolvent by December 31, 2022, as shown in the bottom panel of Figure 1, with negative $3 billion in equity. From these facts, one might wonder what regulators, investors, and uninsured depositors could possibly have been thinking to allow SVB to continue operating for so long after this apparent "insolvency" was clear.

The answer here is that Silicon Valley Bank relied on the stability of their customer relationships—the "stickiness" of deposits—as their main method to hedge interest-rate risk. At first glance, this belief may seem counterintuitive, and perhaps even a little magical. Most deposits are in-demand accounts and can be withdrawn at any time. In principle, if interest rates rise, one would expect that either deposit rates would rise or customers would leave and go to another bank. But reality is different. Loyalty, transactions costs, and simple inertia keep many consumers at their banks even when interest rates change—indeed, this stickiness is the reason for the dotted line in Figure 2.

Silicon Valley Bank is not unusual in relying on the stability of its deposits. In an influential paper, Dreschler, Savov, and Schnabl (2021) demonstrate that profits from the deposit spread have been a remarkably good hedge for interest-rate risk for US banks. Their analysis shows that deposit rates are quite inelastic to market interest rates, so that an increase in market rates leads to an increase in deposit *spreads*. Banks build their business plans around this relationship, using marketing, branch networks, and personal service to maximize the stability of their deposit base. We can think of the net present value of this deposit spread like an additional asset for banks, the "franchise value of deposits," but one that is never included in any formal balance sheets. When interest rates rise, the deposit spread increases and this franchise value goes up, but not even "mark-to-market" accounting will capture this change.

The rise in interest rates in 2022 caused significant losses for the entire banking system (Jiang et al. 2023; Flannery and Sorescu 2023). Hundreds of banks were likely close to insolvency if we were to accurately mark-to-market *only the securities and loans* of their balance sheets. If we try to account for the increased value of the deposit franchise, the insolvency often disappears. If deposits lose their stickiness, however, then the value of the deposit franchise will fall, and fear of insolvency can cause actual insolvency. For Silicon Valley Bank, that is exactly what happened next.

Silicon Valley Bank and the Panic of 2023

Most of the mark-to-market losses shown in the bottom panel of Figure 1 had already manifested by the end of the third quarter of 2022. The existence of these losses was public. Everybody could see—without doing much work—that by

this measure Silicon Valley Bank was "insolvent" on paper. So why didn't anything happen until March 2023?

The crucial shock arrived on March 8, 2023, when Silicon Valley Bank announced that it had sold $24 billion of book value securities for a loss of $1.8 billion, along with a plan to raise $2.25 billion of new equity. This announcement contained new information. By selling the securities, SVB was now required to recognize these losses on its income statement and balance sheet—the losses were now "realized." Banks would prefer not to realize losses, and it was reasonable to conclude that the bank did not have better options. Outside onlookers could ask reasonable questions: Maybe the deposit outflow is more severe than we thought? Maybe SVB will need to recognize even more losses to the point that they are actually insolvent? When these kinds of questions become salient, that is all it takes for uninsured deposits to lose their no-questions-asked property.

Once the no-questions-asked property is lost, the cost-benefit calculation for uninsured depositors changes. While history suggests that uninsured depositors have a good chance of ultimately getting all of their money back, it also suggests the possibility of significant delays before this happens. Thus, uninsured depositors knew that if Silicon Valley Bank failed, the potential costs of delay could be material, easily surpassing the transactions costs of switching banks. Many depositors seemed to share this thinking on Thursday, March 9, 2023. The $42 billion withdrawn that day represented almost one-quarter of SVB deposits. Once the news of those withdrawals spread, even more depositors started asking questions. On Friday, March 10, the pace of withdrawals was so rapid that the authorities did not expect SVB to make it through the day.

The Federal Deposit Insurance Corporation took the bank into receivership in the morning—the first intraday receivership in its history. Its announcement on Friday, March 10, 2023, showed that uninsured depositors were right to be concerned: "All insured depositors will have full access to their insured deposits no later than Monday morning, March 13, 2023. The FDIC will pay uninsured depositors an advance dividend within the next week. Uninsured depositors will receive a receivership certificate for the remaining amount of their uninsured funds. As the FDIC sells the assets of Silicon Valley Bank, future dividend payments may be made to uninsured depositors" (FDIC 2023a).

On that Friday, uncertainty was all the Federal Deposit Insurance Corporation could promise for uninsured depositors. But the failure of Silicon Valley Bank, along with the murky outlook for uninsured depositors, led to a violation of the no-questions-asked property at many other banks. In particular, depositors ran from banks that had the same dangerous combination as SVB: a high percentage of uninsured deposits combined with significant unrealized losses on their assets. Two large banks were particularly hard-hit by deposit outflows that same Friday, March 10: Signature Bank, with $110 billion in assets, had about $10 billion in outflows, and First Republic Bank, with $213 billion in assets, had about $25 billion in outflows. Signature was particularly unprepared for this event. Many banks have collateral "pre-positioned" at the Federal Reserve, which involves filling out paperwork which designates certain bank assets and assures that the Fed would have a top priority

claim on those assets if the bank wants to use them as collateral for emergency discount-window borrowing. However, Signature Bank had no pre-positioned collateral, and thus would not have been able to access emergency borrowing from the Fed. This unpreparedness, combined with long-standing regulatory concerns about the management of the bank, convinced regulators to close the bank on Sunday, March 12, and create another FDIC receivership.

As the Federal Deposit Insurance Corporation sought to reassure the uninsured depositors, it faced a substantial obstacle. In any bank resolution, the FDIC is required by law to cover the insured depositors at the "least cost" to the deposit insurance fund. In many cases, another bank is often willing to take on all of the deposits of the failed bank in order to obtain those banking relationships for itself. However, the Silicon Valley Bank failure happened so fast that there was no time to arrange for such a purchase, nor any way to be certain that any such purchase would eventually occur. The FDIC would have had a hard time making a convincing case it was "least cost" to make noncontractual payments to uninsured depositors. The only way around the least-cost requirement is for the FDIC to invoke a "systemic risk exception," enacted in 1991 legislation. This exception cannot be invoked casually: doing so requires a positive vote from the boards of both the FDIC and Federal Reserve, as well as approval by the US Secretary of the Treasury. Invoking the exception also brings close scrutiny to the FDIC, especially since Silicon Valley Bank had not previously been classified as being systemically important.

However, the Federal Deposit Insurance Corporation invoked the systemic risk exception on Sunday, March 12, and promised to protect uninsured depositors, thus showing how much can happen in two days (FDIC 2023b):

> After receiving a recommendation from the boards of the FDIC and the Federal Reserve, and consulting with the President, Secretary Yellen approved actions enabling the FDIC to complete its resolution of Silicon Valley Bank, Santa Clara, California, in a manner that fully protects all depositors. Depositors will have access to all of their money starting Monday, March 13. No losses associated with the resolution of Silicon Valley Bank will be borne by the taxpayer. We are also announcing a similar systemic risk exception for Signature Bank, New York, New York, which was closed today by its state chartering authority. All depositors of this institution will be made whole. As with the resolution of Silicon Valley Bank, no losses will be borne by the taxpayer.

What changed from Friday, March 10, to Sunday, March 12? Given the information now publicly available, I speculate that on Friday, March 10, when Silicon Valley Bank was closed, the authorities had hoped that its failure was idiosyncratic and that the panic would not spread to other banks—or at least would not spread quickly. However, by Sunday, March 12, it was clear that the panic was contagious, and that the no-questions-asked property had been lost for unsecured deposits at banks with large unrealized losses.

The Federal Reserve also made an important policy announcement on that same Sunday, March 12, by introducing the Bank Term Funding Program, which broke new ground in emergency lending. Historically, the Federal Reserve would use the market value of securities as their collateral value and only allow banks to borrow up to that market value minus a small cushion. For the Bank Term Funding Program, it raised this collateral value to par for government securities. Thus, five-year duration government bonds issued in 2021, which were then trading at about $0.85 on the dollar, would still count as a full $1 of collateral from the discount window. Had this program been in place on March 9, and had Silicon Valley Bank possessed the operational capability to pledge all of its securities to the Fed, it would have been able to survive a much larger run.

The Bank Term Funding Program represented a major break from past Fed practice and required an invocation of the "unusual and exigent circumstances" clause from Section 13(3) of the Federal Reserve Act. This emergency authority, granted by Congress in 1935, went unused for more than 70 years before getting its first workout during the global financial crisis of 2008–2009. Since then, the Fed has decided that the "unusual and exigent circumstances" applied twice more, first during COVID-19 and again in the Panic of 2023.

The combination of the Federal Deposit Insurance Corporation using the systemic risk exception to reassure the uninsured depositors that they would be protected and the Federal Reserve using the unusual and exigent circumstances rule to create the Bank Term Funding Program succeeded in slowing down the outflow of deposits at many banks, but not in stopping it. First Republic Bank, which had seemed on Friday, March 10, only hours away from failure, was able to limp on for seven more weeks before being closed on May 1. This delay provided the FDIC enough time to organize an orderly auction, and the "least-cost" winning bid—from J. P. Morgan—included full assumption of all the uninsured deposits. Thus, the FDIC did not need to use the systemic-risk exception for the resolution of First Republic.

The government actions in March 2023 did not solve the underlying solvency concerns in the banking system. Interest rates remained high, so that the mark-to-market losses arising from higher interest rates remained. What the policies did achieve, however, was to reinforce the no-questions-asked property at a large number of troubled banks, thus allowing the deposit franchise of those banks to retain value. The franchise value from deposits then adds to the solvency strength of the bank, which reinforces the no-questions-asked property again, which further reinforces solvency strength, which further reinforces the no-questions-asked property—and then it is turtles all the way down.

The Regulation and Supervision of Silicon Valley Bank

Bank oversight by the government consists of two main components: regulation and supervision. "Regulation" consists of the specific rules banks must follow; these rules are derived from federal and state law, and go through a detailed and

Bank Financial Group 2023). Because the San Francisco Fed has a much larger staff than the California Department of Financial Protection and Innovation, and also much more experience in the examination of large banks, the Fed took the lead on most of the examinations. Finally, as the insurer, the Federal Deposit Insurance Corporation is the "backup federal regulator," and had access to all information from the supervisory process.

In the aftermath of the Panic of 2023, the performance of these regulations—and the supervisors that enforce them—came under close scrutiny, with several government agencies producing reports (DFPI 2023; Federal Reserve Board 2023; FDIC 2023d; Government Accountability Office 2023). The most comprehensive of these reports came from the Federal Reserve, the agency with the most supervisory resources dedicated to Silicon Valley Bank. The report concludes that SVB was in compliance with the specific capital and liquidity rules in place at the time of its failure, but faults itself for a set of recent reforms that kept SVB (and other similarly-sized banks) from having more stringent standards. They conclude, however, that there is no guarantee that these more stringent standards would have prevented SVB's collapse. The Fed report also criticizes its own lack of supervisory zeal, saying that supervisors were aware of weaknesses at SVB, but were not aggressive enough in using their discretion to insist on timely corrections. This conclusion is well supported by evidence, but the remedy is not obvious. "Supervisors should do their jobs better" is not an easy goal to achieve.

To illustrate the challenge faced by supervisors, it is helpful to examine the largest source of concern—interest-rate risk. Many of the official reports emphasized the mismanagement of interest-rate risk by Silicon Valley Bank and the failure of regulation and supervision to correct this mismanagement. The Fed report concludes that "we need to evaluate how we supervise and regulate a bank's management of interest rate risk. While interest rate risk is a core risk of banking that is not new to banks or supervisors, SVB did not appropriately manage its interest rate risk, and supervisors did not force the bank to fix these issues quickly enough" (Federal Reserve Board 2023, p. 3).

But on this point, the regulations themselves do not provide clear guidance to supervisors. In the computation of regulatory capital measures, most mark-to-market interest-rate losses are exempt from inclusion, allowing banks to ignore such losses in meeting required ratios. Even the regulatory "stress tests" performed on the largest banks, with binding implications for their dividend and capital policy, do *not* include a specific stress for interest-rate risk. I think it is asking too much of supervisors to enforce an ethos that is not already in the plain language of the rules.

In contrast, the European Union carefully monitors "interest-rate risk in the banking book" and uses a variety of mechanisms to discourage banks from taking on too much interest-rate risk. Their methods work: EU banks have lower interest-rate risk then do US banks. But these rules do not make the risk disappear—they just shift it to a different place. For example, one main mechanism in the EU financial system to move interest-rate risk away from banks is for more borrowers to pay

time-consuming administrative process for any changes. Overall, regulation moves slowly. "Supervision" is the day-to-day enforcement of these rules, with some limited discretion given to supervisors as circumscribed by the rules. In principle, supervision can be fast. In practice, it often is not.

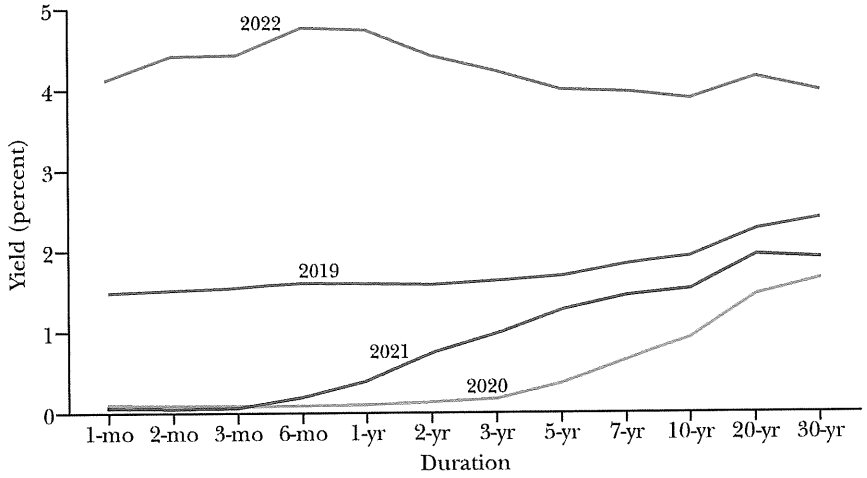
Most bank regulation focuses on either capital or liquidity, but the connections between the two receive far less attention. For capital, banks face a variety of regulations, with standards harmonized internationally through the Basel Committee on Banking Supervision. While the specific rules are complex, they are all variations on a theme: set a minimum ratio where the numerator is some measure of capital and the denominator is some measure of "risk-adjusted" assets. In the simplest case, capital = equity and risk-adjusted assets = total assets, yielding a capital rule based on the equity-to-assets ratio. Indeed, preserving that simple equity-to-assets ratio has proved to be the binding constraint for many of the largest banks since the global financial crisis of 2008–2009. More complex versions of capital rules allow certain types of long-term debt into the numerator of the ratio and reduce the weight of relatively safe assets in the denominator. There are many good references that explain the details of these capital rules; for present purposes, the basic equity-to-assets ratio will suffice. At 7 percent, the ratio at Silicon Valley Bank at the end of 2019 was below the 9.66 percent average for insured banks in the United States, but still above the acceptable minimum of 4 percent.[2]

For liquidity, the classic form of regulation is "reserve requirements," where a bank is required to maintain some minimum cash-to-deposits ratio, with the cash held either in its vault or at the central bank. As with the capital ratio, modern forms of liquidity regulation start with this simple formula and then allow more complex calculations in the numerator and denominator of the ratio.[3] But the main idea remains the same: the bank should have enough liquidity to meet even an unusual level of deposit withdrawals. However, these requirements are not meant to satisfy a full run of all depositors—no bank will have sufficient reserves to do that.

To enforce these capital and liquidity rules, government agencies employ supervisors to perform regular examinations. For Silicon Valley Bank, three agencies shared supervisory oversight. The Department of Financial Protection and Innovation was the chartering agency on behalf of the State of California. Because SVB was a member of the Federal Reserve System, the state-level department shared the regular examination work with the Federal Reserve Bank of San Francisco. The Fed also had authority over the bank holding company, SVB Financial. In this case, 98 percent of the assets of SVB Financial were held in the bank subsidiary, "Silicon Valley Bank" itself, which is the focus of our attention in this paper (Silicon Valley

[2]The historical development of capital rules is described in Haubrich (2020). The changes to international standards imposed after the global financial crisis are described in McNamara, Wedow, and Metrick (2019). A detailed discussion of the current rules and acceptable minimums in the United States is Scott and Labonte (2023). Aggregate statistics for insured banks at the end of 2019 is in FDIC (2020).
[3]A summary of the current international standards for liquidity regulation is given in Bank for International Settlements (2013). The specific application of these standards for Silicon Valley Bank is analyzed in Feldberg (2023a).

Figure 3
Treasury Yield Curves, 2019–2022



Source: US Department of the Treasury (2023).
Note: Lines represent the government's cost of borrowing at different maturities, measured at year-end.

Had the yield curve stayed at these historical lows, Silicon Valley Bank would have been fine. Although the deposit spreads available at the end of 2019 had disappeared, the term spread still existed and the legacy loans from before the COVID era were continuing to perform, preserving credit spreads from that time. But the Fed began fighting the COVID-era inflation in earnest in early 2022, and by the end of the year the government yield curve (in purple) was strikingly different from its blue, orange, and green predecessors; both the level and the slope of the curve had changed. On December 31, 2022, the yield curve for government securities was relatively flat at about 4 percent for all maturities, eliminating the term-spread component.

Figure 4 illustrates the main changes to Silicon Valley Bank's end-of-year balance sheet from 2019 to 2022, using the same color scheme as for interest rates in Figure 3. Taken together, these two figures show how the rapid growth at SVB coincided with changes in the interest-rate environment during the COVID era. In 2020, the powerful easing of rates was also combined with aggressive expansionary fiscal policy. The combined effect of these twin policies was felt particularly strongly in the tech sector of the Silicon Valley region. Younger firms were awash in cash, and a lot of that cash made its way to SVB, where deposits more than tripled from the end of 2019 to the end of 2021. Even in the best of times, it would have been difficult to find enough good lending opportunities to soak up these deposits. SVB did lend out some of these deposits, but the majority went into the purchase of securities. The same dynamics applied in 2021: the loan book grew, but not as fast as the securities portfolio.

variable interest rates. In that case, if interest rates go up, bank balance sheets do not take a hit, but borrowers have to make higher payments. There, the risk of rising interest rates sits with borrowers.[4]

As long as actual investments take time to mature, the provision of liquidity will be a risky endeavor. That risk needs to sit somewhere, and no amount of supervisory vigilance can make this risk disappear. The European Union has chosen to shift this risk to borrowers, while the United States allows much more of that risk to sit on the balance sheets of banks. To the extent that the deposit franchise is a natural hedge for this interest-rate risk, there is a benefit in leaving this risk with banks. But there is also a potential cost, as we saw in March 2023.

Conclusion

The alchemy of banking is that solvency and liquidity reinforce each other. Bank deposits remain money-like because of the assurance of solvency. Money-like deposits tend to be sticky within a given financial institution, because it is costly for depositors to switch banks and replicate an earlier long-term relationship with a new institution. This stickiness gives banks a form of monopoly power, the rents earned from this power comprise a large portion of bank profits, and thus the capitalization of these rents comprises a large portion of the bank's market value. Therein lies the alchemy. As long as the deposit base is stable, the expectation of future profits from deposit spreads adds to the solvency strength that supports the very same deposit stickiness. An information event that calls into question a bank's solvency can quickly become self-reinforcing, as a large component of the solvency disappears when the questions are asked openly. This is the main story of Silicon Valley Bank.

If the stability of the deposit base plays such a central role, why not simply increase the maximum level of deposit insurance? For example, during the global financial crisis of 2008–2009, the Federal Deposit Insurance Commission introduced the Transaction Account Guarantee (TAG) program, which provided unlimited insurance for non-interest-bearing accounts. This program was temporary—expiring at the end of 2010—and has generally been considered to be successful at calming depositors during the worst times of that crisis.

There are several challenges for making a program like the Transaction Account Guarantee permanent. First, when the program was deployed in 2009–2010, interest rates were headed toward zero. Depositors gave up very little by sticking with non-interest-bearing accounts in that environment. In the higher-interest-rate environment that we have today—and which we should expect to recur at least occasionally—the incentives for depositors to leave banks for other vehicles would be significantly stronger. Second, if we went further than the Transaction Account Guarantee and allowed unlimited deposit insurance even for interest-bearing

[4]For a discussion of the US approach to interest-rate risk as compared with the rest of the world, see Feldberg (2023b). For an analysis of EU interest-rate risk, see Dries et al. (2022).

deposits, we should not be surprised to see clever bankers finding ways to sell all kinds of financial products that are ultimately backed by an infinite safety net. For an intermediate solution of raising the deposit limit above $250,000 but less than infinity, the same two problems exist, just in intermediate form.

The challenge of finding the "right" level of deposit insurance is a good example of the general problem of finding the right balance in financial regulation writ large. We should—of course!—try to do the best job we can in enforcing the regulations currently on the books. But in writing new regulations, we must recognize the tradeoffs. In general, bank regulation cannot change the total amount of risk in the economy, but it is highly effective at shifting that risk around. Banks, their customers, their substitutes ("shadow banks"), government, and taxpayers—what is our choice for who should hold what share and what kind of risk?

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References

Bank for International Settlements. 2013. *Basel III: The Liquidity Coverage Ratio and Liquidity Risk Monitoring Tools.* Basel: Bank for International Settlements.

California Department of Financial Protection and Innovation (DFPI). 2023. "Review of DFPI's Oversight and Regulation of Silicon Valley Bank." Sacramento: DFPI.

Dries, Jonathan, Benjamin Klaus, Francesca Lenoci, and Cosimo Pancaro. 2022. "Interest Rate Risk Exposures and Hedging of Euro Area Banks' Banking Books." In *Financial Stability Review, May 2022,* 67–70. Frankfurt: European Central Bank.

Drechsler, Itamar, Alexi Savov, and Philipp Schnabl. 2021. "Banking on Deposits: Maturity Transformation without Interest Rate Risk." *Journal of Finance* 76 (3): 1091–1143.

FDIC. 2020. "Quarterly Banking Profile: Fourth Quarter 2019." *FDIC Quarterly* 14 (1).

FDIC. 2023a. "FDIC Creates a Deposit Insurance National Bank of Santa Clara to Protect Insured Depositors of Silicon Valley Bank, Santa Clara, California." PR-16-2023. https://www.fdic.gov/news/press-releases/2023/pr23016.html.

FDIC. 2023b. "Joint Statement by the Department of the Treasury, Federal Reserve, and FDIC." PR-17-2023. https://www.fdic.gov/news/press-releases/2023/pr23017.html.

FDIC. 2023c. *FDIC's Supervision of Signature Bank.* Washington, DC: FDIC.

FDIC. 2023d. *Options for Deposit Insurance Reform.* Washington, DC: FDIC.

Federal Reserve Board. 2023. Review of the Federal Reserve's Supervision and Regulation of Silicon Valley Bank. Washington, DC: Federal Reserve Board.

Feldberg, Greg. 2023a. "Lessons from Applying the Liquidity Coverage Ratio to Silicon Valley Bank." Yale School of Management, March 27. https://som.yale.edu/story/2023/lessons-applying-liquidity-coverage-ratio-silicon-valley-bank.

Feldberg, Greg. 2023b. "US Banks' Interest-Rate Risk Reporting and Regulation: A Comparative Context." Yale School of Management, April 26. https://som.yale.edu/story/2023/us-banks-interest-rate-risk-reporting-and-regulation-comparative-context.

Flannery, Mark J., and Sorin M. Sorescu. 2023. "Partial Effects of Fed Tightening on U.S. Banks' Capital." Unpublished.

Government Accountability Office. 2023. "Bank Regulation: Preliminary Review of Agency Actions Related to March 2023 Bank Failures." GAO-23-106834. https://www.gao.gov/products/gao-23-106834.

Haubrich, Joseph G. 2020. "A Brief History of Bank Capital Requirements in the United States." Federal Reserve Bank of Cleveland Economic Commentary 2020-05.

Haubrich, Joseph G., and Tristan Young. 2019. "Trends in the Noninterest Income of Banks." Federal Reserve Bank of Cleveland Economic Commentary 2019-14.

Holmstrom, Bengt. 2015. "Understanding the Role of Debt in the Financial System." BIS Working Paper 479.

Jiang, Erica Xuewei, Gregor Matvos, Tomasz Piskorski, and Amit Seru. 2023. "Monetary Tightening and U.S. Bank Fragility in 2023: Mark-to-Market Losses and Uninsured Depositor Runs?" NBER Working Paper 31048.

McNamara, Christian, Michael Wedow, and Andrew Metrick. 2019. "Basel III B: Basel III Overview." *Journal of Financial Crises* 1 (4): 59–69.

Scott, Andrew P., and Marc Labonte. 2023. *Bank Capital Requirements: A Primer and Policy Issues.* CRS Report R47447. Washington, DC: Congressional Research Service.

Silicon Valley Bank (SVB). 2019. "Call Report at the Close of Business December 31, 2019." RSSD-ID 802866. https://cdr.ffiec.gov/public/ManageFacsimiles.aspx#.

Silicon Valley Bank (SVB). 2020a. "Q4 and FY 2019 Financial Highlights." https://s201.q4cdn.com/589201576/files/doc_financials/2019/q4/Q4'19-IR-Presentation_1.31.20.pdf.

Silicon Valley Bank (SVB). 2020b. "Call Report at the Close of Business December 31, 2020." RSSD-ID 802866. https://cdr.ffiec.gov/public/ManageFacsimiles.aspx#.

Silicon Valley Bank (SVB). 2021. "Call Report at the Close of Business December 31, 2021." RSSD-ID 802866. https://cdr.ffiec.gov/public/ManageFacsimiles.aspx#.

Silicon Valley Bank (SVB). 2022. "Call Report at the Close of Business December 31, 2022." RSSD-ID 802866. https://cdr.ffiec.gov/public/ManageFacsimiles.aspx#.

Silicon Valley Bank Financial Group. 2023. "Form 10-K for the Fiscal Year Ended December 31, 2022." Washington, DC: United State Securities and Exchange Commission https://d18rn0p25nwr6d.cloudfront.net/CIK-0000719739/f36fc4d7-9459-41d7-9e3d-2c468971b386.pdf.

US Department of the Treasury. 2023. "Daily Treasury Par Yield Curve Rates." https://home.treasury.gov/resource-center/data-chart-center/interest-rates/TextView?type=daily_treasury_yield_curve&field_tdr_date_value_month=202311.

Economic Quarterly—Volume 94, Number 3—Summer 2008—Pages 235–263

Understanding Monetary Policy Implementation

Huberto M. Ennis and Todd Keister

Over the last two decades, central banks around the world have adopted a common approach to monetary policy that involves targeting the value of a short-term interest rate. In the United States, for example, the Federal Open Market Committee (FOMC) announces a rate that it wishes to prevail in the federal funds market, where commercial banks lend balances held at the Federal Reserve to each other overnight. Changes in this short-term interest rate eventually translate into changes in other interest rates in the economy and thereby influence the overall level of prices and of real economic activity.

Once a target interest rate is announced, the problem of implementation arises: How can a central bank ensure that the relevant market interest rate stays at or near the chosen target? The Federal Reserve has a variety of tools available to influence the behavior of the interest rate in the federal funds market (called the *fed funds rate*). In general, the Fed aims to adjust the total supply of reserve balances so that it equals demand at exactly the target rate of interest. This process necessarily involves some estimation, since the Fed does not know the exact demand for reserve balances, nor does it completely control the supply in the market.

A critical issue in the implementation process, therefore, is the sensitivity of the market interest rate to unanticipated changes in supply and/or demand.

Some of the material in this article resulted from our participation in the Federal Reserve System task force created to study paying interest on reserves. We are very grateful to the other members of this group, who patiently taught us many of the things that we discuss here. We also would like to thank Kevin Bryan, Yash Mehra, Rafael Repullo, John Walter, John Weinberg, and the participants at the 2008 Columbia Business School/New York Fed conference on "The Role of Money Markets" for useful comments on a previous draft. All remaining errors are, of course, our own. The views expressed here do not necessarily represent those of the Federal Reserve Bank of New York, the Federal Reserve Bank of Richmond, or the Federal Reserve System. Ennis is on leave from the Richmond Fed at University Carlos III of Madrid and Keister is at the Federal Reserve Bank of New York. E-mails: hennis@eco.uc3m.es, Todd.Keister@ny.frb.org.

If small estimation errors lead to large swings in the interest rate, a central bank will find it difficult to effectively implement monetary policy, that is, to consistently hit the target rate. The degree of sensitivity depends on a variety of factors related to the design of the implementation process, such as the time period over which banks are required to hold reserves and the interest rate, if any, that a central bank pays on reserve balances.

The ability to hit a target interest rate consistently plays a critical role in a central bank's communication policy. The overall effectiveness of monetary policy depends, in part, on individuals' perceptions of the central bank's actions and objectives. If the market interest rate were to deviate consistently from the central bank's announced target, individuals might question whether these deviations simply represent glitches in the implementation process or whether they instead represent an unannounced change in the stance of monetary policy. Sustained deviations of the average fed funds rate from the FOMC's target in August 2007, for example, led some media commentators to claim that the Fed had engaged in a "stealth easing," taking actions that lowered the market interest rate without announcing a change in the official target.[1] In such times, the ability to hit a target interest rate consistently allows the central bank to clearly (and credibly) communicate its policy to market participants.

Under most circumstances, the Fed changes the total supply of reserve balances available to commercial banks by exchanging government bonds or other securities for reserves in an open market operation. Occasionally, the Fed also provides reserves directly to certain banks through its discount window. In some situations, the Fed has developed other, ad hoc methods of influencing the supply and distribution of reserves in the market. For example, during the recent period of financial turmoil, the market's ability to smoothly distribute reserves across banks became partially impaired, which led to significant fluctuations in the average fed funds rate both during the day and across days. In December 2007, partly to address these problems, the Fed introduced the Term Auction Facility (TAF), a bimonthly auction of a fixed quantity of reserve balances to all banks eligible to borrow at the discount window. In principle, the TAF has increased these banks' ability to access reserves directly and, in this way, has helped ease the pressure on the market to redistribute reserves and avoid abnormal fluctuations in the market rate. Such operations, of course, need to be managed so as to achieve the ultimate goal of implementing the chosen target interest rate. Balancing the demand and supply of reserves is at the very core of this problem.

This article presents a simple analytical framework for understanding the process of monetary policy implementation and the factors that influence a

[1] See, for example, "A 'Stealth Easing' by the Fed?" (Coy 2007).

central bank's ability to keep the market interest rate close to a target level. We present this framework graphically, focusing on how various features of the implementation process affect the sensitivity of the market interest rate to unanticipated changes in supply or demand. We discuss the current approach used by the Fed, including the use of reserve maintenance periods to decrease this sensitivity. We also show how this framework can be used to study a wide range of issues related to monetary policy implementation.

In 2006, the U.S. Congress enacted legislation that will give the Fed the authority to pay interest on reserve balances beginning in October 2011.[2] We use our simple framework to illustrate how the ability to pay interest on reserves can be a useful policy tool for a central bank. In particular, we show how paying interest on reserves can decrease the sensitivity of the market interest rate to estimation errors and, thus, enable a central bank to better achieve its desired interest rate.

The model we present uses the basic approach to reserve management introduced by Poole (1968) and subsequently advanced by many others (see, for example, Dotsey 1991; Guthrie and Wright 2000; Bartolini, Bertola, and Prati 2002; and Clouse and Dow 2002). The specific details of our formalization closely follow those in Ennis and Weinberg (2007), after some additional simplifications that allow us to conduct all of our analysis graphically. Ennis and Weinberg (2007) focused on the interplay between daylight credit and the Fed's overnight treatment of bank reserves. In this article, we take a more comprehensive view of the process of monetary policy implementation and we investigate several important topics, such as the role of reserve maintenance periods, which were left unexplored by Ennis and Weinberg (2007).

1. U.S. MONETARY POLICY IMPLEMENTATION

Banks hold reserve balances in accounts at the Federal Reserve in order to satisfy reserve requirements and to be able to make interbank payments. During the day, banks can also access funds by obtaining an overdraft from their reserve accounts at the Fed. The terms by which the Fed provides daylight credit are one of the factors determining the demand for reserves by banks.

To adjust their reserve holdings, banks can borrow and lend balances in the fed funds market, which operates weekdays from 9:30 a.m. to 6:30 p.m. A bank wanting to decrease its reserve holdings, for example, can do so in this market by making unsecured, overnight loans to other banks.

The fed funds market plays a crucial role in monetary policy implementation because this is where the Federal Reserve intervenes to pursue its policy objectives. The stance of monetary policy is decided by the FOMC, which

[2] After this article was written, the effective date for the authority to pay interest on reserves was moved to October 1, 2008, by the Emergency Economic Stabilization Act of 2008.

selects a target for the overnight interest rate prevailing in this market. The Committee then instructs the Open Market Desk to adjust, via open market operations, the supply of reserve balances so as to steer the market interest rate toward the selected target.[3]

The Desk conducts open market operations largely by arranging repurchase agreements (repos) with primary securities dealers in a sealed-bid, discriminatory price auction. Repos involve using reserve balances to purchase securities with the explicit agreement that the transaction will be reversed at maturity. Repos usually have overnight maturity, but the Desk also employs other maturities (for example, two-day and two-week repos are commonly used). Open market operations are typically conducted early in the morning when the market for repos is most active.

The new reserves created in an open market operation are deposited in the participating securities dealers' bank accounts and, hence, increase the total supply of reserves in the banking system. In this way, each day the Desk tries to move the supply of reserve balances as close as possible to the level that would leave the market-clearing interest rate equal to the target rate. An essential step in this process is accurately forecasting both aggregate reserve demand and those changes in the existing supply of reserve balances that are due to *autonomous factors* beyond the Fed's control, such as payments into and out of the Treasury's account and changes in the quantity of currency in circulation. Forecasting errors will lead the actual supply of reserve balances to deviate from the intended level and, hence, will cause the market rate to diverge from the target rate, even if reserve demand is perfectly anticipated.

Reserve requirements in the United States are calculated as a proportion of the quantity of transaction deposits on a bank's balance sheet during a two-week computation period prior to the start of the maintenance period. These requirements can be met through a combination of vault cash and reserve balances held at the Fed. During the two-week reserve maintenance period, a bank's end-of-day reserve balances must, on average, equal the reserve requirement minus the quantity of vault cash held during the computation period. Reserve requirements make a large portion of the demand for reserve balances fairly predictable, which simplifies monetary policy implementation.

Reserve maintenance periods allow banks to spread out their reserve holdings over time without having to scramble for funds to meet a requirement at the end of each day. However, near the end of the maintenance period, this averaging effect tends to lose force. On the last day of the period, a bank has some level of remaining requirement that must be met on that day. This generates a fairly inelastic demand for reserve balances and makes implementing a target interest rate more challenging. For this reason, the Fed allows banks

[3] See Hilton and Hrung (2007) for a more detailed overview of the Fed's monetary policy implementation procedures.

holding excess or deficient balances at the end of a maintenance period to carry over those balances and use them to satisfy up to 4 percent of their requirement in the following period.

If a bank finds itself short of reserves at the end of the maintenance period, even after taking into account the carryover possibilities, it has several options. It can try to find a counterparty late in the day offering an acceptable interest rate. However, this may not be feasible because of an aggregate shortage of reserve balances or because of the existence of trading frictions in this market. A second alternative is to borrow at the discount window of its corresponding Federal Reserve Bank.[4] The discount window offers collateralized overnight loans of reserves to banks that have previously pledged appropriate collateral. Discount window loans are typically charged an interest rate that is 100 basis points above the target fed funds rate, although changing the size of this gap is possible and has been used, at times, as a policy instrument. Finally, if the bank does not have the appropriate collateral or chooses not to borrow at the discount window for other reasons, it will be charged a penalty fee proportional to the amount of the shortage.

Currently, banks earn no interest on the reserve balances they hold in their accounts at the Federal Reserve.[5] This situation may soon change: The Financial Services Regulatory Relief Act of 2006 allows the Fed to begin paying interest on reserve balances in October 2011. The Act also includes provisions that give the Fed more flexibility in determining reserve requirements, including the ability to eliminate the requirements altogether. Thus, this legislation opens the door to potentially substantial changes in the way the Fed implements monetary policy. To evaluate the best approach within the new, broader set of alternatives, it seems useful to develop a simple analytical framework that is able to address many of the relevant aspects of the problem. We introduce and discuss such a framework in the sections that follow.

2. THE DEMAND FOR RESERVES

In this section, we present a simple framework that is useful for understanding banks' demand for reserves. In this framework, a bank holds reserves primarily to satisfy reserve requirements, although other factors, such as the desire to make interbank payments, may also play a role. Since banks cannot fully predict the timing of payments, they face uncertainty about the net outflows from their reserve accounts and, therefore, are typically unable to exactly satisfy their reserve requirements. Instead, they must balance the possibility

[4] There are 12 regions and corresponding Reserve Banks in the Federal Reserve System. For each commercial bank, the corresponding Reserve Bank is determined by the region where the commercial bank is headquartered.

[5] See footnote 2.

of holding excess reserve balances—and the associated opportunity cost—against the possibility of being penalized for a reserve deficiency. A bank's demand for reserves results from optimally balancing these two concerns.

The Basic Framework

We assume banks are risk-neutral and maximize expected profits. At the beginning of the day, banks can borrow and lend reserves in a competitive interbank market. Let R be the quantity of reserves chosen by a bank in the interbank market. The central bank affects the supply of reserves in this market by conducting open market operations. Total reserve supply is equal to the quantity set by the central bank through its operations, adjusted by a potentially random amount to reflect unpredictable changes in autonomous factors.

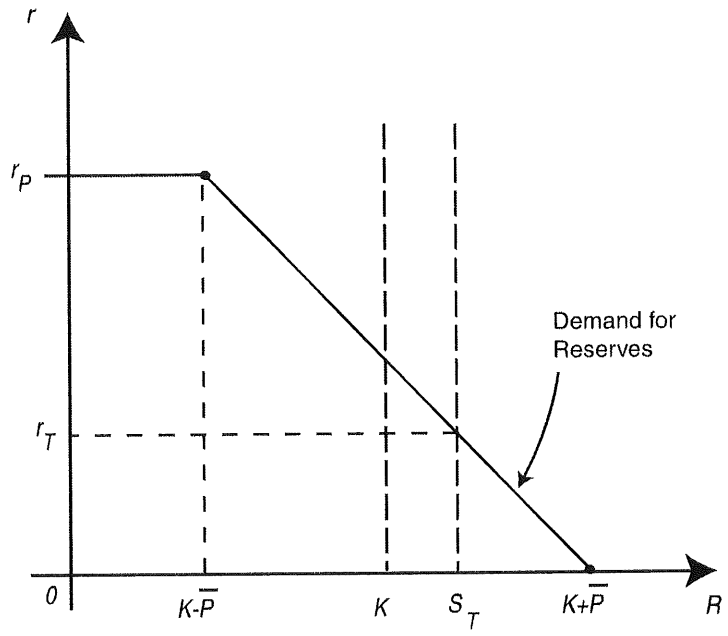
During the day, each bank makes payments to and receives payments from other banks. To keep things as simple as possible, suppose that each bank will make exactly one payment and receive exactly one payment during the "middle" part of the day. Furthermore, suppose that these two payment flows are of exactly the same size, $P_D > 0$, and that this size is nonstochastic. However, the order in which these payments occur during the day is random; some banks will receive the incoming payment before making the outgoing one, while others will make the outgoing payment before receiving the incoming one.

At the end of the day, after the interbank market has closed, each bank experiences another payment shock, P, that affects its end-of-day reserve balance. The value of P can be either positive, indicating a net outflow of funds, or negative, indicating a net inflow of funds. We assume that the payment shock, P, is uniformly distributed on the interval $[-\overline{P}, \overline{P}]$. The value of this shock is not yet known when the interbank market is open; hence, a bank's demand for reserves in this market is affected by the distribution of the payment shock and not the realization.

We assume, as a starting point, that a bank must meet a given reserve requirement, K, at the end of each day.[6] If the bank finds itself holding fewer than K reserves at the end of the day, after the payment shock P has been realized, it must borrow funds at a "penalty" rate of interest, r_P, to satisfy the requirement. This rate can be thought of as the rate charged by the central bank on discount window loans, adjusted to take into account any "stigma" associated with using this facility. In reality, a bank may pay a deficiency fee instead of borrowing from the discount window or it may borrow funds

[6] We discuss more complicated systems of reserve requirements later, including multiple-day maintenance periods. For the logic in the derivations that follow, the particular value of K does not matter. The case of $K = 0$ corresponds to a system without reserve requirements.

Figure 1 Benchmark Demand for Reserves



possible value, $\overline{P}$.[7] The alternative would be to borrow more reserves in the market to reduce this potential need for discount window lending. Since the market rate is equal to the penalty rate, both strategies deliver the same level of profit and the bank is indifferent between them.

For market interest rates below the penalty rate, however, a bank will choose to hold at least $K - \overline{P}$ reserves. As discussed above, if the bank held fewer than $K - \overline{P}$ reserves it would be certain to need to borrow from the discount window, which would not be an optimal choice when the market rate is lower than the discount rate. The bank's demand for reserves in this situation can be described as "precautionary" in the sense that the bank chooses its reserve holdings to balance the possibility of falling short of the requirement against the possibility of ending up with extra reserves in its account at the end of the day.

[7] To see this, note that even in the best case scenario the bank will find itself holding $R+\overline{P}$ reserves after the arrival of the late-day payment flow. When $R < K - \overline{P}$, the bank's end-of-day holdings of reserves is insufficient to satisfy its reserve requirement, K, unless it takes a loan at the discount window.

in the interbank market very late in the day when this market is illiquid. In the model, the rate r_P simply represents the cost associated with a late-day reserve deficiency, whatever the source of that cost may be.

The specific assumptions we make about the number and size of payments that a bank sends are not important; they only serve to keep the analysis free of unnecessary complications. Two basic features of the model are important. First, the bank cannot perfectly anticipate its end-of-day reserve position. This uncertainty creates a "precautionary" demand for reserves that smoothly responds to changes in the interest rate. Second, a bank makes payments during the day as a part of its normal operations and the pattern of these payments can potentially lead to an overdraft in the bank's reserve account. We initially assume that the central bank offers daylight credit to banks to cover such overdrafts at no charge. We study the case where daylight overdrafts are costly later in this section.

The Benchmark Case

We begin by analyzing a simple benchmark case; we show later in this section how the framework can be extended to include a variety of features that are important in reality. In the benchmark case, banks must meet their reserve requirement at the end of each day, and the central bank pays no interest on reserves held by banks overnight. Furthermore, the central bank offers daylight credit free of charge.

Figure 1 depicts an individual bank's demand for reserves in the interbank market under this benchmark scenario. On the horizontal axis we measure the bank's choice of reserve holdings *before the late-day payment is realized.* On the vertical axis we measure the market interest rate for overnight loans. To draw the demand curve, we ask: Given a particular value for the interest rate, what quantity of reserves would the bank demand to hold if that rate prevailed in the market?

A bank would be unwilling to hold any reserves if the market interest rate were higher than r_P. If the market rate were higher than the penalty rate, the bank would choose to meet its requirement entirely by borrowing from the discount window. It would actually like to borrow even more than its requirement and lend the rest out at the higher market rate, but this fact is not important for the analysis. The important point is simply that there will be no demand for (nonborrowed) reserves for any interest rate larger than r_P.

When the market interest rate exactly equals the penalty rate, r_P, a bank would be indifferent between holding any amount of reserves between zero and $K - \overline{P}$ and, hence, the demand curve is horizontal at r_P. As long as the bank's reserve holdings, R, are smaller than $K - \overline{P}$, the bank will need to borrow at the discount window to satisfy its reserve requirement, K, even if the late-day inflow of funds into the bank's reserve account is the largest

If the market interest rate were very low—close to zero—the opportunity cost of holding reserves would be very small. In this case, the bank would hold enough precautionary reserves so that it is virtually certain that unforeseen movements on its balance sheet will not decrease its reserves below the required level. In other words, the bank will hold $K + \overline{P}$ reserves in this case. If the market interest rate were exactly zero, there would be no opportunity cost of holding reserves. The demand curve is, therefore, flat along the horizontal axis after $K + \overline{P}$.

In between the two extremes, $K - \overline{P}$ and $K + \overline{P}$, the demand for reserves will vary inversely with the market interest rate measured on the vertical axis; this portion of the demand curve is represented by the downward-sloping line in Figure 1. The curve is downward-sloping for two reasons. First, the market interest rate represents the opportunity cost of holding reserves overnight. When this rate is lower, finding itself with excess balances is less costly for the bank and, hence, the bank is more willing to hold precautionary balances. Second, when the market rate is lower, the relative cost of having to access the discount window is larger, which also tends to increase the bank's precautionary demand for reserves.

The linearity of the downward-sloping part of the demand curve results from the assumption that the late-day payment shock is uniformly distributed. With other probability distributions, the demand curve will be nonlinear, but its basic shape will remain unchanged. In particular, the points where the demand curve intersects the penalty rate, r_P, and the horizontal axis will be the same for any distribution with support $[-\overline{P}, \overline{P}]$.[8]

The Equilibrium Interest Rate

Suppose, for the moment, that there is a single bank in the economy. Then the demand curve in Figure 1 also represents the total demand for reserves. Let S denote the total supply of reserves in the interbank market, as jointly determined by the central bank's open market operations and autonomous factors. Then the equilibrium interest rate is determined by the height of the demand curve at point S. As shown in the diagram, there is a unique level of reserve supply, S_T, that will generate a given target interest rate, r_T.

Now suppose there are many banks in the economy, but they are all identical in that they have the same level of required reserves, face the same payment shock, etc. When there are many banks, the total demand for reserves can be found by simply "adding up" the individual demand curves. For any interest

[8] The *support* of the probability distribution is the set of values of the payment shock that is assigned positive probability. An explicit formula for the demand curve in the uniform case is derived in Ennis and Weinberg (2007). If the shock instead had an unbounded distribution, such as the normal distribution used by Whitesell (2006) and others, the demand curve would asymptote to the penalty rate and the horizontal axis but never intersect them.

rate r, total demand is simply the sum of the quantity of reserves demanded by each individual bank.

For presentation purposes, it is useful to look at the average demand for reserves, that is, the total demand divided by the number of banks. When all banks are identical, the average demand is exactly equal to the demand of each individual bank. In other words, in the benchmark case where banks are identical, the demand curve in Figure 1 also represents the *aggregate* demand for reserves, expressed in per-bank terms. The determination of the equilibrium interest rate then proceeds exactly as in the single-bank case. In particular, the market-clearing interest rate will be equal to the target rate, r_T, if and only if reserve supply (expressed in per-bank terms) is equal to S_T.

Note that the central bank has two distinct ways in which it can potentially affect the market interest rate: changing the supply of reserves available in the market and changing (either directly or indirectly) the penalty rate. Suppose, for example, that the central bank wishes to decrease the market interest rate. It could either increase the supply of reserves through open market operations, leading to a movement down the demand curve, or it could decrease the penalty rate, which would rotate the demand curve downward while leaving the supply of reserves unchanged. Both policies would cause the market interest rate to fall.

Heterogeneity

While the assumption that all banks are identical was useful for simplifying the presentation above, it is clearly a poor representation of reality in most economies. The United States, for example, has thousands of banks and other depository institutions that differ dramatically in size, range of activities, etc. We now show how the analysis above changes when there is heterogeneity among banks and, in particular, how the size distribution of banks might affect the aggregate demand for reserves.

Each bank still has a demand curve of the form depicted in Figure 1, but now these curves can be different from each other because banks may have different levels of required reserves, face different distributions of the payment shock, and/or face different penalty rates. These individual demand curves can be aggregated exactly as before: For any interest rate r, the total demand for reserves is simply the sum of the quantity of reserves demanded by each individual bank. The aggregate demand curve, expressed in per-bank terms, will again be similar to that presented in Figure 1, with the exact shape being determined by the properties of the various individual demands. If different banks have different levels of required reserves, for example, the requirement K in the aggregate demand curve will be equal to the average of the individual banks' requirements.

As the figure shows, when daylight credit is costly, the level of reserves required to implement a given target rate is higher (S_2 rather than S_1 in the diagram). In other words, costly daylight credit tends to increase banks' reserve holdings. The demand curve is also flatter, meaning that reserve holdings are more sensitive to changes in the interest rate.

3. INTEREST RATE VOLATILITY

One of the key determinants of a central bank's ability to consistently achieve its target interest rate is the slope of the aggregate demand curve for reserves. In this section, we describe the relationship between this slope and the volatility of the market interest rate in the basic framework. The next two sections then discuss policy tools that can be used to limit this volatility.

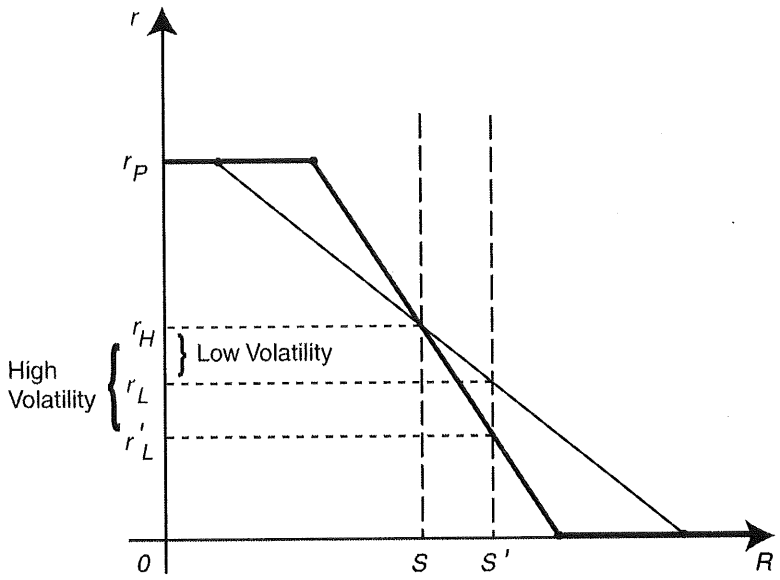
While the central bank can use open market operations to affect the supply of reserves available in the market, it typically cannot completely control this supply. Payments into and out of the Treasury account, as well as changes in the amount of cash in circulation, also affect the total supply of reserves. The central bank can anticipate much of the change in such autonomous factors, but there will often be significant unanticipated changes that cause the total supply of reserves to be different from what the central bank intended. As is clear from Figure 1, if the supply of reserves ends up being different from the intended amount, S_T, the market interest rate will deviate from the target rate, r_T.

Figure 4 illustrates the fact that a flatter demand curve for reserves is associated with less volatility in the market interest rate, given a particular level of uncertainty associated with autonomous factors. Suppose this uncertainty implies that, after a given open market operation, the total supply of reserves will be equal to either S or S' in the figure. With the steeper (thick) demand curve, this uncertainty about the supply of reserves leads to a relatively wide range of uncertainty about the market rate. With the flatter (thin) demand curve, in contrast, the variation in the market rate is smaller. For this reason, the slope of the demand curve, and those policies that affect the slope, are important determinants of the observed degree of volatility of the market interest rate around the target.

As discussed in the previous section, a variety of factors affect the slope of the aggregate demand for reserves. Figure 4 can be viewed, for example, as comparing a situation where all banks face relatively little late-day uncertainty with one where all banks face more uncertainty; the latter case corresponds

unaffected. The analysis also takes the size and timing of payments as given. Several papers have studied the interesting question of how banks respond to incentives in choosing the timing of their outgoing payments and, hence, their daylight credit usage. See, for example, McAndrews and Rajan (2000) and Bech and Garratt (2003).

Figure 4 Interest Rate Volatility



to the thin line in the figure. However, it should be clear that the reasoning presented above does not depend on this particular interpretation. The exact same results about interest rate volatility would obtain if the demand curves had different slopes because banks face different penalty rates in the two scenarios or because of some other factor(s). What the figure shows is that there is a direct relationship between the slope of the demand curve and the amount of interest rate volatility caused by forecast errors or other unanticipated changes in the supply of reserves.

Central banks generally aim to limit the volatility of the interest rate around their target level to the extent possible. For this reason, a variety of policy arrangements have been designed in an attempt to decrease the slope of the demand curve, at least in the region that is considered "relevant." In the remainder of the article, we show how some of these tools can be analyzed in the context of our simple framework. In Section 4 we discuss reserve maintenance periods, while in Section 5 we discuss approaches that become feasible when the central bank pays interest on reserves.

4. RESERVE MAINTENANCE PERIODS

Perhaps the most significant arrangement designed to flatten the demand curve for reserves is the introduction of reserve maintenance periods. In a system

5. PAYING INTEREST ON RESERVES

We now introduce the possibility that the central bank pays interest on the reserve balances held overnight by banks in their accounts at the central bank. As discussed in Section 1, most central banks currently pay interest on reserves in some form, and Congress has authorized the Federal Reserve to begin doing so in October 2011. The ability to pay interest on reserves gives a central bank an additional policy tool that can be used to help minimize the volatility of the market interest rate and steer this rate to the target level. This tool can be especially useful during periods of financial distress. For example, during the recent financial turmoil, the fed funds rate has experienced increased volatility during the day and has, in many cases, collapsed to values near zero late in the day. As we will see below, the ability to pay interest on reserves allows the central bank to effectively put a floor on the values of the interest rate that can be observed in the market. Such a floor reduces volatility and potentially increases the ability of the central bank to achieve its target rate.

In this section, we describe two approaches to monetary policy implementation that rely on paying interest on reserves: an interest rate corridor and a system with clearing bands. We explain the basic components of each approach and how each tends to flatten the demand curve for reserves.

Interest Rate Corridors

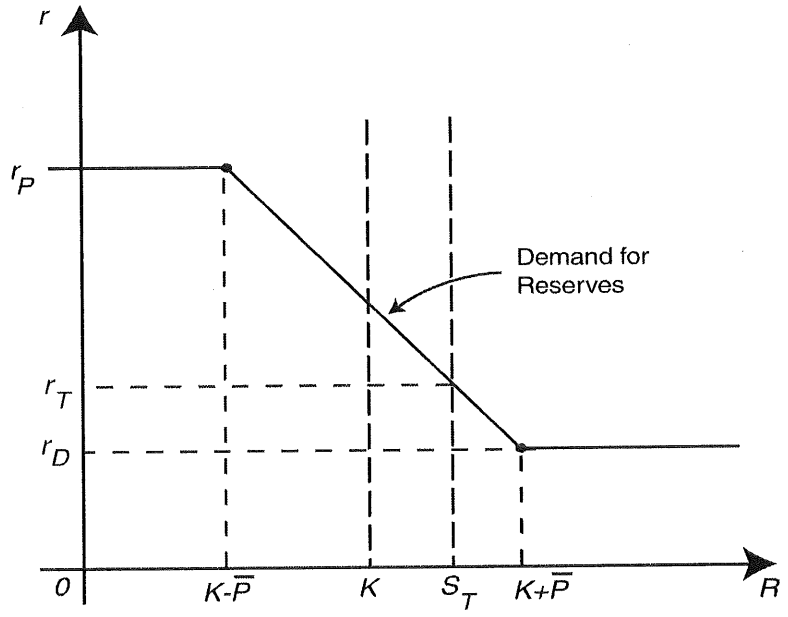
One simple policy a central bank could follow would be to pay a fixed interest rate, r_D, on all reserve balances that a bank holds in its account at the central bank.[15] This policy places a floor on the market interest rate: No bank would be willing to lend reserves at an interest rate lower than r_D, since they could instead earn r_D by simply holding the reserves on deposit at the central bank. Together, the penalty rate, r_P, and the deposit rate, r_D, form a "corridor" in which the market interest rate will remain.[16]

Figure 6 depicts the demand for reserves under a corridor system. As in the earlier figures, there is no demand for reserves if the market interest rate is higher than the penalty rate, r_P. For values of the market interest rate below r_P, a bank will choose to hold at least $K - \overline{P}$ reserves for exactly the same

[15] In practice, reserve balances held to meet requirements are often compensated at a different rate than those that are held in excess of a bank's requirement. For the daily process of targeting the overnight market interest rate, the rate paid on *excess* reserves is what matters; this is the rate we denote r_D in our analysis.

[16] A central bank may prefer to use a *lending facility* that is distinct from its discount window to form the upper bound of the corridor. Banks may be reluctant to borrow from the discount window, which serves as a lender of last resort, because they fear that others would interpret this borrowing as a sign of poor financial health. The terms associated with the lending facility could be designed to minimize this type of stigma effect and, thus, create a more reliable upper bound on the market interest rate.

Figure 6 A Conventional Corridor



reason as in Figure 1: if it held a lower level of reserves, it would be certain to need to borrow at the penalty rate, r_P. Also as before, the demand for reserves is downward-sloping in this region. The big change from Figure 1 is that the demand curve now becomes flat at the deposit rate. If the market rate were lower than the deposit rate, a bank's demand for reserves would be essentially infinite, as it would try to borrow at the market rate and earn a profit by simply holding the reserves overnight.

The figure shows that, regardless of the level of reserve supply, S, the market interest rate will always stay in the corridor formed by the rates r_P and r_D. The width of the corridor, $r_P - r_D$, is then a policy choice. Choosing a relatively narrow corridor will clearly limit the range and volatility of the market interest rate. Note that narrowing the corridor also implies that the downward-sloping part of the demand curve becomes flatter (to see this, notice that the boundary points $K - \overline{P}$ and $K + \overline{P}$ do not depend on r_P or r_D). Hence, the size of the interest rate movement associated with a given shock to an autonomous factor is smaller, even when the shock is small enough to keep the rate within the corridor.

An interesting case to consider is one in which the lending and deposit rates are set the same distance on either side of the target rate (x basis points above and below the target, respectively). This system is called *a symmetric*

corridor. A change in policy stance that involves increasing the target rate, then, effectively amounts to changing the levels of the lending and deposit rates, which shifts the demand curve along with them. The supply of reserves needed to maintain a higher target rate, for example, may not be lower. In fact— perhaps surprisingly—in the simple model studied here, the target level of the supply of reserves would not change at all when the policy rate changes.

If the demand curve in Figure 6 is too steep to allow the central bank to effectively achieve its goal of keeping the market rate close to the target, a corridor system could be combined with a reserve maintenance period of the type described in Section 4. The presence of a reserve maintenance period would generate a flat region in the demand curve as in Figure 5. The features of the corridor would make the two downward-sloping parts of the demand curve in Figure 5 less steep, which would limit the interest rate volatility associated with events where reserve supply exits the flat region of the demand curve, as well as on the last day of the maintenance period when the flat region is not present.

Another way to limit interest rate volatility is for the central bank to set the deposit rate equal to the target rate and then provide enough reserves to make the supply, S_T, intersect the demand curve well into the flat portion of the demand curve at rate r_D. This "floor system" has been recently advocated as a way to simplify monetary policy implementation (see, for example, Woodford 2000, Goodfriend 2002, and Lacker 2006). Note that such a system does not rely on a reserve maintenance period to generate the flat region of the demand curve, nor does it rely on reserve requirements to induce banks to hold reserves. To the extent that reserve requirements, and the associated reporting procedures, place significant administrative burdens on both banks and the central bank, setting the floor of the corridor at the target rate and simplifying, or even eliminating, reserve requirements could potentially be an attractive system for monetary policy implementation.

It should be noted, however, that the market interest rate will always remain some distance above the floor in such a system, since lenders in the market must be compensated for transactions costs and for assuming some counterparty credit risk. In other words, in a floor system the central bank is able to fully control the risk-free interest rate, but not necessarily the market rate. In normal times, the gap between the market rate and the rate paid on reserves would likely be stable and small. In periods of financial distress, however, elevated credit risk premia may drive the average market interest rate significantly above the interest rate paid on reserves. Our simple model abstracts from these important considerations.[17]

[17] The central bank could also set an upper limit for the quantity of reserves on which it would pay the target rate of interest to a bank; reserves above this limit would earn a lower rate (possibly zero). Whitesell (2006) proposed that banks be allowed to choose their own upper

the market interest rate is low, for example, simply to earn the higher interest rate paid by the central bank.

The intertemporal aspect of reserve maintenance periods has two clear drawbacks. First, if—for whatever reason—the expected future rate differs from the target rate, r_T, it becomes difficult for the central bank to achieve the target rate in the current period. Second, large shocks to the supply of reserves on one day can have spillover effects on subsequent days in the maintenance period. If, for example, the supply of reserves is unusually high one day, banks will satisfy an unusually large portion of their reserve requirements and, as a result, the flat portion of the demand curve will be smaller on all subsequent days, increasing the potential for rate volatility on those days.

The clearing band approach, in contrast, generates a flat portion in the demand curve that always lies at the current target interest rate, even if market participants expect the target rate to change in the near future. Moreover, the width of the flat portion is "reset" every day; it does not depend on past events. These features are important potential advantages of the clearing band approach. We should again point out, however, that our simple model has abstracted from transaction costs and credit risk. As with the floor system discussed above, these considerations could result in the average market interest rate being higher than the rate r_T, as the latter represents a risk-free rate.

6. CONCLUSION

A recent change in legislation that allows the Federal Reserve to pay interest on reserves has renewed interest in the debate over the most effective way to implement monetary policy. In this article, we have provided a basic framework that can be useful for analyzing the main properties of the various alternatives. While we have conducted all our analysis graphically, our simplifying assumptions permit a fairly precise description of the alternatives and their effectiveness at implementing a target interest rate.

Many extensions of our basic framework are possible and we have analyzed several of them in this article. However, some important issues remain unexplored. For example, we only briefly mentioned the difficulties that fluctuations in aggregate credit risk can introduce in the implementation process. Also, as the debate continues, new questions will arise. We believe that the framework introduced in this article can be a useful first step in the search for much-needed answers.

REFERENCES

Ashcraft, Adam, James McAndrews, and David Skeie. 2007. "Precautionary Reserves and the Interbank Market." Mimeo, Federal Reserve Bank of New York (July).

Bartolini, Leonardo, Giuseppe Bertola, and Alessandro Prati. 2002. "Day-To-Day Monetary Policy and the Volatility of the Federal Funds Interest Rate." *Journal of Money, Credit, and Banking* 34 (February): 137–59.

Bech, M. L., and Rod Garratt. 2003. "The Intraday Liquidity Management Game." *Journal of Economic Theory* 109 (April): 198–219.

Clouse, James A., and James P. Dow, Jr. 2002. "A Computational Model of Banks' Optimal Reserve Management Policy." *Journal of Economic Dynamics and Control* 26 (September): 1787–814.

Cox, Albert H., Jr., and Ralph F. Leach. 1964. "Open Market Operations and Reserve Settlement Periods: A Proposed Experiment." *Journal of Finance* 19 (September): 534–9.

Coy, Peter. 2007. "A 'Stealth Easing' by the Fed?" *BusinessWeek.* http://www.businessweek.com/investor/content/aug2007/pi20070817_445336.htm [17 August].

Dotsey, Michael. 1991. "Monetary Policy and Operating Procedures in New Zealand." Federal Reserve Bank of Richmond *Economic Review* (September/October): 13–9.

Ennis, Huberto M., and John A. Weinberg. 2007. "Interest on Reserves and Daylight Credit." Federal Reserve Bank of Richmond *Economic Quarterly* 93 (Spring): 111–42.

Goodfriend, Marvin. 2002. "Interest on Reserves and Monetary Policy." Federal Reserve Bank of New York *Economic Policy Review* 8 (May): 77–84.

Guthrie, Graeme, and Julian Wright. 2000. "Open Mouth Operations." *Journal of Monetary Economics* 46 (October): 489–516.

Hilton, Spence, and Warren B. Hrung. 2007. "Reserve Levels and Intraday Federal Funds Rate Behavior." Federal Reserve Bank of New York Staff Report 284 (May).

Keister, Todd, Antoine Martin, and James McAndrews. 2008. "Divorcing Money from Monetary Policy." Federal Reserve Bank of New York *Economic Policy Review* 14 (September): 41–56.

Lacker, Jeffrey M. 2006. "Central Bank Credit in the Theory of Money and Payments." Speech. http://www.richmondfed.org/news_and_speeches/presidents_speeches/index.cfm/2006/id=88/pdf=true.

McAndrews, James, and Samira Rajan. 2000. "The Timing and Funding of Fedwire Funds Transfers." Federal Reserve Bank of New York *Economic Policy Review* 6 (July): 17–32.

Poole, William. 1968. "Commercial Bank Reserve Management in a Stochastic Model: Implications for Monetary Policy." *Journal of Finance* 23 (December): 769–91.

Sternlight, Peter D. 1964. "Reserve Settlement Periods of Member Banks: Comment." *Journal of Finance* 19 (March): 94–8.

Whitesell, William. 2006. "Interest Rate Corridors and Reserves." *Journal of Monetary Economics* 53 (September): 1177–95.

Woodford, Michael. 2000. "Monetary Policy in a World Without Money." *International Finance* 3 (July): 229–60.

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https://www.stlouisfed.org/publications/regional-economist/april-2016/interest-rate-control-is-more-complicated-than-you-thought

Interest Rate Control Is More Complicated Than You Thought

Stephen D. Williamson

Most people are aware that decisions by the Federal Reserve (Fed) affect market interest rates. These decisions have consequences for the interest rates that consumers pay on mortgage loans, credit cards and auto loans, and for the interest rates faced by businesses on bank loans, corporate bonds and commercial paper.

But there is more than one interest rate that the Fed sets, either as a target or by administrative fiat. Many people are aware of the target for the federal funds rate, or fed funds rate, that the Federal Open Market Committee (FOMC) of the Fed sets at its eight regular meetings a year. The fed funds rate is an interest rate on overnight credit arrangements among financial institutions—that is, a very short-term interest rate. The Fed also sets the discount rate, or the interest rate on primary credit, which is an interest rate at which the Fed lends to commercial banks in its role as a lender of last resort. Still another rate is that on interest paid by the Fed on reserves. Banks hold reserve accounts with the Fed; these accounts essentially play the role of checking accounts for financial institutions. (A reserve account is useful when a bank needs to make large payments to other financial institutions.) Thus, a reserve account is a loan to the Fed from a bank. Before late 2008, reserve accounts paid zero interest, as dictated by Congress in the Federal Reserve Act.

Prior to the financial crisis (late 2007 through 2008), the Fed conducted monetary policy within what economists call a *channel system*. The Fed targeted the overnight fed funds rate within a "channel," with the discount rate as the upper bound on the channel and the interest rate on reserves as the lower bound on the channel. For example, in January 2007, the discount rate was set at 6.25 percent, the fed funds rate was targeted at 5.25 percent and the interest rate on reserves was 0 percent. The fed funds rate could not, in principle, go above the discount rate because no bank would choose to borrow from another bank at an interest rate higher than the rate at which it could borrow from the Fed (the discount rate). Similarly, no bank would lend to another bank at an interest rate lower than the interest rate it could receive from the Fed (the interest rate on reserves). In 2007, the New York Fed would intervene every day in financial markets—through open market operations, which are the purchase and sale of assets by the Fed—to try to bring the fed funds rate as close as possible to the target set by the FOMC.

But between 2007 and now, the details of how the Fed conducts monetary policy have changed in important ways. First, since late 2008, the reserves held at the Fed by financial institutions have

earned interest; such interest payments are allowed under an amendment to the Federal Reserve Act passed by Congress. Further, and more importantly, the interest rate on excess reserves, or IOER, is set by the Fed and can be changed over time.

Second, during the Great Recession (late 2007 to mid-2009) and its aftermath, the Fed engaged in some unconventional monetary policy actions. For our purposes, the most important of these was a program of large-scale asset purchases, sometimes known as quantitative easing. This program led to a large increase in the stock of reserves at the Fed—effectively, the Fed purchased a large quantity of assets (U.S. Treasury securities and agency mortgage-backed securities) by issuing more reserves.

For the Fed, the large stock of reserves outstanding implies that monetary policy works differently now—within a *floor system* rather than a channel system. In a floor system, the IOER plays a key role. In principle, what should happen in a floor system is that, with plenty of reserves in the system, the Fed can achieve its target for the fed funds rate by simply setting the IOER. Why? If the fed funds rate were lower than the IOER, then banks would be able to make a profit from borrowing on the fed funds market and lending to the Fed at the IOER, thus forcing up the fed funds rate. If the fed funds rate were higher than the IOER, then a bank wanting to lend would earn more interest on the fed funds market than by lending to the Fed at the IOER. The large demand for fed funds would then force the fed funds rate down.

According to this logic, controlling the fed funds rate should be easy for the Fed under a floor system. But theory and reality sometimes do not agree. From late 2008 to December 2015, the IOER was set at 0.25 percent. However, contrary to what many people might think, since early 2009 the fed funds rate has generally been 5 to 20 basis points (one basis point is equal to 0.01 percentage points) lower than the IOER. This difference between the IOER and the fed funds rate is typically ascribed to costs for commercial banks associated with borrowing on the fed funds market.1

The persistent difference between the IOER and the fed funds rate was a concern for the Fed as it anticipated the time when "liftoff" would occur, where liftoff refers to the date at which the Fed would depart from its long period (since late 2008) of zero interest rate policy, or ZIRP. Could the Fed expect that the fed funds rate would increase along with the IOER if the Fed attempted to control the fed funds rate only through increases in the IOER?

The solution adopted by the Fed is unique in central banking—a floor system with a subfloor. The New York Fed, in intervening in overnight financial markets, is now making use of an overnight reverse repurchase agreement (ON-RRP) facility. ON-RRPs are essentially reserves by another name. In ON-RRP transactions, financial institutions lend to the Fed, just as they do when they hold reserve accounts with the Fed. The difference between reserves and ON-RRPs is that, in an ON-RRP arrangement, the Fed posts securities in its portfolio as collateral, just as in any private repurchase agreement transaction. A repurchase agreement is simply a special kind of financial market loan that is secured by collateral just as, for example, your mortgage is secured by your house, which can be seized if you default on the mortgage.

Without getting into all the details,2 the idea behind the floor-with-subfloor system is that the Fed sets, along with the discount rate and IOER, an ON-RRP rate, which is the rate at which financial

institutions can lend to the Fed in the market for repurchase agreements. The ON-RRP rate is set below the IOER, and then policy is announced as a target range for the fed funds rate, with the top of the range given by the IOER and the bottom of the range determined by the ON-RRP rate. Thus, the IOER sets the floor, and the ON-RRP rate sets the subfloor.

But could this system work? On Dec. 16, 2015, the FOMC decided to increase the target range for the federal funds rate from 0-0.25 percent to 0.25-0.50 percent,3 with the discount rate at 1.0 percent, the IOER at 0.50 percent and the ON-RRP rate set at 0.25 percent.

As shown in Figure 1, the value of ON-RRPs outstanding increased from $105 billion on Dec. 17, 2015, to $475 billion on Dec. 31, following which the quantity dropped back to the neighborhood of $100 billion. In the fed funds market, as shown in Figure 2, the average daily fed funds rate has typically been within a tight range of 0.35-0.37 percent, except on Dec. 31, 2015, when the average rate was 0.20 percent. Thus, in terms of results, the Fed has been successful in controlling the fed funds rate within the 0.25-0.50 percent range.

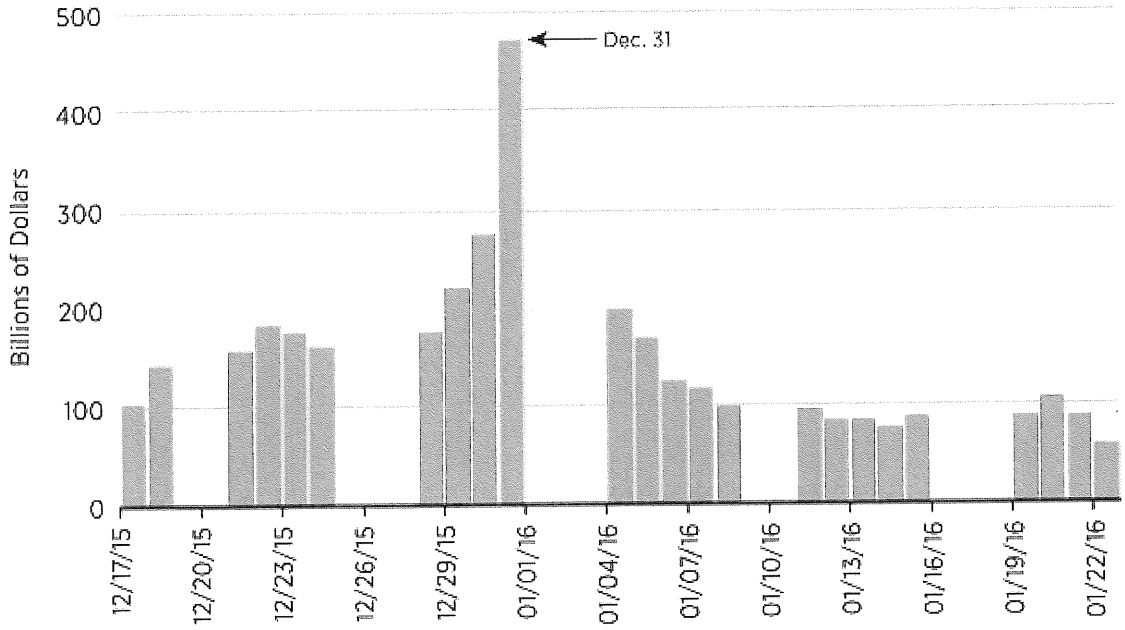
But why was the average fed funds rate so low and the ON-RRP quantity so high on Dec. 31, 2015? This date was both the quarter-end and year-end, which is important because at this time financial reporting takes place and financial institutions want to have their balance sheets appear as favorable as possible to their shareholders and regulators. Lending on the fed funds market can be a risky activity, as lending is unsecured, while lending to the Fed in the form of ON-RRPs is essentially riskless. Therefore, we might expect that, on Dec. 31, lenders in the overnight market would shift their activity from the fed funds market to the ON-RRP market, as this would reduce risk on their balance sheets. Sure enough, we saw a large increase in ON-RRP activity on Dec. 31.

Still, why were fed funds market lenders accepting an average interest rate of 0.20 percent on Dec. 31, 2015, which is lower than the ON-RRP rate on that date, and why were some participants accepting interest rates as low as 0.08 percent? A potential explanation for this is that fed funds market trades and ON-RRP trades are very different in terms of the time of the day lending occurs and when the loan is paid back the next day. In particular, ON-RRP borrowing by the Fed occurs between 12:45 and 1:15 p.m. ET, and loans are paid back the next day between 3:30 and 5:15 p.m. ET. However, a fed funds transaction can occur as late as 6:30 p.m., with funds potentially returned early the next day.4 So, while a fed funds market transaction may be riskier because lending is unsecured, it is also more liquid, as lending can occur later in the day and funds can be returned more quickly the next day. Thus, lenders may be willing to pay for liquidity with a lower overnight interest rate, and this would have a larger effect at the quarter-end, when trading on the fed funds market is thin.

Research assistance was provided by Jonas Crews, a research analyst at the Bank.

Figure 1

Value of ON-RRPs Outstanding

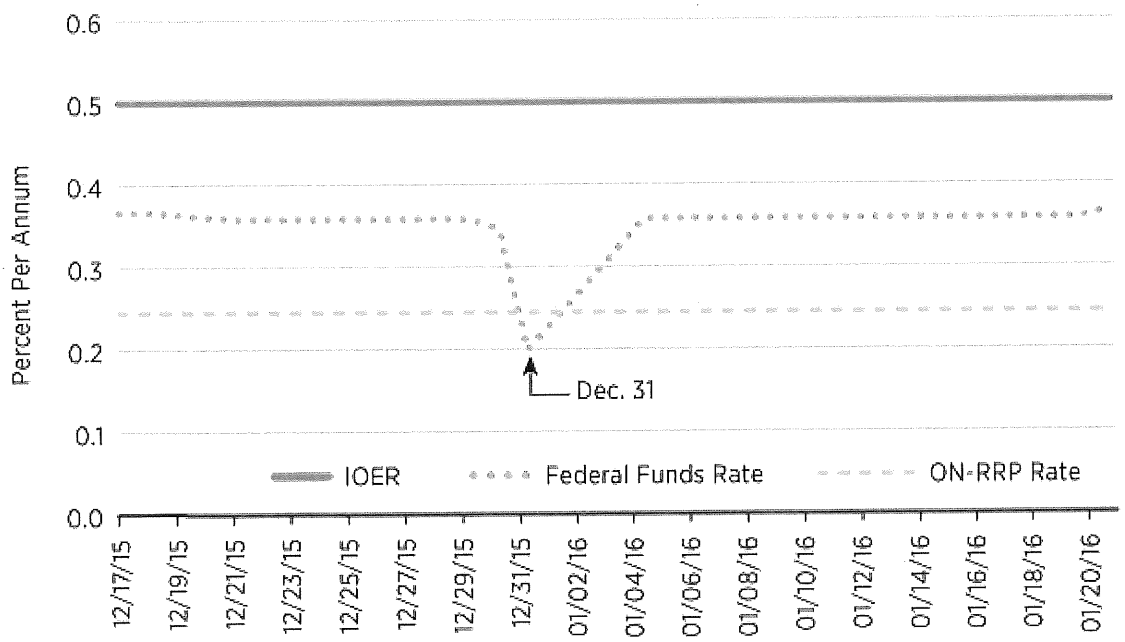


SOURCES: Federal Reserve Board/Haver Analytics.
NOTE: ON-RRP stands for overnight reverse repurchase agreement.

■ FEDERAL RESERVE BANK OF ST. LOUIS

Figure 2

A Floor and a Subfloor for the Federal Funds Rate



SOURCES: Federal Reserve Board/Haver Analytics.

NOTE: In principle, the large stock of reserves outstanding should result in the fed funds rate equaling the interest on excess reserves (IOER), but economic factors have resulted in the former rate running below the latter. The rate for overnight reverse repurchase agreements (ON-RRP) should serve as a secondary floor for the fed funds rate, and it largely has. The only time the fed funds rate has fallen below the ON-RRP rate since liftoff was Dec. 31, 2015, and this is likely explained, in part, by the fact that financial reporting took place on that day and the fact that there are differences in the time frames of fed funds and ON-RRP transactions.

■ FEDERAL RESERVE BANK OF ST. LOUIS

Endnotes

1. See Williamson. [back to text]
2. See Williamson for more information. [back to text]
3. See Board of Governors. [back to text]
4. See Bartolini, Hilton and McAndrews for more information on the timing of transactions. [back to text]

References

Bartolini, Leonardo; Hilton, Spence; and McAndrews, James. "Settlement Delays in the Money Market." New York Federal Reserve Bank *Staff Reports,* 2008, No. 319. See www.newyorkfed.org/medialibrary/media/research/staff_reports/sr319.pdf.

Board of Governors of the Federal Reserve System. *Press Release,* Dec. 16, 2015. See www.federalreserve.gov/newsevents/press/monetary/20151216a.htm.

Williamson, Stephen D. "Monetary Policy Normalization in the United States." Federal Reserve Bank of St. Louis *Review,* 2015, Vol. 97, No. 2, pp. 87-108. See https://research.stlouisfed.org/publications/review/2015/q2/Williamson.pdf.

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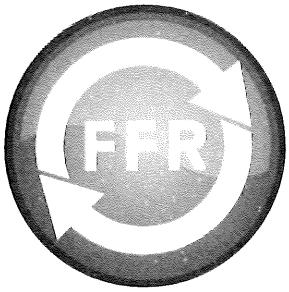


A New Frontier: Monetary Policy with Ample Reserves

Scott A. Wolla, Ph.D., Economic Education Coordinator

GLOSSARY

Arbitrage: The simultaneous purchase and sale of a good in order to profit from a difference in price.

Balance sheet: A statement of the assets and liabilities of a firm or individual at some given time.

Federal funds rate (FFR): The interest rate at which a depository institution lends funds that are immediately available to another depository institution overnight.

Federal Open Market Committee (FOMC): A committee created by law that consists of the seven members of the Board of Governors; the president of the Federal Reserve Bank of New York; and, on a rotating basis, the presidents of four other Reserve Banks. Nonvoting Reserve Bank presidents also participate in FOMC deliberations and discussion.

Liquidity: The quality that makes an asset easily convertible into cash with relatively little loss of value in the conversion process.

Monetary policy: Central bank actions involving the use of interest rate or money supply tools to achieve such goals as maximum employment and stable prices.

Open market operations: The buying and selling of government securities through primary dealers by the Federal Reserve in order to influence the money supply.

Stimulus: Actions taken by a government or a central bank that are intended to encourage economic activity and growth.

> "Consistent with its statutory mandate, the Committee seeks to foster maximum employment and price stability. In support of these goals, the Committee decided to maintain the target range for the federal funds rate at 2-1/4 to 2-1/2 percent."
> —FOMC Statement, March 20, 2019[1]

Introduction

The Federal Reserve is the central bank of the United States. Its dual mandate from Congress is to promote maximum employment and price stability. To achieve this mandate, the Federal Reserve conducts monetary policy by influencing market interest rates. However, the means by which the Federal Reserve influences interest rates have changed over time.

Influencing the Economy through the Federal Funds Rate

For decades prior to 2008, the Federal Reserve's **Federal Open Market Committee (FOMC)** would adjust monetary policy to match economic conditions by raising or lowering its target for the **federal funds rate (FFR)**, the rate that banks charge each other for overnight loans.[2] The Fed can influence the general cost of borrowing through this one rate because, although short-term interest rates differ from each other, they are closely linked.[3] If one short-term rate gets much below others, financial institutions will tend to borrow in that market and lend where rates are higher. This tendency puts upward pressure on the lower rate and downward pressure on the higher rate—keeping rates linked. This is known as **arbitrage**, an important aspect of the way financial markets, and monetary policy, work. So, by influencing one rate—the FFR—the Federal Reserve can influence other short-term rates, which affect longer-term interest rates, consumer and producer decisions, and ultimately the level of employment and inflation in the U.S. economy (Figure 1).

Monetary Policy with Scarce Reserves

Prior to September 2008, the Federal Reserve primarily bought and sold relatively small quantities of Treasury securities in the open market, termed **open market operations**, to adjust the level of bank reserves and thereby influence the FFR. Bank reserves are the sum of cash that banks hold in

Figure 1
Transmission of Monetary Policy

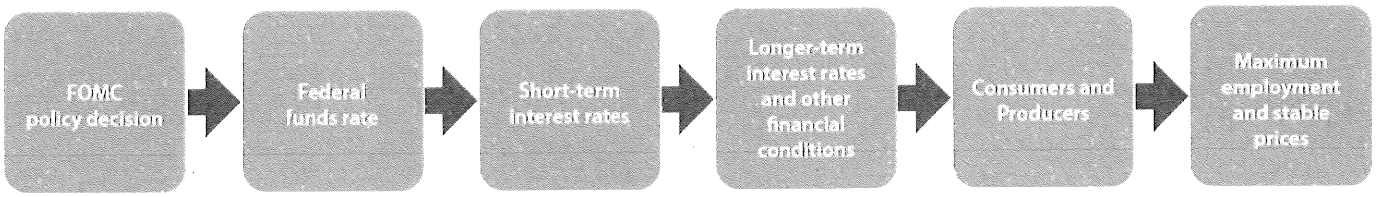
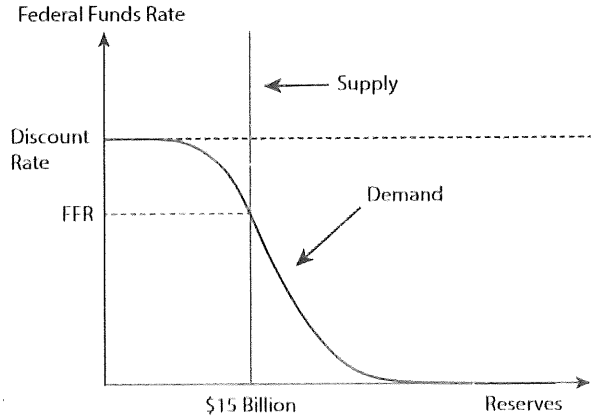


Figure 2
Monetary Policy with Scarce Reserves



The supply of bank reserves is vertical because the supply of reserves collectively held by the banking system is determined by the Federal Reserve.* When reserves are scarce, the Federal Reserve can shift the supply curve to the right or left by adding or subtracting reserves from the banking system using open market operations. The intersection of supply and demand determines the FFR.

When the supply curve was in the downward-sloping region of the demand curve, relatively small shifts in supply had a significant effect on the FFR. The Trading Desk at the Federal Reserve Bank of New York used open market operations to fine-tune the supply of reserves to achieve the target FFR set by the FOMC. This fine-tuning was done by selling or purchasing securities to shift the reserve supply curve left or right.

*More precisely, a central bank, such as the Federal Reserve, determines a country's "monetary base," which is the sum of currency held by the public plus total bank reserves. The monetary base equals the value of the central bank's assets. But, conditional on the public's choice of how much currency to hold, the choice of the monetary base pins down total bank reserves.

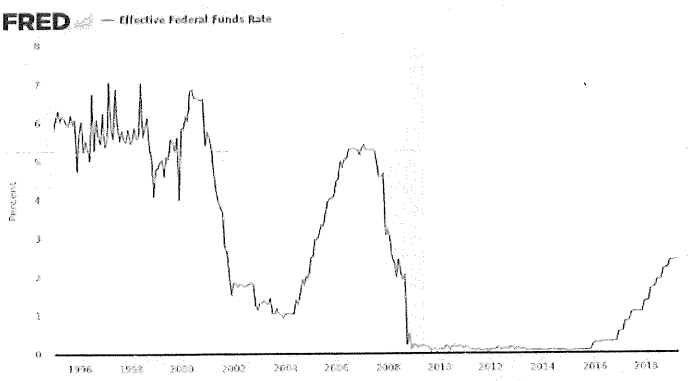
their vaults and the deposits they maintain at Federal Reserve Banks. Reserves fall into two categories. First, banks hold *required reserves*, funds that must be held as vault cash or deposits at a Federal Reserve Bank.[4] And banks can also hold *excess reserves*, funds held as vault cash or deposits at a Federal Reserve Bank in excess of required reserves. Banks had long argued that because they had to hold required reserves, these reserves were a tax because the Fed did not pay interest on these holdings. Absent the requirement, banks could lend or invest those reserves to earn interest. As a result, banks maintained required reserves, but minimized excess reserves, preferring to earn interest by lending or investing the funds. And, because reserves were scarce, Banks frequently had to borrow in the federal funds market (paying the FFR) to ensure they were meeting their overnight reserve requirements.

In that framework, the Federal Reserve could raise or lower the FFR by making relatively small changes to the supply of reserves (Figure 2). For example, the Fed could increase reserves by buying Treasury securities on the open market and crediting the accounts of the seller with reserves as payment. A greater quantity of reserves shifted the reserves supply curve to the right and put downward pressure on the FFR. And a lower FFR tended to put downward pressure on other interest rates in the economy.

Likewise, the Fed could decrease reserves by selling Treasury securities on the open market and debiting the accounts of buyers. As the supply of reserves decreased, it shifted the reserves supply curve to the left and put upward pressure on the FFR. And as the FFR increased, so did other interest rates.

The Federal Reserve used these policies to achieve its dual mandate. For example, the Fed could increase reserves to decrease the FFR and other interest rates, thereby encouraging economic activity when the economy was in recession (to achieve its maximum employment objective). Or, it could reduce reserves to increase the FFR and other interest rates in an attempt to restrain spending when inflation exceeded its 2 percent inflation objective (to achieve its price stability objective). The Trading Desk of the Federal Reserve Bank of New York conducted open market operations, as needed, to maintain the FFR very near the FOMC's target rate (Figure 3).

Figure 3
Monetary Policy Prior to 2008: The FFR Target

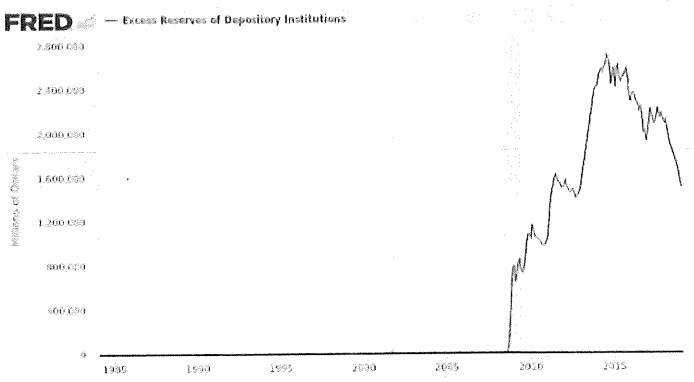


The FOMC's FFR target has varied widely in response to economic conditions. Prior to 2008, the FOMC set a single target for the FFR and used open market operations to move the rate toward its target.

NOTE: Gray bars indicate recessions as determined by the National Bureau of Economic Research (NBER).

SOURCE: FRED®, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/graph/?g=n3lM, accessed February 22, 2019.

Figure 4
Excess Reserves



NOTE: Gray bars indicate recessions as determined by the NBER.

SOURCE: FRED®, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/graph/?g=mc6A , accessed February 22, 2019.

The Financial Crisis

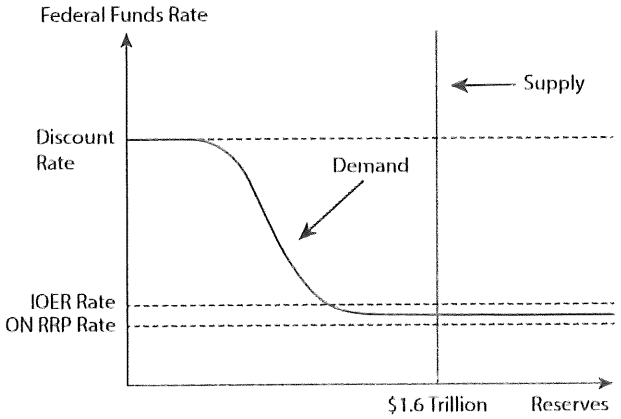
The Financial Crisis and resulting recession, known as the Great Recession, hit the U.S. economy hard. By December 2008, the Federal Reserve had lowered the FFR to a target rate range of 0 to 25 basis points.[5] Then, to provide further **stimulus** and **liquidity**, the Federal Reserve made a series of large-scale asset purchases between late 2008 and 2014.[6] The primary purpose of these purchases was to lower long-term interest rates to encourage consumption and investment. The purchases, which were also open market operations, increased the size of the Fed's **balance sheet** and also dramatically increased the amount of reserves in the banking system. In addition, over the course of the crisis, the Fed introduced two new tools to U.S. monetary policy: interest on reserves (IOR) and the overnight reverse repurchase agreement (ON RRP) facility. (See the table for a list of monetary policy acronyms.)

Congress had enacted IOR in 2006, with an originally scheduled start in 2011. To enable the Fed to use this tool during the Financial Crisis, the start was pushed up to October 2008, and it applied to both required reserves (paying interest on required reserves, or IORR) *and* excess reserves (paying interest on excess reserves, or IOER).[7] IORR eliminates the implicit tax on reserves requirements. And, because the IOER rate influences banks' decision to hold more or fewer reserves, it gives the Fed an additional tool for conducting monetary policy.[8] Prior to the summer of 2008, excess reserves had not exceeded $2 billion; by December 2008 they reached $767 billion, eventually peaking near $2.7 trillion in August 2014 (Figure 4) because of the large-scale asset purchases by the Fed over this period.

Monetary Policy Acronyms	
Federal funds rate	FFR
Federal open market committee	FOMC
Interest on reserves	IOR
Interest on required reserves	IORR
Interest on excess reserves	IOER
Overnight reverse repurchase agreement	ON RRP

The second new tool of monetary policy is the ON RRP facility: When an institution uses the ON RRP facility it essentially deposits reserves at the Fed overnight (with a U.S. government security from the Federal Reserve's portfolio acting as collateral) and earns interest (the ON RRP rate) on the deposit.[9] This is similar to a consumer buying a certificate of deposit, holding it for a specified time, and being paid interest when it is redeemed. The purpose of the ON RRP facility is to set a floor on interest rates.

Figure 5
Monetary Policy with Ample Reserves



In a world with ample reserves, the Federal Reserve operates where the following are true:

(i) The demand curve is flat and near the IOER rate.

(ii) The supply of reserves is ample and far to the right of the origin, intersecting demand on the flat portion of the curve. As such, making slight adjustments to the supply of reserves no longer puts upward or downward pressure on the FFR and instead the FFR is guided by the IOER rate as well as the ON RRP rate.

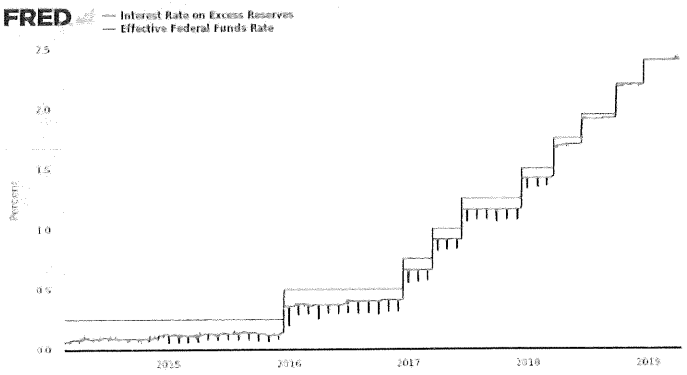
The Current Framework: Monetary Policy with Ample Reserves

Although the quantity of excess reserves has been declining since its peak in 2014, reserve balances are currently far in excess of banks' reserve requirements and the FOMC has indicated that it will in the longer-run conduct policy with ample reserves. With such a large quantity of reserves in the banking system, the Federal Reserve can no longer effectively influence the FFR by small changes in the supply of reserves. For example, a relatively small increase in reserves will not lower interest rates, nor will a relatively small reduction in reserves raise short-term interest rates (Figure 5). Instead, the Fed uses its newer tools—IOER and the ON RRP facility—to influence the FRR and short-term interest rates more generally.

IOER

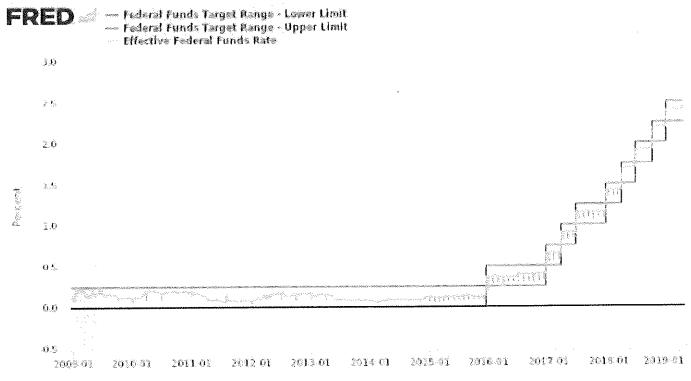
The IOER rate offers a safe, risk-free investment option to banks holding reserves at the Fed. Given this rate, banks will not lend reserves in the market for less than the IOER rate. Arbitrage plays a key role in steering the federal funds toward the target. For example, if the FFR falls very far below the IOER rate, banks have an incentive to borrow in the federal funds market and to deposit those reserves at the Fed, earning a profit on the difference.

Figure 6
Interest on Excess Reserves



SOURCE: FRED®, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/graph/?g=mXVq, accessed February 22, 2019.

Figure 7
Monetary Policy with Ample Reserves



The FFR target is now communicated as a range 25 basis points wide rather than a single rate.

NOTE: Gray bar indicates recession as determined by the NBER.

SOURCE: FRED®, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/graph/?g=n3lV, accessed February 22, 2019.

This tends to pull the FFR in the direction of the IOER rate (Figure 6). As such, to conduct monetary policy, the Federal Reserve moves the FFR into the target range set by the FOMC primarily by adjusting the IOER rate.[10] But not every financial institution can hold reserves with the Fed.

ON RRP Facility

More types of financial institutions can participate in the ON RRP program than can earn interest on reserves. These institutions use the facility's rate to arbitrage other short-

term rates. In particular, because these institutions will never be willing to lend funds for lower than the ON RRP rate, the FFR will not fall below the ON RRP rate. As such, the rate paid on ON RRP transactions acts as a floor for the FFR.

FFR Range

Rather than setting a single target for the FFR, the target is now communicated as a range 25 basis points wide. As stated above, the IOER rate and ON RRP rate are used to guide the FFR within the target range (Figure 7).

Despite the recent changes, the FFR will continue to be the primary means of adjusting the stance of monetary policy.[11] And the transmission channels are the same—the FFR influences other interest rates in the economy, which influence the decisions of consumers and producers (see Figure 1). To conduct monetary policy, the FOMC increases or decreases the target range in a manner consistent with its policy goals of price stability and maximum employment.[12]

Conclusion

When reserves were scarce, the Federal Reserve could influence the FFR with small changes in the supply of reserves by conducting open market operations that would shift the supply curve to the right (increasing reserves) or left (decreasing reserves). In the past few years, the Federal Reserve has adopted a new strategy for implementing monetary policy. With ample reserves in the banking system, the Fed now sets a target range for the FFR and uses the rates on IOER and the ON RRP facility to keep the FFR rate in the FOMC's target range. ■

Notes

[1] Board of Governors of the Federal Reserve System. "FOMC Statement." March 20, 2019; https://www.federalreserve.gov/newsevents/pressreleases/monetary20190320a.htm.

[2] In 2008, as the FFR neared zero, the FOMC began to implement monetary policy primarily through purchases of long-term bonds to reduce long-term interest rates, a strategy commonly (but inaccurately) known as "quantitative easing." Such purchases are one type of "unconventional" monetary policy. The FOMC supplemented this strategy with "forward guidance" to financial markets. The FFR remained near zero until December 2015.

[3] Short rates can differ because of several factors: the duration of the loan, the credit worthiness of the borrower, and whether collateral is required/available.

[4] Although legal reserve requirements still exist, in practice, financial innovation in the 1990s had enabled banks to avoid nearly any obligation to hold reserves.

[5] A basis point is 1/100th of 1 percent. It is used chiefly to express differences in interest rates. For example, an increase in a particular interest rate of 0.25 percent can be described as an increase of 25 basis points.

[6] Board of Governors of the Federal Reserve System. "What Were the Federal Reserve's Large-Scale Asset Purchases?" https://www.federalreserve.gov/faqs/what-were-the-federal-reserves-large-scale-asset-purchases.htm.

[7] Board of Governors of the Federal Reserve System. "Interest on Required Reserve Balances and Excess Balances." https://www.federalreserve.gov/monetarypolicy/reqresbalances.htm.

[8] Board of Governors of the Federal Reserve System. See footnote 7.

[9] Federal Reserve Bank of New York. "Reverse Repo Counterparties." https://www.newyorkfed.org/markets/rrp_counterparties

[10] Board of Governors of the Federal Reserve System. See footnote 7.

[11] Board of Governors of the Federal Reserve System. "FOMC Communications Related to Policy Normalization." https://www.federalreserve.gov/monetarypolicy/policy-normalization.htm.

[12] Board of Governors of the Federal Reserve System. See footnote 11.

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The Fed's "Ample-Reserves" Approach to Implementing Monetary Policy

Jane Ihrig, Zeynep Senyuz, and Gretchen C. Weinbach*

February 19, 2020

Abstract

We describe the Federal Reserve's (the Fed's) approach to implementing monetary policy in an ample-reserves regime. We use a stylized model to explain the factors the Fed considers and the tools it uses to ensure interest rate control when the quantity of reserves is ample. Then, we take a close look at the Fed's experience operating in this regime in the post-crisis period, both as it has raised and lowered its policy rate. Looking ahead, we highlight some considerations relevant for maintaining a level of reserves consistent with the efficient and effective implementation of monetary policy, and conclude with an overview of the benefits of an ample-reserves regime. This primer is intended to enhance discussions and understanding of the Fed's actions and communications regarding monetary policy implementation, as many resources on this topic may be out of date given the recent evolution of the policy environment.

Keywords: Monetary policy implementation, reserve balances, ample-reserves regime, administered rates, interest on reserves, open market operations
JEL: E58, E52, E43

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1. Introduction

The Federal Open Market Committee's (FOMC) primary means of achieving its dual mandate of maximum employment and stable prices is to set the target range for its policy rate—the federal funds rate—and communicate any expected changes in the near-term path of that rate.[1] Adjustments to the target range, when combined with careful policy communications and transparent policy strategy, transmit to other short-term interest rates and set off a chain of broader influences on financial conditions, making them more or less accommodative of economic growth. But how does the Federal Reserve (the Fed) ensure that adjustments in the target range for its policy rate affect the market-determined federal funds rate and other short-term rates? It does so through careful attention to monetary policy *implementation.*

In January 2019, the FOMC communicated its intention to continue implementing monetary policy in a regime with an ample supply of reserves.[2] This decision was reached following more than a decade of successful policy implementation in an environment with plentiful reserves in the banking system. In this regime, when the FOMC wants to adjust the stance of policy, it moves the target range for the federal funds rate up or down and communicates information about the range to the public. To implement a corresponding change in market rates, the Fed adjusts its administered interest rates. Together these steps affect the market-determined federal funds rate and other overnight market interest rates. In contrast to the Fed's previous implementation regime, in which the quantity of reserves was substantially less plentiful (and thus termed "limited," or sometimes "scarce"), the Fed is not required to

[1] The Federal Reserve Act directs the Board of Governors and the FOMC to conduct monetary policy "so as to promote effectively the goals of maximum employment, stable prices, and moderate long-term interest rates." Because long-term interest rates remain moderate in a stable economy with low expected inflation, this set of goals is often referred to as the "dual mandate" of maximum employment and price stability.

[2] The FOMC's announcement may be found on the Federal Reserve Board's web site at the following link: https://www.federalreserve.gov/newsevents/pressreleases/monetary20190130c.htm.

implementation regime and reminds the reader of some key takeaways about its use going forward.

2. Policy implementation with ample reserves

The Fed implements monetary policy with the aim of keeping the federal funds rate in the FOMC's target range.[4] The federal funds rate (FFR) is the interest rate at which depository institutions, or what we term "banks," borrow reserves from and lend reserves to one another on an overnight basis to meet short-term funding needs.[5] To understand how the Fed implements policy, it is easiest to consider a stylized model of the demand for and supply of reserves.

2.1 Banks' demand for reserves

Banks may hold a portion of their cash in an account at the Fed; these funds are referred to as reserve balances, or reserves. One can think of banks' reserve accounts in much the same way as households' checking accounts. Just as individuals use the cash in their checking and other transactional accounts to facilitate their deposit and payment activities, banks use reserves in managing their liquidity needs. Unlike other liquid assets, reserve balances are immediately available throughout the day to make payments for lending, securities settlement, meeting deposit outflows, and for other intermediation activities.

There are many reasons for banks to demand reserves. Before the crisis, banks' demand was largely driven by the Fed's reserve requirements and banks' intraday payment needs. Today, a host of additional factors come into play. First, the Fed now pays interest on reserves,

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[4] The Fed actually seeks to keep the daily "effective" FFR in the target range. The effective FFR is the volume-weighted median rate of all overnight federal funds transactions that occurred on a given day. These data, published daily, may be found on the Federal Reserve Bank of New York's web site here: https://apps.newyorkfed.org/markets/autorates/fed%20funds.

[5] We use the term "banks" throughout to refer to depository institutions, which include commercial banks, savings banks, credit unions, thrift institutions, and most U.S. branches and agencies of foreign banks.

actively manage, or frequently adjust, the supply of reserves to maintain interest rate control. The ample-reserves regime provides good control of the federal funds rate in a simple and efficient manner and enables effective transmission of the stance of policy to broader financial markets. Moreover, this regime has proven resilient to significant changes in the monetary and regulatory environments since the Global Financial Crisis of 2007-09.[3]

In this paper, we describe the Fed's "ample reserves" approach to implementing monetary policy, review its experience operating in this regime, and highlight some operational issues it may face on the path forward. This information is intended to enhance discussions and understanding of the Fed's actions and communications related to monetary policy implementation. In particular, the material may be used to supplement textbooks and other existing learning materials that may be out of date in their descriptions of how the Fed implements monetary policy when reserve supply is considered ample.

The rest of the paper proceeds as follows. Using a stylized demand and supply framework, we begin in section 2 by describing the roles of banks and the Fed in influencing reserves. We then describe how an "ample" quantity of reserves is determined and how the Fed controls the federal funds rate when the quantity of reserves is ample, including the basic mechanics of the tools the Fed uses in this operating regime. In section 3, we take a close look at the Fed's experience using this regime, and discuss the technical adjustments the Fed has implemented to ensure interest rate control. Turning to section 4, we describe some operational considerations the Fed may encounter as it seeks to maintain an ample quantity of reserves over time. Finally, section 5 concludes by highlighting the benefits of the FOMC's chosen

[3] For an overview of these changes and an analysis of their effects on money markets, see Klee, Senyuz, and Yoldas (2019).

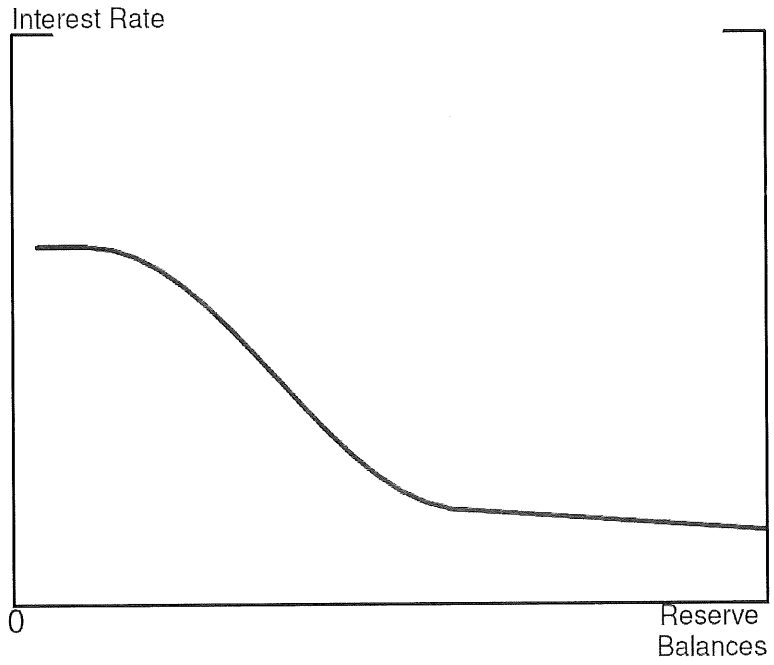
and so holding these balances has become more attractive. Second, in response to the financial crisis, banks have enhanced their internal liquidity risk management practices, taking into account their individual business models and liquidity preferences, and reserves are useful for this purpose. Third, banks may hold reserves to help meet several post-crisis regulatory liquidity standards created in part to enhance banks' self-sufficiency in times of financial stress, such as resolution planning and the liquidity coverage ratio. Finally, some changes in the federal funds market since the financial crisis have also boosted banks' demand for reserves. In particular, late-day trading conditions are less liquid and banks are more hesitant to tap intraday or other credit from the Fed. Taken together, the mix of factors influencing banks' demand for reserves today is complex and also likely to continue to evolve over time.[6]

Figure 1 provides a stylized illustration of a demand curve for reserves. This downward-sloping curve has two portions. The steep portion of the curve captures the idea that the higher the opportunity cost of holding reserve balances, the lower is banks' demand. Conversely, as the cost of overnight borrowing in the federal funds market falls, banks are generally inclined to hold more reserves to provide themselves with an extra liquidity cushion. On this steep portion of the curve, banks' demand is quite sensitive to changes in reserve supply; the rate at which these funds are traded, the federal funds rate, adjusts with even modest changes in reserve supply. The demand curve also has a nearly flat, or flat, portion, located where the quantity of reserves in the banking system is significantly larger. The transition from the steep portion of the curve to the nearly flat portion illustrates that as the quantity of reserves in the banking system increases, at

[6] Beginning in September 2018, the Federal Reserve has periodically conducted a *Senior Financial Officer Survey* to ask individual banks about their reserve balance management practices, including the importance of various factors in driving their reserve demand. In August 2019, banks responded that meeting routine intraday payment flows and satisfying internal liquidity stress metrics were very important factors in determining their demand for reserves. A summary of the results of each survey is published on the Federal Reserve Board's web site, available at the following link: https://www.federalreserve.gov/data/sfos/sfos.htm. In addition, Logan (2019a) discusses banks' demand for reserves.

some point, banks do not find much benefit from holding additional reserves other than earning the interest the Fed pays on these balances. As a result, and as we'll see below, the demand curve flattens out at a level that is close to the interest rate earned on reserve balances. On the flat portion of the curve, banks' demand is not sensitive to changes in reserve supply; the federal funds rate does not materially move when supply is adjusted either up or down.

Figure 1
Banks' Demand for Reserves



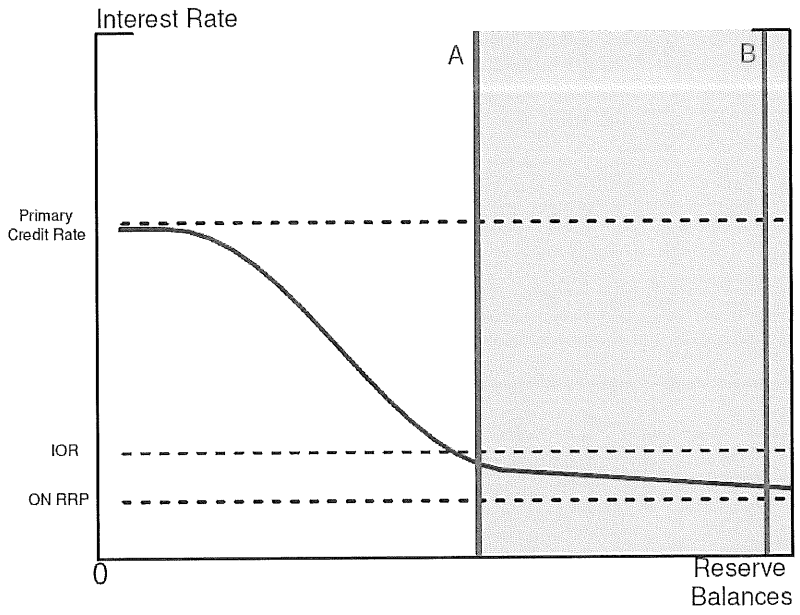
2.2 The Fed's supply of reserves

Many factors that affect the supply of reserves. Some influences are independent of the Fed's control, termed autonomous factors, and others are directly related to the Fed's actions, termed open market operations. Because the Fed understands how autonomous factors affect the supply of reserves, it can choose what operations to take, if any, in response. As a result, one should think of the Fed as controlling the supply of reserves in the banking system.

So what quantity of reserves must the Fed supply to be in an ample-reserves regime? The term "ample" is fundamentally tied to the location of the Fed's supply curve relative to banks' demand curve. In particular, to be ample, the Fed's reserve supply must be positioned so that the equilibrium FFR does not materially change with movements in the quantity of reserves in the banking system. This condition is met when the Fed's supply curve intersects banks' demand curve on the portion of the demand curve that is nearly flat.

Figure 2 illustrates the Fed's ample-reserves regime. The red supply curves are vertical because the Fed controls the level of reserves. To be in an ample reserves-regime, the quantity

Figure 2
The Fed's Ample-Reserves Regime



of reserves must be at least as large as the (stylized) quantity labeled "A"—reserve supply must fall in the gray shaded region. In this region, any supply curve will intersect the demand curve at its relatively flat portion, meeting the condition for being in an ample regime. While the quantity labeled "A" represents the minimum level of reserves needed to be in an ample-reserves regime,

the quantity "B" represents a super plentiful amount of reserves, and one that is also consistent with being in an ample regime.

An important takeaway from figure 2 is that the stylized gray region is very wide. An ample-reserves regime functions well with a wide range of reserve levels in the banking system, such as a quantity near, or even greater than, vertical line "B," as well as a quantity that is significantly smaller, such as closer to vertical line "A," or with any reserve quantity in between.

Over the past several years, the quantity of reserves supplied by the Fed has moved widely within this gray range. During the period from late 2008 to late 2014, the Fed conducted a series of large-scale purchases of longer-term securities to put downward pressure on longer-term interest rates in response to the Great Recession that severely weaken the U.S economy. When the Fed completed these purchases, reserves stood at a peak of $2.8 trillion, or 15 percent of U.S. nominal GDP.[7] At this time, the vertical supply curve was essentially near "B," a quantity sometimes referred to as "abundant" or "super abundant."[8] Then, as the economy recovered, the Fed took steps to reduce the supply of reserves. Between late 2014 and August 2019, reserves slowly declined, on balance, and at the end of this period, they stood near $1.5 trillion, a quantity much closer to "A." So at what approximate quantity of reserves might the Fed prefer to operate in the long run?

In January 2019, the FOMC announced its plans for implementing monetary policy over the longer run. The Committee described its choice of implementation regime this way:[9]

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[7] A summary of the Fed's purchase programs may be found on the Federal Reserve Board's web site at this link: https://www.federalreserve.gov/monetarypolicy/bst_openmarketops.htm. In addition, see Bernanke (2012) for a broader discussion of the Fed's response to the crisis.

[8] See Yellen (2017) for a discussion of the role of reserves in the policy implementation framework, both when reserves were relatively limited and when they were characterized as abundant.

[9] The FOMC's announcement may be found on the Federal Reserve Board's web site at the following link: https://www.federalreserve.gov/newsevents/pressreleases/monetary20190130c.htm.

> The Committee intends to continue to implement monetary policy in a regime in which an ample supply of reserves ensures that control over the level of the federal funds rate and other short-term interest rates is exercised primarily through the setting of the Federal Reserve's administered rates, and in which active management of the supply of reserves is not required.

With this announcement, the Committee communicated that it will not return to its pre-crisis implementation regime. In that limited-reserves regime, the Fed supplied an amount of reserves well to the left of vertical line "A" in figure 2; it operated on the steep portion of banks' demand curve where even modest changes in the supply of reserves affect the equilibrium level of the FFR. In addition, characterizing the desired supply of reserves as "ample" signaled that the Committee does not want to operate in the long run with a super plentiful amount of reserves, such as one depicted as being closer to vertical line "B." This indication is also tied to the Committee's previously stated intention that the Fed will, in the longer run, hold no more securities than necessary to implement monetary policy efficiently and effectively.[10] Thus, taking the pieces together, the Committee's announcement indicated that, going forward, the Fed will keep supplying a quantity of reserves in the gray region, and that the quantity will be closer to the vertical line labeled "A" than "B." With this framing, we now turn to how the Fed controls the FFR when the quantity of reserves in the banking system is in the gray region.

2.3 Rate control tools

When implementing monetary policy in an ample-reserves regime, the Fed primarily relies on its administered interest rates to keep the FFR within its target range. But it also

[10] Holding other parts of the Fed's balance sheet constant, an increase (decrease) in securities will increase (decrease) reserves. So a statement about "holding no more securities than necessary" is also saying the Fed plans to hold no more reserves than necessary to implement policy efficiently and effectively. Information about the Federal Reserve's Policy Normalization Principles and Plans is summarized on the Federal Reserve Board's web site at the following link: https://www.federalreserve.gov/monetarypolicy/policy-normalization-discussions-communications-history.htm.

periodically needs to adjust the quantity of reserves in the banking system, using open market operations, to maintain an ample supply. We describe each of these rate control tactics in turn.

Administered rates

Administered rates are standing interest rates the Fed sets, or administers. Currently, the Fed predominantly relies on two such interest rates. Each rate is available to a specific set of counterparties on particular cash deposits held at the Fed. The counterparties can decide if they want to deposit their cash at the Fed and earn the relevant standing rate or lend it instead to another market participant at a negotiated rate in one of the various money markets for cash. One can think of the Fed's administered rates as reservation rates—they set a lower bar on the return a counterparty is willing to accept from others in money markets. Hence, movements in the Fed's administered rates directly help steer money market interest rates.

The Fed's key administered rate is the interest on reserves (IOR) rate, the rate that banks earn from the Fed on the funds they deposit in their reserve accounts.[11] When choosing whether to hold some cash in their accounts at the Fed and earn the IOR rate or invest the cash in another money market instrument, such as Treasury bills, banks mainly consider their liquidity needs and the relative returns available on alternative investments. With the payment of IOR, banks have little or no incentive to lend reserves at rates lower than IOR, which is reflected in the flattening out of banks' reserve demand curve near the IOR rate (see figure 2). In this sense, the IOR rate acts as a reservation rate in banks' intermediation activities, helping to establish a minimum, or a

[11] Technically, the Fed pays interest on two different components of reserves—required reserves, tied to the Fed's reserve requirements as specified in Regulation D, and excess reserves, balances that are above the level of reserves banks are required by the Fed to hold. Under authority from Congress granted in the Financial Services Regulatory Relief Act of 2006 and the Emergency Economic Stabilization Act of 2008, the Board of Governors directed the Federal Reserve Banks to pay interest on required reserve balances and on excess balances, and these two rates are currently set equal. For simplicity, we use "IOR rate" to refer to the single rate at which the Federal Reserve Banks pay interest on all reserve balances.

floor, under the various overnight market returns that banks consider. In addition, as long as the supply of reserves remains ample, banks should compete with each other so that lending in the federal funds market occurs at rates that are never too far above the IOR rate. As a result, in an ample reserves regime, the FFR is expected to trade near the IOR rate. While it can be modestly above or below the IOR rate depending on seasonal factors and market conditions, the incentives described above combine to prevent the FFR from drifting away from the IOR rate. Because of the close linkage between the IOR rate and the FFR, the IOR rate is the Fed's primary tool of policy implementation—for keeping the FFR in its target range.

In addition to banks, various nonbank institutions actively participate in U.S. money markets, and these institutions are not eligible to earn IOR. For example, government-sponsored enterprises account for the majority of lending in the federal funds market since the financial crisis, and they often lend excess cash at rates below IOR. As a result, IOR by itself is unable to set a firm floor under the constellation of overnight money market rates. To enhance its rate control, the Fed introduced a supplementary tool, the standing overnight reverse repurchase (ON RRP) facility, to influence the interest rates at which nonbanks lend cash in money markets. The Fed began testing this form of open market operation in September 2013 and employed the facility when the FOMC first raised interest rates following the crisis in December 2015.[12]

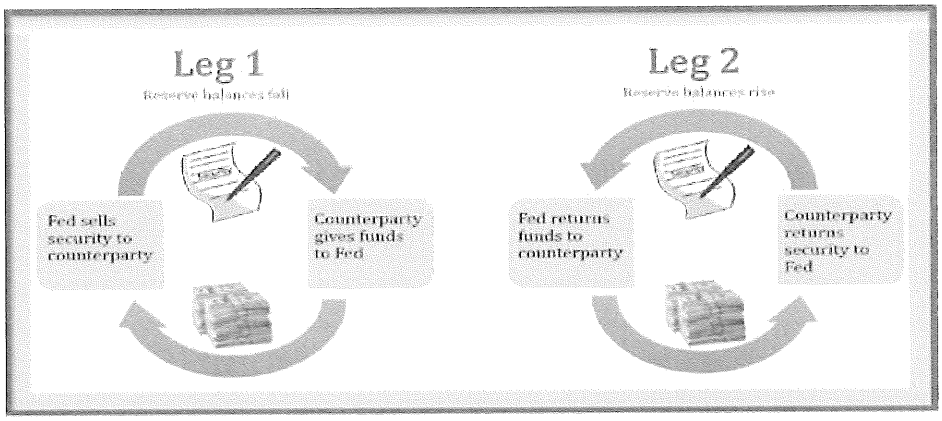
The FOMC sets the facility's offering rate (ON RRP rate), the maximum interest rate the Fed is willing to pay in an ON RRP transaction.[13] Figure 3 illustrates a reverse repurchase

[12] The Fed introduced the ON RRP facility in September 2013 and conducted test operations through late 2015. In September 2014, the FOMC indicated that it intended to use the facility as needed to help control the federal funds rate. For more information, see the Federal Reserve Board's and the Federal Reserve Bank of New York's web sites at these links, respectively: https://www.federalreserve.gov/monetarypolicy/overnight-reverse-repurchase-agreements.htm; https://www.newyorkfed.org/markets/rrp_faq.html.

[13] The interest rate a counterparty receives is the facility's offering rate except in the highly unlikely event that the amount of propositions the Fed receives exceeds the amount of securities available for the operation. In that case, the interest rate would be determined by an auction process conducted by the Federal Reserve Bank of New York, as described in the FAQs available at the following link: https://www.newyorkfed.org/markets/rrp_faq.html.

agreement (or reverse repo, or RRP) transaction between the Fed and one of its counterparties, and notes its effect on reserves. In the first leg of the transaction, the counterparty deposits its cash in the Fed's ON RRP facility and the Fed recognizes that some of its Treasury securities are temporarily sold to the counterparty. With this step, reserve supply declines by the amount of cash deposited in the Fed's facility. On the second day, or leg 2, the transaction is unwound, with the Fed returning to the counterparty their cash deposit plus interest earned, and with the interest tied to the ON RRP transaction rate. In addition, the temporary sale of the Treasury securities is unwound, and reserve supply increases. Given the nature of this transaction, take-up of the Fed's ON RRPs constitutes a type of open market operation.

Figure 3
Illustration of a Reverse Repo (RRP) Transaction



The ON RRP facility is available to about 130 counterparties. Many of these counterparties, including money market funds, government-sponsored enterprises, in addition to banks, are very active in money markets.[14] Because of the possibility of doing reverse repo with the Fed at its standing offering rate, these market participants have little incentive to lend cash to

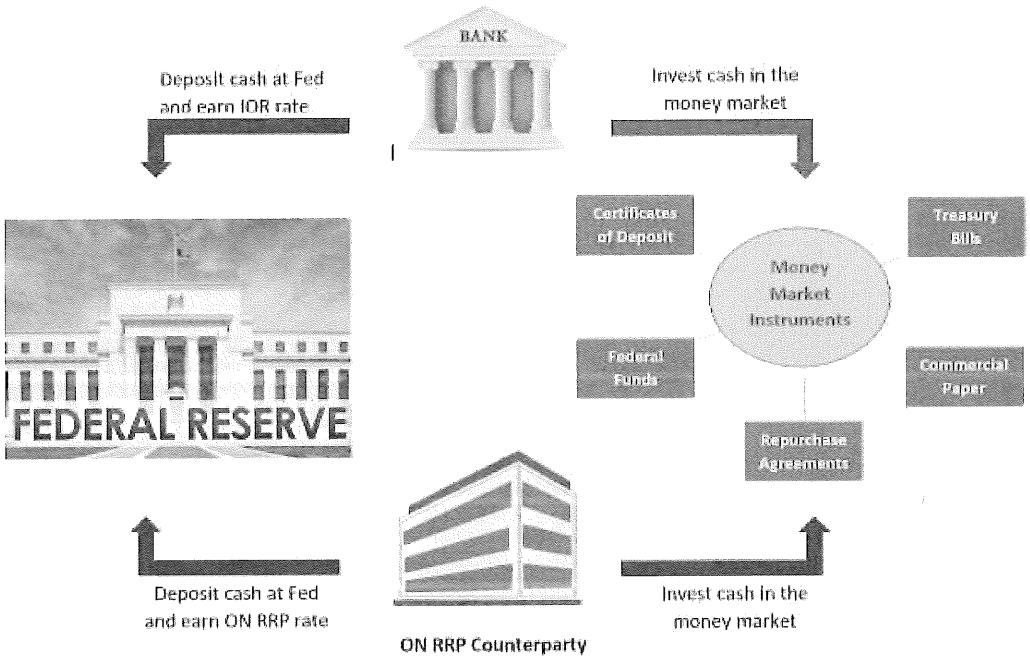
[14] For more on how the ON RRP facility complements the use of IOR and helps control short-term interest rates, including some issues the Fed considered in its design, see Frost et al. (2015).

others at a lower rate. Thus, for these counterparties, the ON RRP facility's offering rate plays a role similar to that of the IOR rate for banks—the ON RRP rate acts as a reservation rate in money market investment and cash management decisions, helping to put a floor under the various overnight market rates that these institutions consider, regardless of whether these counterparties actually use the Fed's facility on any given day or not. So while it's true that when take-up at the ON RRP facility rises, reserves decline (all else equal), the primary purpose of the facility is not to adjust reserve supply but to directly influence short-term interest rates faced by nonbanks.

Figure 4 illustrates how the Fed's IOR and ON RRP rates act as reservation rates for the Fed's counterparties—providing standing options for a range of money market participants when they consider investing their cash in various money market instruments or with the Fed.

Figure 4

The Fed's Administered Rates act as Reservation Rates



The Fed adjusts these administered rates in concert with changes in the target range for its policy rate, and its counterparties use the new levels of these reservation rates in their evaluation of where to invest cash. This dynamic allows the Fed to achieve the FOMC's desired stance of policy.[15] And, importantly, this approach to interest rate control does not require the Fed to frequently adjust the quantity of reserves in the banking system. But how does the Fed ensure the quantity of reserves remains ample over time?

Open market operations (OMOs)

Open market operations, or OMOs—purchasing or selling securities in the open market—are a long-standing tool of policy implementation. This tool is currently used in two different ways. As we noted above, for the past several years the Fed has been using an ON RRP facility designed to directly influence short-term *interest rates*. In addition, for decades, the Fed has used OMOs to alter the *quantity* of reserves it supplies—to purposefully expand or contract the amount of reserves in the banking system.[16] The latter type of OMOs, designed to adjust reserve quantities, is specifically used by the Fed to maintain an ample level of reserves in the banking system. As discussed above, to be in an ample-reserves regime, the Fed needs to maintain a quantity of reserves that is in the gray shaded region in figure 2, one that is at least as large as the (stylized) quantity "A." And, in so doing, the Fed must account for the effects of autonomous factors on the supply of reserves.

As noted in section 2.2, the Fed monitors several autonomous factors. Highlighted in Table 1, these factors are liabilities of the Fed other than reserves and include currency in

[15] Some erroneously refer to the Fed's ample-reserves implementation regime as a "corridor" regime. The Fed's ample-reserves regime is a "floor" regime with two floor, or deposit rates: one for banks (the IOR rate) and one primarily for nonbanks (the ON RRP rate). The fact that the Fed may set the IOR rate a bit above the ON RRP rate does not reflect an intention to create a rate corridor.

[16] For more information on how various OMOs affect reserves, see Ihrig, Mize, and Weinbach (2017).

circulation, the Treasury's cash account, or General Account, at the Fed (the TGA), and outstanding reverse repo agreements (the latter includes the Fed's foreign repurchase pool and balances at the ON RRP facility). Box 1 describes each of these non-reserve liabilities and their purpose. Here we describe how these factors intersect policy implementation.

Table 1
The Fed's Liabilities: Autonomous Factors Highlighted

Fed Liability Item	Amount* ($ billions)
Currency in circulation	1,748
Reserve Balances	1,695
U.S. Treasury, General Account (TGA)	404
Reverse repurchase agreements	224
Other liabilities	73

* As of February 12, 2020.
Source: Federal Reserve Board, H.4.1 statistical release.

The levels of the Fed's non-reserve liabilities move over time, exhibiting both long-run trend growth as well as short-run fluctuations. For example, currency in circulation has grown on average about 6 percent a year, and the public's demand often temporarily expands around holidays. Each of these influences causes reserves to decline, all else equal. In addition, Treasury's account at the Fed fluctuates, sometimes substantially, including around corporate and personal tax payment dates; the movements cause aggregate reserves to fluctuate in response, in the opposite direction. In general, reserves decline dollar-for-dollar when the Fed's non-reserve liabilities increase, and vice versa. The effects on reserves from changes in the

autonomous factors reflect the fact that the activities associated with each of the Fed's non-reserve liabilities clear through reserve accounts at the Fed.[17]

Does the Fed need to respond to the effects of changes in autonomous factors on reserves? The answer is, sometimes. When currency or another non-reserve liability grows, the Fed has to decide if it wants to offset the decline in reserves by purchasing securities in the open market. The Fed will conduct a permanent OMO (buy securities and hold them to maturity) if it thinks the drain in reserves is permanent; it will conduct a temporary OMO (a repurchase agreement or repo) if it thinks the drain is temporary.[18] Either of these actions will immediately expand the supply of reserves in the banking system, shifting any supply curve in figure 2 rightward within the gray region. Whether the Fed judges it needs to undertake one of these actions or not depends on the location of the original supply curve and the size of the effect on reserve supply relative to the quantity associated with the vertical line "A" in figure 2.

The discount window and other tools

The Fed also continues to administer several interest rates that it charges to banks for loans extended through its long-standing lending programs known collectively as the discount window. The Fed typically adjusts these rates in sync with its other administered rates. The main lending program is for primary credit—overnight loans extended to banks in generally sound financial condition. The primary credit rate is typically set above the general level of

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[17] For example, when a bank requests currency for its customers, an armored truck comes to a regional Federal Reserve Bank, picks up the cash that was ordered, and delivers it to the requesting bank. The Fed decreases the ordering bank's reserve account to take payment for the cash. (These steps are similar to those that occur when you go to your bank or an ATM for cash: When you withdraw cash, your bank takes payment by debiting your bank account.)

[18] A repo (or RP) operation is the opposite of the RRP transaction shown in figure 3. When the Fed conducts a repo, it lends cash to the market, temporarily purchases a security from an eligible counterparty, and agrees to sell the security back when the term of the contract ends, receiving the lent cash back plus interest when the transaction unwinds. Each year, the Federal Reserve Bank of New York publishes an annual report of open market operations conducted during the previous year, available at the following link: https://www.newyorkfed.org/markets/annual_reports.

short-term interest rates. This rate is depicted in figure 2 as the intercept of the demand curve on the y-axis because banks should be unwilling to buy reserves at market rates that are much, if any, above the rate they can pay to borrow from the Fed. In that sense, the discount window provides a backup source of funding for banks, with pricing that is intended to discourage frequent borrowing while still providing a ceiling on short-term market rates. However, for many years, banks have demonstrated reluctance to use the discount window out of concern that borrowing from the central bank sends negative signals about their financial condition, a dynamic typically referred to as the stigma associated with the use of the discount window. The Fed also maintains other policy implementation tools, ones that are less frequently relied upon.[19]

3. How has policy implementation worked with ample reserves?

The Fed has accumulated a lot of experience implementing policy with a sizable level of reserves. Here we take a look at the Fed's experience using an ample-reserves regime, including how the Fed has adjusted its tools to maintain the FFR in the FOMC's target range.

3.1 Transmission of the policy rate to other interest rates

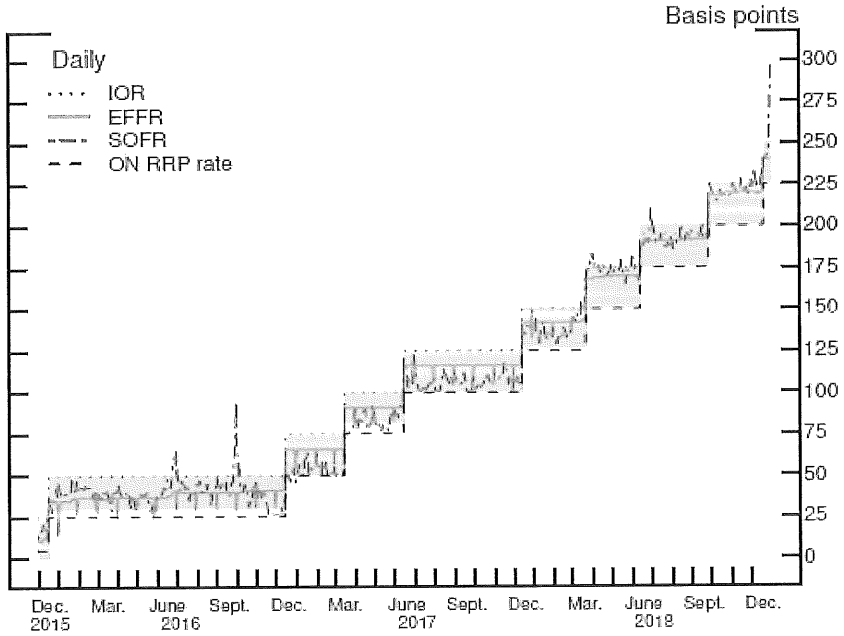
Figure 5 illustrates the movements in the Fed's administered rates and selected overnight money market rates over the most recent period of ups (panel A) and downs (panel B) in the target range, shown by the gray shaded regions. The IOR and ON RRP rates are shown by the dotted and dashed black lines, respectively. The blue solid line shows the (effective) federal funds rate, and the red dash-dotted line shows the secured overnight financing rate, or SOFR, which is a broad measure of the cost of borrowing cash overnight when collateralized by Treasury securities. Panel A begins with the first step in the Fed's process of normalizing the stance of monetary policy after the Great Recession. Specifically, in December 2015, after seven

[19] A summary of all of the Fed's policy tools can be found on the Federal Reserve Board's website. https://www.federalreserve.gov/monetarypolicy/policytools.htm.

Figure 5

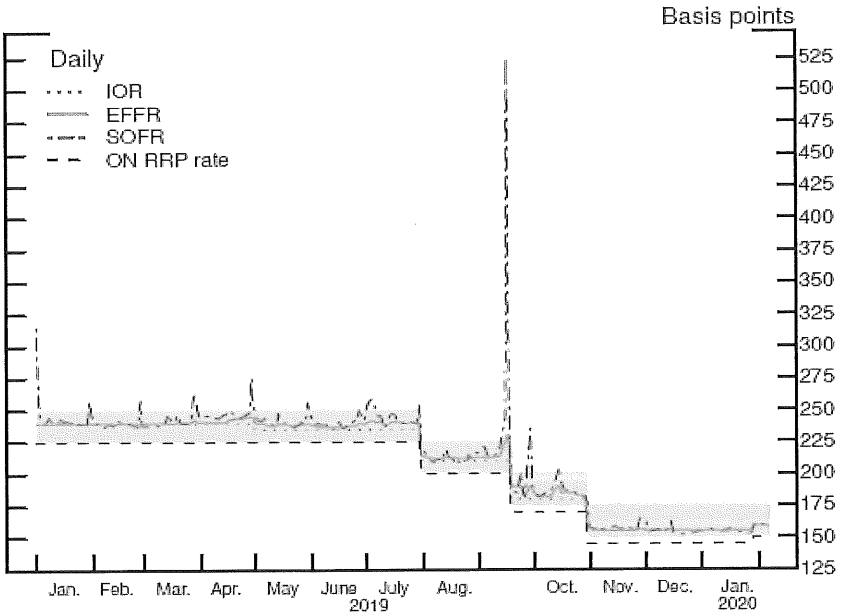
Policy Rate Pass-through to Selected Overnight Money Market Rates

Panel A: Pass through of policy rate hikes



Source: Federal Reserve Bank of New York.

Panel B: Pass through of policy rate cuts



Source: Federal Reserve Bank of New York.

years of keeping the fed funds rate near zero (in a range of 0 to ¼ percent), the FOMC increased its target range for the federal funds rate by ¼ percent (25 basis points), to a range of ¼ to ½ percent. At that time, the Fed's key administered rates, the IOR and ON RRP rates, were set at the top (0.50 percent) and bottom (0.25 percent) of the target range, respectively.[20] Immediately after the Fed increased both administered rates, a constellation of short-term market interest rates moved up simultaneously. Since then, the FOMC increased the target range for the federal funds rate eight more times through the end of 2018. Then, as shown in panel B, the FOMC reduced the target range three times in 2019 to cushion the economy from possible headwinds to economic growth. With each of the FOMC's decisions to move the target range up or down, the Fed adjusted its administered rates accordingly, and the federal funds rate and other short-term market rates followed suit.[21]

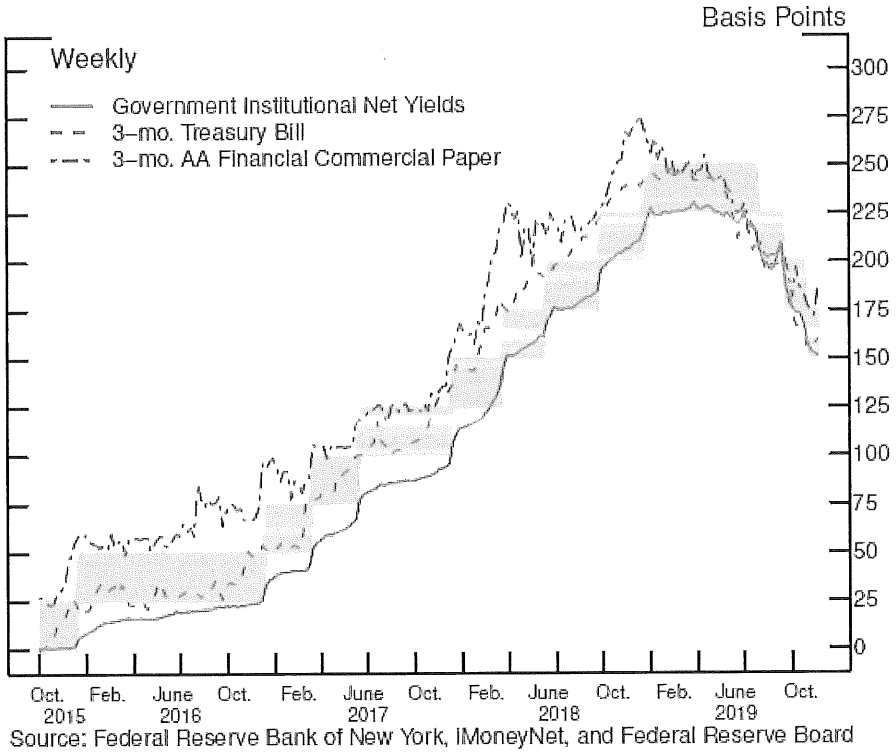
One can see that the changes in the FFR and other short-term interest rates also passed through to longer-term interest rates. For example, figure 6 plots three such rates. The rate shown in solid green is the net yield on government money funds held by institutional investors, which reflects the weighted-average return on the underlying assets held, less fees charged, by the fund. Also shown are rates on 3-month Treasury bills (the purple dashed line) and AA-rated commercial paper of financial companies (the red dash-dotted line). Each of these rates also moved with the changes in the FOMC's target range. In fact, these rates moved up and down a bit in anticipation of the Fed's policy rate changes as term interest rates reflect not only prevailing overnight interest rates but also market participants' expectations for the level of

[20] For a full discussion of how the Fed designed its tools to work at liftoff, see Ihrig, Meade, and Weinbach (2015).
[21] During the period shown, there were two days only when the daily effective FFR printed outside of the target range. On December 31, 2015, the effective FFR printed five basis points below the bottom of the target range and on September 17, 2019, it printed five basis point above the top of the target range.

overnight rates in the future.[22] When market participants expect the Fed to tighten or ease the stance of policy, term rates can rise or fall to some extent ahead of the FOMC's actual decision.

Figure 6

Policy Rate Pass-through to Selected Longer-term Interest Rates



Source: Federal Reserve Bank of New York, IMoneyNet, and Federal Reserve Board H.15 release.

Overall, the FOMC's adjustments to the stance of policy have transmitted to a relatively broad set of market interest rates and influenced financial conditions, as well as consumers' and businesses' economic decisions. These adjustments ultimately created conditions that have helped prolong the post-crisis economic expansion by fostering the achievement of both legs of the FOMC's dual mandate.

[22] For a more detailed account of how the first three post-crisis rate hikes were transmitted to other interest rates, see Anderson, Ihrig, Styczynski, and Weinbach (2017).

3.2 Technical adjustments within the implementation regime

As we just discussed, the FOMC has been successful in steering the federal funds rate up and down to reflect the desired stance of monetary policy, and those changes have transmitted to broader financial conditions. Part of the Fed's success in maintaining the FFR within the target range has been due to its flexibility in adjusting the parameters of its implementation tools as needed to support interest rate control. These actions are purely technical measures to support the effective implementation of monetary policy; such actions do not represent a change in the stance of monetary policy. In this subsection, we discuss two broad categories of technical adjustments that the Fed has made in response to evolving financial market conditions and as it has gained more experience with the current operating regime.

Technical adjustments to the Fed's administered rates

A close look at either panel in figure 5 reveals that the position of the IOR rate (the dotted black line) relative to the top of the FOMC's target range (the top of the shaded region) has not remained fixed. At times, such as when pressures in short-term funding markets have emerged, the Fed has made technical adjustments to the setting of the IOR rate to help keep the FFR trading within the target range. For example, in the spring of 2018, upward pressure on money market rates, including the effective FFR, materialized. The pressure seemed to stem from a large increase in the net supply of Treasury bills, which pushed the yields on those securities higher and, with increased repo financing activity on the part of the bill holders, put some upward pressure on repo rates. As a result, a constellation of short-term money market interest rates moved higher, the effective FFR increased within the target range, and money funds allocated their cash investments into higher-yielding Treasury bills and private repo instead of into the Fed's ON RRP facility. To ensure that the effective FFR remained well within the target

range, the Fed made a small downward technical adjustment to the IOR rate, reducing it by 5 basis points, to a level that was 5 basis points below the top of the target range. This change was accomplished by implementing a 20-basis-point increase in the IOR rate at a time when the FOMC raised the target range by 25 basis points.

The Fed made a few more technical adjustments to the IOR rate between 2018 and 2020. In 2018 and 2019, the Fed again lowered the IOR rate relative to the top of the target range. And in September 2019, the Fed also simultaneously lowered the ON RRP rate, setting it 5 basis points below the bottom of the target range, keeping a spread between the IOR and the ON RRP rates of 10 basis points. These small technical adjustments exerted downward pressure on the federal funds rate and other money market rates and fostered trading in the federal funds market at rates well within the target range. The Fed has also made adjustments in the other direction. In January 2020, the Fed unwound its previous step, adjusting the IOR and ON RRP rates each higher by 5 basis points, to keep the FFR trading well within the target range. These technical adjustments, all made within the ample-reserves regime, are used for policy implementation purposes only.[23]

Technical adjustments to the supply of reserves

Although active management of the supply of reserves is not, by design, a feature of an ample-reserves regime, there are times when the Desk may take steps, in accordance with the direction it receives from the FOMC, to adjust the supply of reserves in order to support interest rate control. This step was taken in mid-September 2019 when strains in funding markets

[23] The Fed publishes an Implementation Note after every FOMC meeting and any time implementation adjustments are made, available on the Federal Reserve Board's web site (with other FOMC meeting documents) at the following link: https://www.federalreserve.gov/monetarypolicy/fomccalendars.htm.

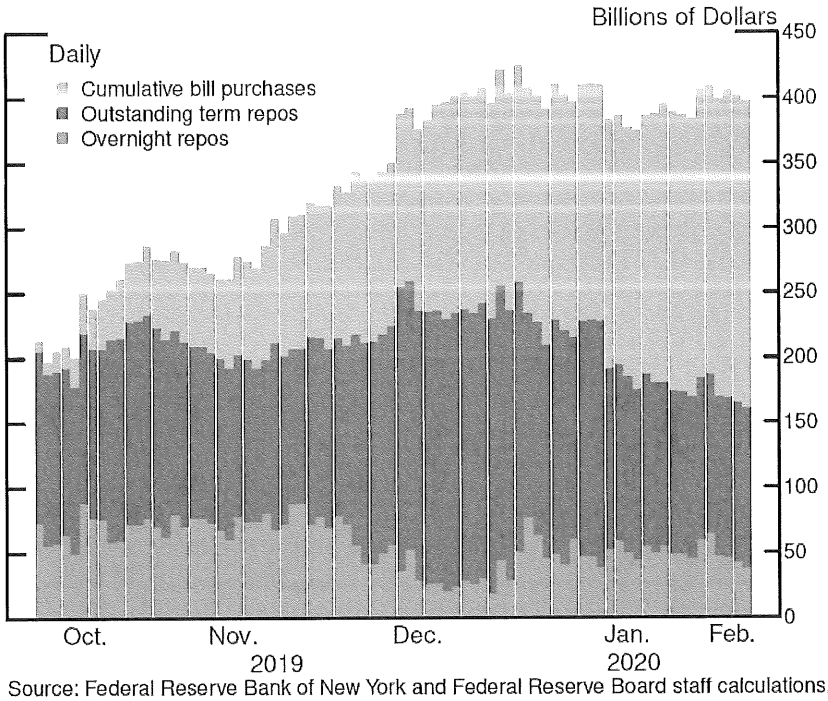
emerged as quarterly corporate tax payments and the settlement of Treasury securities coincided and resulted in a large amount of cash being drained from money markets.[24] In fact, reserve balances fell by more than $100 billion over just two days. Although the drain in reserves associated with seasonal tax payments was expected to put some upward pressure on money market rates, the increases in rates that materialized were exceptionally large by historical standards. As shown in panel B of figure 5, the SOFR (red dash-dotted line) spiked and the effective FFR (blue solid line) moved 5 basis points above the target range. The moves in each rate were much larger than those observed over the past few years. (Box 2 presents an analysis of the relationship between changes in the quantity of reserves and the FFR and provides estimates of rate sensitivity at various reserve levels.) In response to these market developments, and consistent with the directive from the FOMC to maintain the FFR in the FOMC's target range, the Desk undertook OMOs to temporarily purchase securities to add reserves. Specifically, the Desk conducted repos to provide immediate liquidity to the market and help alleviate the funding strains, ensuring the FFR resumed trading within the target range.

In addition, the FOMC judged that the prevailing level of reserve supply at that time may have been a bit too low to be consistent with operating in an ample-reserves regime. Accordingly, in early October 2019, the FOMC directed the Desk to maintain over time reserve balances at least as large as the level that had prevailed in "early September," a time when there were no evident pressures in money markets, and instructed the Desk how to go about increasing reserve supply. Consistent with those instructions, the Desk announced further overnight and term repos (temporary OMOs) as well as reserve management purchases in the form of outright

[24] See Anbil, Anderson, and Senyuz (forthcoming 2020) for an overview of money market events in September 2019, including a more detailed discussion of the factors that contributed to the strains that emerged in the repo market.

purchases (permanent OMOs) of Treasury bills at a pace of about $60 billion per month at least into the second quarter of 2020. The Committee explicitly noted that these bill purchases were purely a technical measure to increase reserve levels and support the effectiveness of monetary policy implementation.[25] Figure 7 shows the composition of these reserve management OMOs, which totaled several hundred billion dollars as of February 2020.

Figure 7
The Fed's Reserve Management OMOs in 2019-2020



Source: Federal Reserve Bank of New York and Federal Reserve Board staff calculations.

Looking ahead, once reserve balances are judged to be sufficiently high, the need for sizable Treasury bill purchases will diminish, and the Fed will likely scale back or phase out its repo operations.[26] At that time, the Fed will be in position to conduct OMOs over time solely to

[25] See the FOMC's October 2019 "Statement Regarding Monetary Policy Implementation," available at this link: https://www.federalreserve.gov/monetarypolicy/files/monetary20191011a1.pdf. Logan (2019b) reviews money market developments over the year and also discusses these particular open market operations.
[26] For a discussion of FOMC participants' views on this issue, see the minutes to the January 2020 FOMC minutes, available at the following link: https://www.federalreserve.gov/newsevents/pressreleases/monetary20200219a.htm.

accommodate trend growth in autonomous factors to maintain an ample level of reserves, a discussion we take up in the next section.

4. Maintaining ample reserves

Looking ahead, the Fed will seek to stay in an ample-reserves regime by supplying a quantity of reserves that is consistently ample, avoiding the need to actively manage the supply of reserves. To do so, the Fed will continue to be vigilant in monitoring various factors that could potentially affect the level or variability of reserves, continue to gain more information about banks' evolving demand for reserves, and remain ready to respond if the need arises. Here we discuss some considerations that might arise in maintaining an ample reserves-regime. Note that our discussion of these issues is intended to be illustrative, not exhaustive.

4.1 Evolution of autonomous factors

As we discussed in section 2.3, autonomous factors include currency, the Treasury's General Account (TGA), reverse repos, and other Fed liabilities that are directly linked, operationally, with the supply of reserves. As the level of these factors increase or decrease, they drain or add reserves, shifting the Fed's supply curve left or right, respectively.

Equation 1 shows how the Fed's supply of reserves, R, evolves over time:

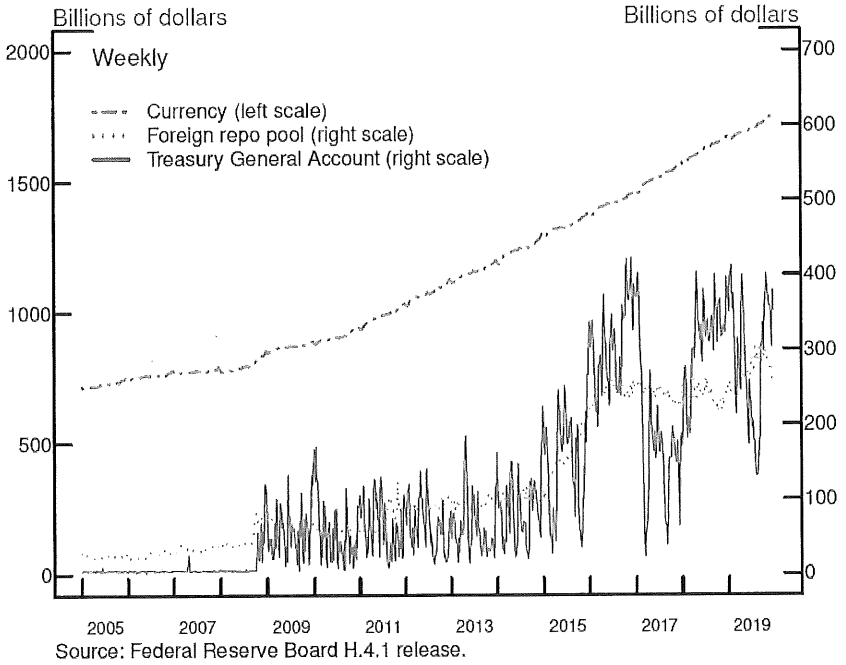
$$R_t = R_{t-1} - \Delta AF_t + OMOs_t \qquad (1)$$

The equation captures the fact that today's level of reserves will be equal to yesterday's quantity in the absence of any changes in autonomous factors (*AF*) or OMOs.[27] But, as shown in Figure

[27] In this equation, "*OMOs*" are defined as the aggregate net addition to reserves from these operations (any reverse repos would be accounted for with a negative sign).

8, autonomous factors exhibit substantial fluctuations in the short run and also grow over time. Moreover, the degree of variation in these factors can change over time; each of the factors exhibits more variability now than prior to the crisis. This pattern is particularly true for the TGA, the most volatile factor (the solid red line). Taken together, over the past few years, the weekly swings in the factors suggest that, at the extreme, they can jointly change by about $200 billion from one week to the next.

Figure 8
Selected Fed Non-Reserve Liabilities



Source: Federal Reserve Board H.4.1 release.

The Fed needs to consider these short-run movements in autonomous factors in ensuring its supply of reserves remains ample. In particular, the variability of the autonomous factors influences the Fed's judgment about the practical location of the vertical line "A" in figure 2—the minimum quantity of reserves that constitutes being in an ample-reserves regime. So what is

the Fed's desired minimum level of reserves? When asked about this topic, Chair Powell replied with a detailed response that is linked to our discussion.[28]

> *"... in terms of the actually desired reserve level, we know that reserves will continue to move up and down over the course of the calendar year in a wide range depending on volatility in non-reserve liabilities, particularly the Treasury General Account, or TGA. In particular, reserve levels will need to be at a level high enough to remain ample even when the TGA peaks during the April tax season. Effectively, what that means is that we need reserves at all times to be no lower than they were in early September [2019]—and, I would say, around $1½ trillion, subject to learning more. ... So, most of the time, reserves will be moving in a range substantially higher than that but not going below $1½ trillion."*

In other words, in setting the quantity "A," the Fed explicitly accounts for the short-run variability in autonomous factors. The Fed sets "A" large enough to stay consistently in an ample reserves-regime, even when autonomous factors occasionally cause a very large drain in reserves. And, given that the behavior of the autonomous factors could evolve over time, the Fed's view of the location of "A" could change going forward.

In addition to daily fluctuations in autonomous factors, the Fed also needs to consider their long-run growth in ensuring its supply of reserves remains ample, that is, at least as large as a given quantity "A." As shown in figure 8, currency (the purple dash-dotted line), trends up over time. As noted above, currency has expanded an average of about 6 percent per year, and with more than $1.5 trillion of currency in circulation, such growth amounts to a large nominal increase each year.[29] The TGA has also grown over the past decade, and the size of this account

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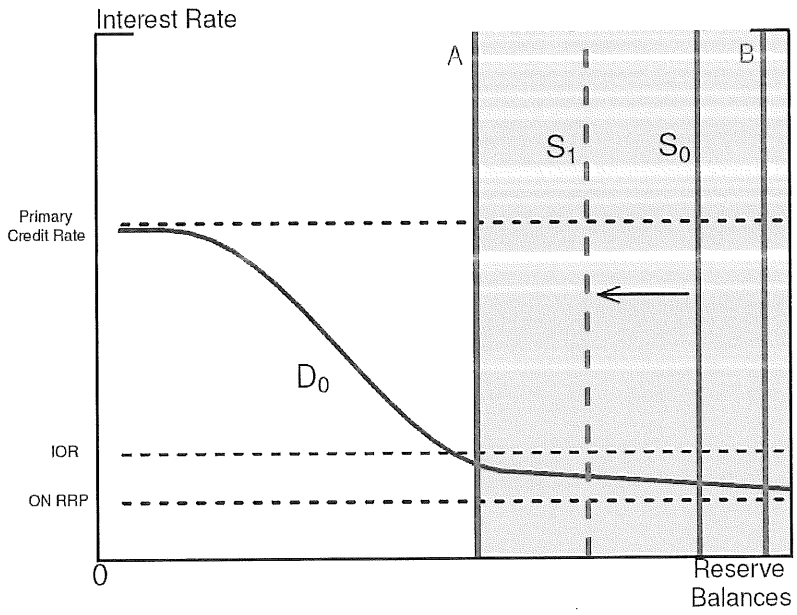
[28] See the transcript of Chair Powell's January 2020 press conference, available on the Federal Reserve Board's web site at the following link: https://www.federalreserve.gov/mediacenter/files/FOMCpresconf20200129.pdf.

[29] For example, currency in circulation has nearly doubled over the past decade, expanding from about $985 billion at the end of 2010 to about $1.7 trillion in February 2020. This means that the Fed's balance sheet would have expanded by more than $700 billion over that period regardless of any other factors. Data on currency in circulation are available on the Federal Reserve Board's web site at the following link: https://www.federalreserve.gov/releases/h6/.

could continue to expand as the nominal value of payment flows managed by the Treasury increases over time. Overall, the long-term growth of these autonomous factors will slowly, but permanently, drain reserves. This reserve-draining effect is illustrated in figure 9, with the leftward shift in the supply curve, from S_0 to S_1.

Figure 9
Reserve Supply is Drained by an Expansion of Autonomous Factors



To offset the reserve-draining effect of trend growth in its non-reserve liabilities, the Fed will, over time, need to regularly conduct permanent OMOs (reserve management purchases) to inject reserves into the banking system and shift the supply curve back to the right. For example, if the Fed estimates that its non-reserve liabilities will grow by $10 billion a month, it would need to purchase $10 billion of Treasury securities each month to offset the reserve-draining effects of this growth. These OMOs will be necessary over time to keep the quantity of reserves ample.

4.2 Other factors

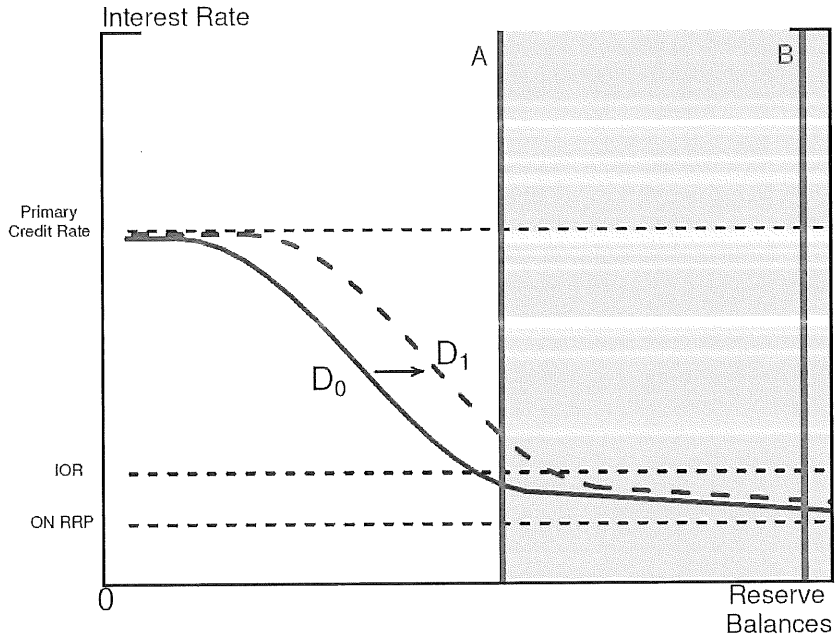
Unlike the autonomous factors that are known to affect the supply of reserves each day, other, less certain, factors may change the supply of or demand for reserves over time. And, of course, still other factors may one day need to be taken into consideration that are not yet conceived today. Here we provide a couple of examples of such potential factors for illustrative purposes. Given the uncertainty with which various factors may materialize, as well as their ultimate influence on the federal funds and other money markets, the Fed will need to stay vigilant in monitoring conditions in money markets going forward.

We start by thinking about factors that could affect the demand for reserves. First, consider a development that significantly reduces banks' demand for reserves. For example, a technological change could enable banks to speed the processing of payments and economize on cash, or the Fed could introduce a change to its existing policies or tools that lead banks to have a greater preference for investing in non-reserve liquid assets. In this situation, the Fed's existing supply of reserves would still be ample. Next, consider the opposite case, a development that results in a marked increase in banks' demand for reserves. For example, banks' preference for holding reserves could shift higher as a result of new or persistently heightened perceptions of liquidity risks. In this situation, the Fed could need to take action to ensure the quantity of reserves it supplies remains ample.

Figure 10 illustrates a rightward shift in the demand curve, from D_0 to D_1. In this scenario, the vertical line "A" would move to the right along with the outward shift of the demand curve. Would the Fed need to adjust its supply curve? The answer is that it depends. If supply was sufficiently to the right of "A" when that point shifts, the Fed's current implementation regime would still work fine. If instead reserve supply was close to "A" when

that point shifts, the Fed would likely need to add some reserves to the banking system, by conducting OMOs in the form of permanent purchases of securities, to remain in an ample-reserves regime relative to the new position of "A."

Figure 10
Increase in Demand for Reserves in an Ample-Reserves Regime



One can also conceive of considerations that could affect the Fed's long-run supply of reserves. One such consideration is the long-run implications of the current, low interest rate environment on reserve supply. For some time now in the United States and in other advanced economies around the world, macroeconomic variables such as average inflation, output growth, and short- and longer-term interest rates have been persistently low relative to their longer-term historical norms.[30] As a result, the Fed and many other central banks have been operating in

[30] Many factors are contributing to the current macroeconomic environment—well-anchored inflation expectations in the context of improved monetary policy, aging demographics, increased globalization, slower productivity

economic environments in which the policy rate is set relatively low. If growth of the U.S. economy were to significantly slow, the FOMC would likely lower the policy rate, as usual, to provide stimulus to economy activity. However, there is less room for the FOMC to provide stimulus to the economy by lowering the policy rate if the federal funds rate is already relatively low. To provide additional policy accommodation in such circumstances, the FOMC would most likely need to employ large-scale asset purchases, as it did during the financial crisis and subsequent severe recession. Regardless of its starting point, purchases of this size would shift the supply curve well to the right, closer to vertical line "B" in figure 2. On balance in this situation, the current regime would seamlessly continue to work, providing the Fed a means of stable interest rate control as the FOMC provided needed economic stimulus to the economy.

5. Concluding remarks

The Fed is one of many central banks around the world that is implementing monetary policy with plentiful reserves. In this primer, we provided a stylized framework to describe how a central bank implements policy in such a regime, including the specific tools the Fed uses to ensure interest rate control with ample reserves. We reviewed the effectiveness of the regime over the past decade and discussed some operational considerations relevant for maintaining an ample supply of reserves going forward.

Our discussion highlighted some of the Fed's key motivations for choosing to operate in an ample-reserves regime in the long run. First, as described in section 2, an ample-reserves regime is simple and efficient to operate. While the Fed needs to manage reserve supply in any implementation regime, the ample-reserves regime eliminates the need for the Fed to intervene in

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growth, greater demand for safe assets, and weaker links between unemployment and inflation. And these factors seem likely to persist. For more discussion of this issue, see Chair Powell's speech on "Challenges for Monetary Policy," available at the following link: https://www.federalreserve.gov/newsevents/speech/powell20190823a.htm.

markets on a daily basis, which is an operationally attractive feature. Second, as shown in section 3, the regime is effective. The Fed's administered rates have enabled successful control of the federal funds rate and its transmission to other short-term interest rates as well as to broader financial conditions, all of which support the FOMC's achievement of its dual mandate. Third, as highlighted in section 3 and discussed in section 4, the regime has proven resilient to a variety of changes in the economic, financial, and regulatory environments, and is expected to stay so going forward.

Finally, we emphasized that operating in an ample-reserves regime going forward, the Fed will periodically need to add reserves to the banking system to accommodate ongoing growth in its non-reserve liabilities, and also highlighted the importance of monitoring for developments that could necessitate a shift in the Fed's assessment of the minimal quantity of reserves needed to stay in an ample-reserves regime. Overall, the Fed will need to be vigilant in monitoring conditions that influence banks' evolving reserve demand, the autonomous factors that affect reserve supply, and other dynamics that might shift reserve demand or supply as the economy and financial markets continue to evolve.

Box 1
The Fed's Non-reserve Liabilities

Many of the Fed's liabilities arise from its statutory responsibilities, such as supplying currency to the public and serving as the U.S. Treasury's fiscal agent. Each liability has social benefits and plays an important role as a safe and liquid asset for the public, the banking system, the U.S. government, or other institutions. Here we briefly describe each of the Fed's primary non-reserve liabilities.[31] A key point is that, taken together, the Fed's non-reserve liabilities tend to increase over time. This is because the Fed's largest liability, currency, and to which we first turn, exhibits trend growth.

Federal Reserve notes. Federal Reserve notes outstanding—also known as (paper) currency in circulation, or simply currency, shown as the green region in the chart—have traditionally been the largest liability item on the Fed's balance sheet. The public's demand for currency tends to increase with the nominal size of the economy because households and businesses have sought, collectively, to hold more cash as the volume of economic transactions grows. In addition, with heavy usage of U.S. currency overseas, changes in global economic growth, as well as in financial and geopolitical stability, can also materially affect the rate of U.S. currency growth. Over the past decade, the amount of notes in circulation has almost doubled, from about $900 billion in late 2009 to almost $1.8 trillion by early 2020.

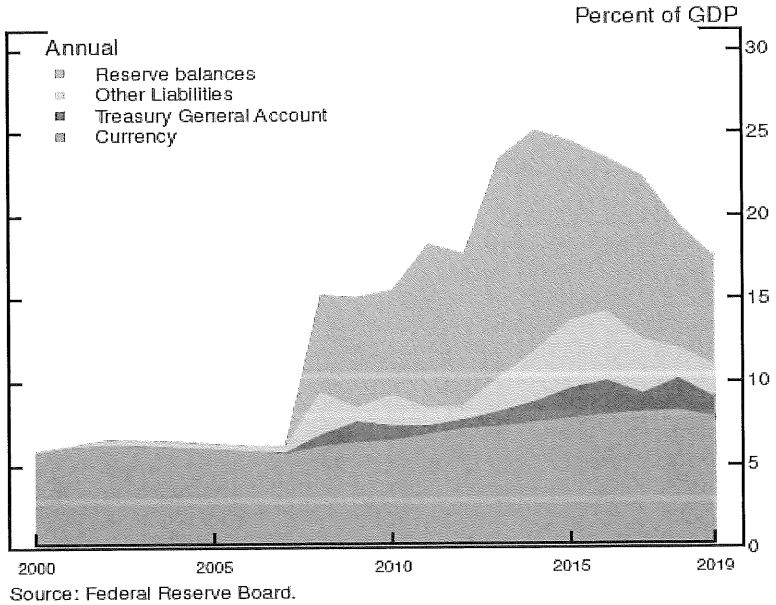
Treasury General Account (TGA). The U.S. Treasury holds cash balances at the Fed in the TGA, shown by the blue region in the chart. Treasury's payments activity flows through this account—the account is used to collect tax payments and to receive the proceeds of Treasury's securities sales, and it is used to pay the federal government's bills, including interest and principal on maturing Treasury securities. Prior to 2008, the Treasury targeted a steady, low balance of $5 billion in the TGA on most days, and it used separate, private accounts at commercial banks to manage the bulk of its cash flows outside of the TGA. Since 2008, the Treasury has used the TGA as its primary account for managing its cash flows. In May 2015, the Treasury announced its intention to hold in the TGA a level of cash generally sufficient to cover

[31] Data on the Fed's assets and liabilities are published weekly on the Board's H.4.1 statistical release, available at the following link: https://www.federalreserve.gov/releases/h41/.

one week of outflows, subject to a minimum balance of roughly $150 billion.[32] The rationale for this decision was to protect the resilience of government payments and to avoid potential concerns about the safety of U.S. government debt that could be damaging for the global financial system. As of the end of 2019, the TGA stood above $300 billion.

Foreign Repo Pool. The Fed conducts overnight reverse repo with foreign official accounts, also known as the foreign repo pool and included in the yellow region of the chart, in order to provide an investment option for foreign official institutions. The daily amount invested in the foreign repo pool has also increased in recent years. The Fed has long offered this custodial service to foreign central banks, foreign governments, and international official institutions to facilitate immediate access to dollar liquidity to support their operational needs, to clear and settle securities in their accounts, or to address any unexpected dollar shortages. The foreign repo pool has grown from an average level of around $30 billion before the crisis to a current average of about $250 billion, equivalent to a little more than 1 percent of GDP, reflecting in part foreign central banks' preference to maintain more substantial dollar liquidity buffers since the crisis.

Figure 1.1
The Fed's Liabilities as a Share of Nominal GDP



Source: Federal Reserve Board.

[32] Treasury's press release containing this announcement may be found on its web site at the following link: https://www.treasury.gov/press-center/press-releases/Pages/jl0249.aspx.

Other deposits. Other deposits, also included in the yellow region of the chart, consist of balances held at the Fed by international and multilateral organizations as well as government-sponsored enterprises. This liability item also includes the accounts of Designated Financial Market Utilities (DFMUs) which provide the infrastructure for transferring, clearing, and settling payments, securities, and other transactions among financial institutions. Other deposits have risen from less than $1 billion before the crisis to about [$80 billion] at the end of 2019, owing mainly to the establishment of accounts for DFMUs that have been designated as systemically important by the Financial Stability Oversight Council (FSOC).

Overnight reverse repo (ON RRP) facility. When the Fed's eligible counterparties choose to take up ON RRPs at the Fed's facility, the cash they deposit is logged as an increase in the Fed's reverse repo liabilities; this item is also included in the yellow region of the chart. Over the past half-decade, the outstanding amount of ON RRPs has ranged from $0 to more than $350 billion, largely depending on the relative positions of comparable money market interest rates and other conditions in money markets.

Potter, Simon (2018). "U.S. Monetary Policy Normalization is Proceeding Smoothly," Remarks at the China Finance 40 Forum-Euro 50 Group-CIGI Roundtable, Banque de France, Paris, France: https://www.newyorkfed.org/newsevents/speeches/2018/pot181026.

Schulhofer-Wohl, Sam, and James Clouse (2018). "A Sequential Bargaining Model of the Fed Funds Market with Excess Reserves," Federal Reserve Bank of Chicago working paper 2018-08.

Yellen, Janet L. (2017). "A Challenging Decade and a Question for the Future." Remarks at the 2017 Herbert Stein Memorial Lecture, National Economists Club, Washington D.C.: https://www.federalreserve.gov/newsevents/speech/files/yellen20171020a.pdf.

References

Afonso, Gara, Roc Armenter, and Benjamin Lester (2018). "A Model of the Federal Funds Market: Yesterday, Today and Tomorrow." Federal Reserve Bank of New York Staff Reports, no.840.

Anbil, Sriya, Alyssa Anderson, Zeynep Senyuz (2020). "What Happened in Money Markets in September 2019?," forthcoming FEDS Notes, Board of Governors of the Federal Reserve System (U.S.).

Anderson, Alyssa, Jane Ihrig, Mary-Frances Styczynski, and Gretchen C. Weinbach (2017). "How Have the Fed's Three Rate Hikes Passed Through to Selected Short-term Interest Rates?," FEDS Notes 2017-06-02. Board of Governors of the Federal Reserve System (U.S.).

Bernanke, Ben S. (2012). "Monetary Policy since the Onset of the Crisis." Remarks at the Federal Reserve Bank of Kansas City Economic Symposium, Jackson Hole, Wyoming: https://www.federalreserve.gov/newsevents/speech/bernanke20120831a.htm.

Frost, Josh, Lorie Logan, Antoine Martin, Patrick McCabe, Fabio Natalucci, and Julie Remache, (2015). "Overnight RRP Operations as a Monetary Policy Tool: Some Design Considerations," Finance and Economics Discussion Series 2015-010. Board of Governors of the Federal Reserve System (U.S.).

Ihrig, Jane E., Ellen E. Meade, and Gretchen C. Weinbach (2015). "Rewriting Monetary Policy 101: What's the Fed's Preferred Post-Crisis Approach to Raising Interest Rates?," *Journal of Economic Perspectives*, vol. 29, no. 4, pp.177-98.

Ihrig, Jane E., Lawrence Mize, Gretchen C. Weinbach (2017). "How does the Fed adjust its Securities Holdings and Who is Affected?," Finance and Economics Discussion Series 2017-099. Washington: Board of Governors of the Federal Reserve System, https://doi.org/10.17016/FEDS.2017.099.

Klee, Elizabeth, Zeynep Senyuz, and Emre Yoldas (2019). "Effects of Changing Monetary and Regulatory Policy on Overnight Money Markets," *International Journal of Central Banking*, vol. 15, no. 4, pp. 165-205.

Logan, Lorie K. (2019a). "Observations on Implementing Monetary Policy in an Ample-Reserves Regime," Remarks before the Money Marketeers of New York University, New York City: https://www.newyorkfed.org/newsevents/speeches/2019/log190417.

Logan, Lorie K. (2019b). "Money Market Developments: Views from the Desk." Remarks at the Annual Primary Dealer Meeting, Federal Reserve Bank of New York, New York City: https://www.newyorkfed.org/newsevents/speeches/2019/log191104.html.

Poole, William (1968). "Commercial Bank Reserve Management in a Stochastic Model: Implications for Monetary Policy," *The Journal of Finance*, vol.23, no.5, pp. 769-791.