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Contents

Since the global financial crisis of 2007-09, policymakers and academics have advocated the use of prudential policy tools to reduce the risks that could inhibit the financial sector's ability to intermediate credit. The use of such tools in the service of financial stability is often called macroprudential policy. This article describes a "tabletop" exercise in which Federal Reserve Bank presidents were presented with a hypothetical scenario of overheating markets and asked to consider the effectiveness of macroprudential policy approaches in averting or moderating the financial disruptions that were likely to follow. The prudential tools examined as part of this exercise ranged from countercyclical capital buffers and sectoral capital requirements to liquidity requirements and leverage ratios, and from stress testing to supervisory guidance and moral suasion. In addition, participants were asked to consider the use of monetary policy tools to achieve financial stability ends. The participants found that implementation lags and a narrow scope of application limited the effectiveness of many prudential tools; the tools that posed the fewest implementation challenges, such as stress testing, margins on repo funding, and supervisory guidance, were the most favorably regarded. Interestingly, monetary policy emerged as an attractive supplemental tool for promoting financial stability. The tabletop exercise abstracted from governance issues within the Federal Reserve System, focusing instead on economic mechanisms of alternative tools.

57 Supervising Large, Complex Financial Institutions: What Do Supervisors Do?

Thomas Eisenbach, Andrew Haughwout, Beverly Hirtle, Anna Kovner, David Lucca, and Matthew Plosser

The supervision of large, complex financial institutions is one of the most important, but least understood, activities of the Federal Reserve. Supervision entails monitoring and oversight to assess whether firms are engaged in unsafe or unsound practices, and to ensure that firms take appropriate action to correct such practices. It is distinct from regulation, which involves the development and promulgation of the rules under which firms operate. This article brings greater transparency to the Federal Reserve's supervisory activities by considering how they are structured, staffed, and implemented on a day-to-day basis at the Federal Reserve Bank of New York as part of the broader Systemwide supervisory program. The goal of the article is to generate insight into what supervisors do and how they do it. While the authors do not undertake to evaluate the effectiveness of the activities they describe, they note that understanding how supervision works is a critical precursor to determining how to measure its impact.

Tobias Adrian, Patrick de Fontnouvelle, Emily Yang, and Andrei Zlate

Macroprudential Policy: A Case Study from a Tabletop Exercise

- In June 2015, a group of Federal Reserve Bank presidents participated in a tabletop exercise designed to assess the value of prudential policy tools in averting or easing financial crises.
- Presented with a hypothetical scenario of overheating financial markets, the participants were asked to consider how effectively various capital-based, liquidity-based, and credit-based tools, as well as stress testing and supervisory guidance, could address the risks inherent in the scenario.
- The group concluded that many prudential tools had limited applicability and could only be implemented with a lag. Tools that could be implemented more quickly, such as stress testing and margins on repo funding, were preferred to others. Surprisingly, monetary policy tools were judged to be an attractive alternative means of promoting financial stability.

1. Introduction

Since the global financial crisis of 2007-09, policymakers around the world have advocated the use of prudential policy tools to promote financial stability—that is, to reduce risks that could inhibit the financial sector's ability to intermediate credit (Bernanke 2008; Bank of England 2009; Basel Committee on Banking Supervision 2010; Tarullo 2013). Prudential policy tools are rules or requirements that enhance the safety and soundness of specific firms, sectors, or practices. The use of such prudential policy tools for financial stability purposes is often called macroprudential policy. Academic work on the implementation of macroprudential methods has flourished recently,[1] and even prior to the crisis, some researchers and policymakers argued for a macroprudential approach to financial regulation.[2]

This article describes a "tabletop" inquiry into macroprudential tools that was conducted by members of the Financial

[1] See Brunnermeier et al. (2009); Hanson, Kashyap, and Stein (2011); and Hirtle, Schuermann, and Stiroh (2009).

[2] See the classic contributions by Robinson (1950) and Bach (1949), and more recent work by Crockett (2000) and Borio (2003).

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To view the authors' disclosure statements, visit https://www.newyorkfed.org/research/author_disclosure/ad_epr_2016_adrian-macroprudential-policy.html.

Stability Subcommittee of the Conference of Presidents (COP) of the Federal Reserve Banks in June 2015.[3] In the tabletop exercise, Federal Reserve Bank presidents were presented with a plausible, albeit hypothetical, scenario of financial market overheating. They were asked to identify the risks to financial stability present in the scenario, and to review a variety of possible macroprudential and monetary responses to those risks. In exploring the actions and tools available to policymakers, the participants drew conclusions about the advantages and the limitations of the different approaches.

Before describing the hypothetical scenario, the available policy tools, and their transmission mechanism in detail, we define the macroprudential objectives that guided the exercise and the framework used in assessing financial vulnerabilities.

In the tabletop exercise, the primary macroprudential objective is to reduce the occurrence and severity of major financial crises and the possible adverse effects on employment and price stability. The macroprudential objective, because it focuses on economy-wide financial stability, differs from the Federal Reserve's monetary policy objectives of full employment and stable prices and goes beyond its microprudential objective of ensuring the safety and soundness of individual firms. However, the objectives and transmission mechanisms of microprudential, macroprudential, and monetary policies are intertwined, generating the potential for trade-offs among objectives. For example, trade-offs may arise between preemptive macroprudential actions and the cost of financial intermediation, because preemptive macroprudential actions that reduce vulnerabilities may slow economic performance in the short term.[4] Furthermore, the trade-off between macroprudential and microprudential objectives might be more severe in busts than in booms, while the trade-off between macroprudential and monetary policy objectives might be more severe in booms than in busts. Therefore, a secondary objective is to manage such trade-offs—in other words, to mitigate the side effects of macroprudential policy actions through time. Financial system disruptions that macroprudential objectives aim to avoid include fire sales in financial markets, destabilizing runs on banking and quasi-banking institutions, shortages of money-like assets, disruptions in credit availability to the nonfinancial business sector, spikes in risk premia, disorderly dissolution of systemically important financial institutions, excessive spillovers from disruptions in international funding and currency markets, and disruptions of the payments system.

Our assessment framework of financial vulnerabilities follows Adrian, Covitz, and Liang (2013). The framework is a forward-looking monitoring program designed to identify and track the sources of systemic risk over time and to facilitate the development of policies to promote financial stability. Under this framework, macroprudential tools and actions can be classified according to whether they serve preemptive or resilience goals. The preemptive goal—reducing the occurrence of crises—leans against the financial cycle by limiting the buildup of financial risks to reduce the probability or magnitude of a financial bust. The resilience goal—reducing the severity of crises—strengthens the resilience of the financial system to economic downturns and other adverse aggregate shocks. The framework also distinguishes between shocks, which are difficult to prevent, and vulnerabilities that amplify shocks. Such vulnerabilities may arise from excessive increases in asset valuations, leverage, and liquidity and maturity transformation. Nonetheless, the framework monitors vulnerabilities across four sectors of the economy: the nonfinancial business sector, the household sector, the banking sector, and the nonbank financial sector.

In the tabletop exercise, the primary macroprudential objective is to reduce the occurrence and severity of major financial crises and the possible adverse effects on employment and price stability.

The scenario explored in this exercise provides a path for key macroeconomic and financial variables, which are assumed to be observed through the fourth quarter of 2016, as well as the corresponding projections for the interval from the first quarter of 2017 to the fourth quarter of 2018, which are assumed to reflect staff forecast and market expectations as of the fourth quarter of 2016. The variables are grouped according to their potential to have a significant impact on three types of vulnerabilities—valuation, leverage, and liquidity and maturity transformation—across the four economic sectors noted above (nonfinancial firms, households, banks, and nonbank financial institutions). The assessment of financial vulnerabilities by participants is assumed to take place as of the first quarter of 2017.

[3] The subcommittee is chaired by Eric Rosengren (Federal Reserve Bank of Boston) and includes William Dudley (Federal Reserve Bank of New York), Esther George (Federal Reserve Bank of St. Louis), Loretta Mester (Federal Reserve Bank of Cleveland), and Narayana Kocherlakota (Federal Reserve Bank of Minneapolis).

[4] In the longer term, financial stability and economic growth likely complement each other (Dudley 2011).

The hypothetical scenario features a compression of U.S. term and risk premia through the fourth quarter of 2016—projected to continue thereafter—which keeps financial conditions loose and fuels valuation pressures in U.S. financial markets. The compression of risk premia encourages the issuance of corporate debt and leveraged loans, which boosts leverage in the nonfinancial business sector. In addition, the real price index in the commercial property market rises rapidly. At the same time, the nonbank financial sector, including money market mutual funds, expands in size and provides short-term wholesale funding to the nonfinancial business sector. These developments occur while the Federal Reserve removes the degree of monetary accommodation only gradually in 2015 and 2016, as inflation is assumed to persist at slightly below its target rate and unemployment to persist at the hypothetical scenario-specific non-accelerating inflation rate of unemployment (NAIRU), as discussed in Section 2. As such, the constraint on monetary policy and the looser-than-desired financial conditions boost the rationale for the use of macroprudential tools.

The hypothetical scenario resembles some well-known cases of financial overheating from recent decades that have been documented in the literature, although with some notable differences. First, the scenario bears similarity to the case of New England during the mid-1980s, when rapid growth in regional mortgage lending led to a real estate boom (Federal Deposit Insurance Corporation 1997). Second, the scenario resembles the real estate boom that took place in Sweden from 1989 to 1990, which was fueled by accommodative fiscal policies, rapid growth in lending by banks and mortgage companies, and capital inflows (Englund 1999; Jaffee 1994). However, unlike the cases of New England or Sweden, our scenario places greater emphasis on the increase in nonfinancial business leverage as opposed to bank leverage. It also allows for a greater role for the nonbank financial sector as a provider of short-term funding (rather than mortgage loans, as in Sweden) and highlights constraints on monetary tightening that can keep financial conditions relatively loose. Finally, compared with the U.S. financial crisis in 2008-09, our hypothetical scenario highlights an increase in leverage at nonfinancial firms instead of households and features overheating in commercial property rather than in the residential housing market.

Participants were asked to consider several types of macroprudential tools in pursuing macroprudential objectives under the hypothetical scenario. Capital-based tools included leverage ratios, countercyclical capital buffers, and sectoral capital requirements. Liquidity-based tools included liquidity and net stable funding requirements. Credit-based tools included loan-to-value (LTV) and debt-to-income (DTI) caps, margin requirements for securities financing transactions, and other restrictions concerning underwriting standards. Stress tests included capital and liquidity stress tests. Supervisory guidance and moral suasion, including speeches and public announcements, were additional tools that participants in the exercise considered. In addition, participants could also use monetary policy tools for macroprudential objectives. We note that the tabletop exercise abstracted from governance issues within the Federal Reserve System, focusing instead on economic mechanisms of alternative tools.

In evaluating the various tools available, tabletop participants found many of the prudential tools less attractive owing to implementation lags and limited scope of application. Among the prudential tools, participants favored those deemed to pose fewer implementation challenges—in particular, stress testing, margins on repo funding, and supervisory guidance. Nonetheless, monetary policy came more quickly to the fore as a financial stability tool than might have been expected before the exercise.

The scenario . . . provides a path for key macroeconomic and financial variables. . . . The variables are grouped according to their potential to have a significant impact on three types of vulnerabilities—valuation, leverage, and liquidity and maturity transformation.

The remainder of this article is structured in five sections. Section 2 describes the hypothetical macrofinancial scenario. Sections 3 and 4 provide an overview of prudential and monetary instruments that are available to the Federal Reserve Board and the Federal Open Market Committee (FOMC), respectively, to achieve macroprudential objectives. Section 5 gives a brief description of the transmission channels of the tools. Section 6 presents a summary of the tabletop exercise, and Section 7 summarizes the findings.

Table 1

Summary of Indicators and Risks Highlighted in the Hypothetical Scenario, by Sector

	Risk		
Sector	Asset Valuation	Leverage	Maturity Transformation
Nonfinancial business	Term and credit spreads	Debt-to-GDP	
	Equity valuations	Debt-to-assets	
	Commercial property prices		
Household	Mortgage spreads	Debt-to-GDP	
	Residential property prices	Debt-to-assets	
		GSE lending	
Banking		Debt-to-GDP	High-quality liquid asset share
		Capital ratios	Maturity mismatches
Nonbank financial		Nonbank size	Money market fund risks
			Short-term funding size
			Repo funding backed by bonds
			Bond mutual funds

Notes: The color code represents a suggestive assessment of risks in the hypothetical scenario provided by the authors ahead of the tabletop exercise, and does not necessarily reflect the views that the Conference of Presidents members shared during the exercise, which are summarized in Section 6. Dark green suggests relatively higher risk, and light green suggests relatively lower risk. Medium green indicates moderate risk.

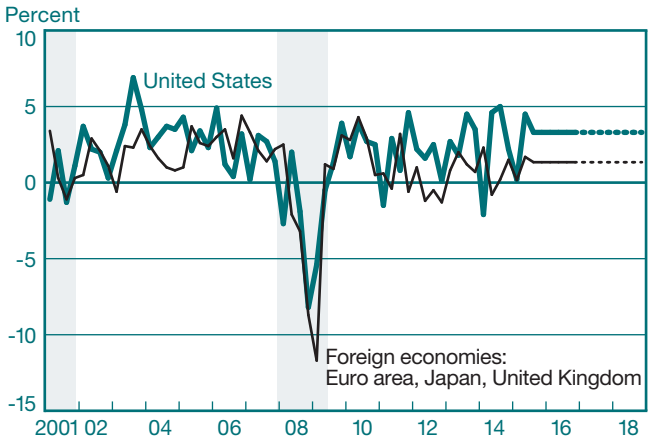
2. The Hypothetical Scenario

The scenario assumes that data are observed through the fourth quarter of 2016. Data for the period from the first quarter of 2017 through the fourth quarter of 2018 are assumed to reflect staff forecasts and market expectations as of the fourth quarter of 2016.[5] The scenario features rapid expansion in U.S. economic activity and gradual removal of monetary accommodation in 2015 and 2016. In this context, a persistent decline in foreign sovereign bond yields and high risk appetite among investors put downward pressure on the U.S. term and risk premia, which keeps financial conditions loose and fuels valuation pressures in U.S. markets. Most notably, valuation pressures emerge in the corporate debt and commercial property markets. The compression of risk premia encourages the issuance of corporate debt and leveraged loans, which boosts leverage in the nonfinancial business

[5] Without loss of generality, the variables in the hypothetical scenario, which are assumed to be observed through the fourth quarter of 2016, do not exhibit the volatility that characterizes actual macroeconomic and financial time series data beyond the last data point available at the time the scenario was built (in other words, the first quarter of 2015 or fourth quarter of 2014 for most variables). The last actual data point was the first quarter of 2015 for Charts 1 through 7 (except for commercial property prices); the fourth quarter of 2014 for Chart 7 (commercial property prices), Charts 9 through 11, and Charts 13 through 20; the third quarter of 2014 for Chart 8; and 2013 for Chart 12 (which uses annual data).

Chart 1

United States and Foreign Economies: Real GDP Growth



Sources: U.S. Bureau of Economic Analysis; Statistical Office of the European Communities; Cabinet Office of Japan; U.K. Office for National Statistics. All sources accessed through Haver Analytics.

Notes: All data reflect seasonally adjusted annual rates. Foreign growth reflects the average quarterly GDP growth at an annual rate in the euro area, Japan, and the United Kingdom, weighted by the quarterly nominal GDP in U.S. dollars. The extrapolation takes the weighted average of the growth projections for the three economies from the 2015 stress test baseline scenario, with the weights given by the quarterly nominal GDP from the latest quarter available. The shaded areas indicate periods designated recessions by the National Bureau of Economic Research.

Chart 2
United States: Unemployment and Inflation

Source: Bureau of Labor Statistics. Source accessed through Haver Analytics.

Notes: Inflation is computed as the four-quarter percentage change in the quarterly average of the consumer price index for all urban consumers (CPI-U). Unemployment reflects the quarterly average of the monthly series for the civilian noninstitutional population, aged sixteen years and over. The shaded areas indicate periods designated recessions by the National Bureau of Economic Research.

sector. The nonbank financial sector expands and provides short-term wholesale funding to the nonfinancial business sector. Table 1 provides a summary of the indicators used to monitor three types of risks in the hypothetical scenario (valuation pressures, excess leverage, and excess liquidity and maturity transformation) across four sectors in the U.S. economy (nonfinancial businesses, households, banks, and nonbank financial institutions). The table also includes a color-coded assessment of the severity of risks in the hypothetical scenario that was provided to participants ahead of the tabletop exercise.

2.1 Hypothetical Macroeconomic Context

In the United States, it is assumed that there is a sustained, rapid expansion in real economic activity, which is fueled in part by the overheating of financial markets. Real GDP grows at 3¼ percent per year (Chart 1), unemployment steadily declines to 5 percent by the end of 2016, and inflation does not exceed 2 percent per year (Chart 2). Beyond 2016, real GDP is forecast to continue rising at a rate of 3¼ percent per year, unemployment to persist at 5 percent, and inflation to remain at only 2 percent per year. Despite the rapid pace of GDP growth, U.S. inflation is dampened by dollar appreciation and stable energy prices amid slow growth in foreign economies (Chart 1), forces that are expected to persist through 2018. In addition, we assume for the purposes of this scenario that NAIRU is around 5 percent, and that unemployment does not decline below that level as a result of fast productivity growth and rising labor force participation.

In the hypothetical scenario, given the decline in unemployment and pickup in inflation, the FOMC is assumed to start raising the federal funds target rate in the second quarter of 2015 and to increase it to about 1½ percent by the end of 2016 (Chart 3). However, despite rapid GDP growth, the pace of U.S. monetary tightening is assumed to be constrained by unemployment persisting at 5 percent and inflation remaining stable at 2 percent over the forecast horizon. Markets expect the federal funds target rate to rise to only 3 percent by the end of 2018.

Downside risks to the hypothetical macroeconomic forecast stem from the potential of adverse financial developments, especially in markets where overheating concerns persist. Three key risks are highlighted in the scenario: (1) a severe disruption in the corporate debt market, (2) a sharp reversal in commercial property prices, and (3) a sudden stop in short-term funding, as discussed in Sections 2.2 through 2.5 below. The realization of any of these risks would undermine GDP growth, put downward pressure on inflation, and increase unemployment.[6] In such a case, the relatively low level of the federal funds rate would curtail the Federal Reserve's ability to provide monetary accommodation, and the zero lower bound might again become a binding constraint.

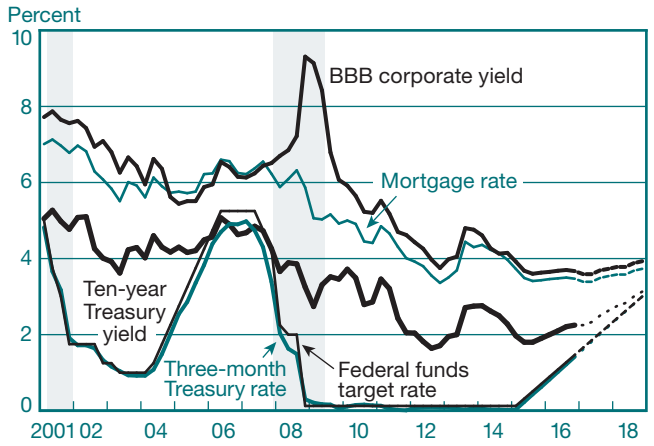
2.2 Hypothetical Valuation Pressures

Valuation pressures arise in selected U.S. financial markets, fueled in part by spillovers from the foreign sector and high risk appetite among investors. In particular, sovereign bond yields in the euro area decline and persist at low levels through late 2016, and are expected to remain depressed thereafter (Chart 4). Low foreign yields and high risk appetite trigger portfolio reallocations toward U.S. assets, including Treasury bonds and risky assets. As a result, term premia and risk premia in U.S. markets narrow, especially for riskier assets (Chart 5). The compression

[6] A financial bust would impair real economic activity through the same channels that are at work during the financial boom. In other words, the firms' lost access to funding would curtail investment, increase unemployment, and decrease wage growth and inflation; a decline in commercial property prices would also depress construction.

Chart 3

United States: Borrowing Rates

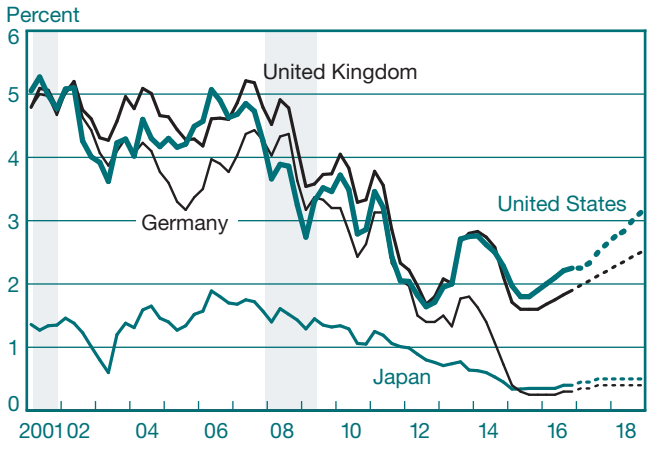


Sources: Federal Reserve Board, Statistical Release H.15, Selected Interest Rates; Federal Home Loan Mortgage Corporation; Standard and Poor's Global Fixed Income Research. All sources accessed through Haver Analytics.

Notes: Mortgage rate reflects the interest rate of a conventional thirty-year fixed-rate mortgage, expressed as quarterly averages. The shaded areas indicate periods designated recessions by the National Bureau of Economic Research.

Chart 4

Select Economies: Ten-Year Sovereign Bond Yields

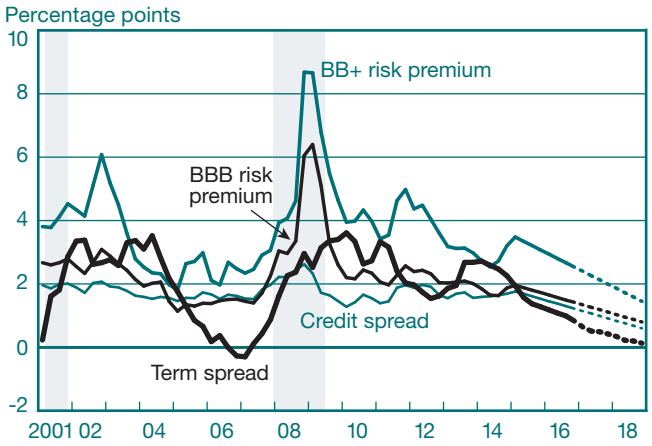


Sources: U.S. data: Federal Reserve Board. Non-U.S. data: Deutsche Bundesbank; Bank of England; Ministry of Finance of Japan. Sources for non-U.S. data accessed through Haver Analytics and the Federal Reserve Bank of St. Louis Federal Reserve Economic Data (FRED) database.

Notes: All data reflect quarterly averages of government bond yields. The shaded areas indicate periods designated recessions by the National Bureau of Economic Research.

Chart 5

United States: Interest Rate Spreads

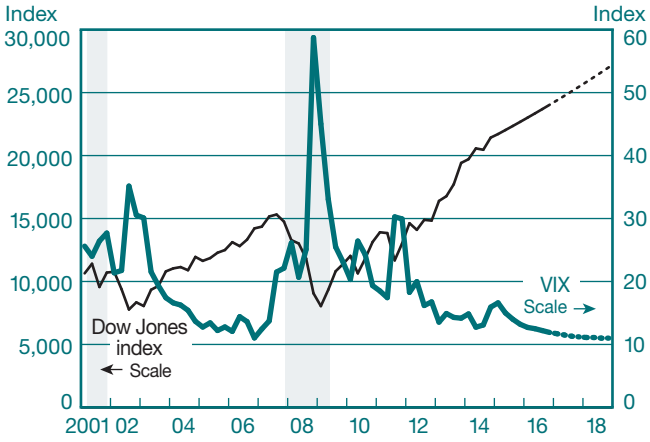


Sources: Federal Reserve Board, Statistical Release H.15, Selected Interest Rates; Federal Home Loan Mortgage Corporation; Standard and Poor's Global Fixed Income Research. All sources accessed through Haver Analytics.

Notes: BB+ risk premium reflects the yield spread between BB+ corporate bonds and ten-year Treasuries. BBB risk premium reflects the yield spread between BBB corporate bonds and ten-year Treasuries. Term spread reflects the difference in yield between ten-year Treasuries and three-month Treasuries. Credit spread reflects the difference between the thirty-year mortgage rate and the ten-year Treasury yield. The shaded areas indicate periods designated recessions by the National Bureau of Economic Research.

Chart 6

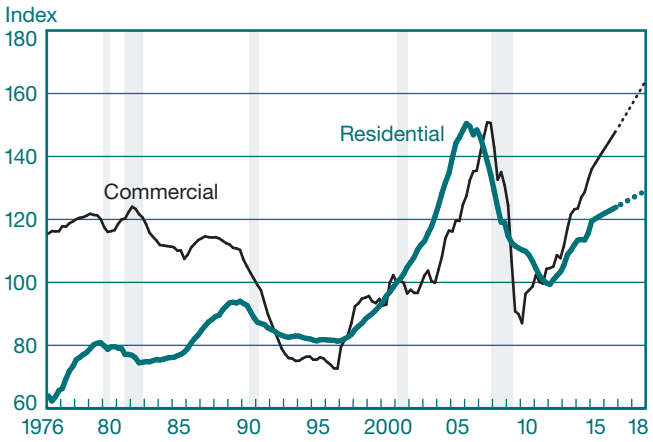
Stock Market Activity



Sources: Dow Jones; Chicago Board Options Exchange. Sources accessed through Haver Analytics.

Notes: The chart shows the Dow Jones Total Stock Market Index weighted by the float-adjusted market capitalization, obtained as quarterly averages of end-of-period weekly observations. VIX is the Chicago Board Options Exchange (CBOE) Volatility Index. The VIX reflects the quarterly average of weekly observations, with the later data given by the weekly averages of the daily close. The shaded areas indicate periods designated recessions by the National Bureau of Economic Research.

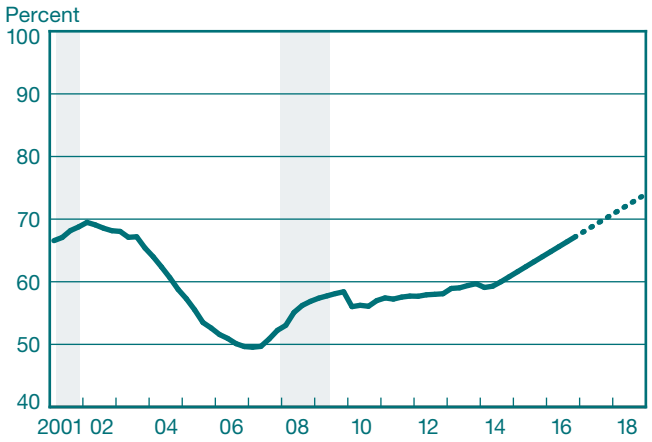
Chart 7
Real Property Prices



Sources: CoreLogic; Federal Reserve Board.

Notes: Residential prices reflect CoreLogic's National Home Price Index excluding distressed sales. Commercial prices reflect the Federal Reserve Board's Commercial Real Estate Price Index. All data are seasonally adjusted, deflated by the consumer price index, and normalized to 100 at 2001:Q1. The shaded areas indicate periods designated recessions by the National Bureau of Economic Research.

Chart 8
GSE Lending as a Percentage of Total Outstanding Residential Mortgage Lending



Source: Federal Reserve Board, Financial Accounts of the United States. Source accessed through Haver Analytics.

Notes: GSE is government-sponsored enterprise. The shaded areas indicate periods designated recessions by the National Bureau of Economic Research.

of term and risk premia leads to looser-than-desired financial conditions in U.S. markets, despite rising short-term interest rates, providing a rationale for macroprudential policy.

The increased demand for U.S. assets puts upward pressure on U.S. equity prices, dampens stock market volatility (Chart 6), and compresses the equity risk premium. With the Dow Jones Total Stock Market Index rising 6 percent per year through 2016 (and expected to rise at a similar pace thereafter), the equity risk premium is expected to narrow by more than 1 percentage point by the end of 2018.[7]

The compressed risk spreads, looser underwriting standards, and rising demand for commercial mortgage-backed securities (CMBS) fuel growth in commercial mortgage lending. As a result, valuation pressures emerge in the commercial property market, with the price index matching its pre-Lehman Brothers peak in real terms by the end of 2016 and expected to exceed it substantially by the end of 2018 (Chart 7).

[7] With real GDP growing at 3¼ percent per year, inflation persisting at about 2 percent, and the stock market rising at 6 percent per year, the dividend yield declines from 2 to 1.95 percent between early 2015 and late 2018. As such, and with the ten-year Treasury yield rising from about 2 percent to 3.15 percent, the equity risk premium is compressed from 3.33 percent to 2.1 percent during the same interval.

The share of government-sponsored enterprise (GSE) mortgages increases (Chart 8) because of the GSEs' loosened underwriting standards for prime mortgages and the continued reluctance of banks to engage in nonprime residential mortgage lending. However, in the aggregate, residential mortgage lending increases more slowly than commercial lending, and hence residential property prices rise more slowly than commercial prices, remaining below their pre-Lehman peak (Chart 7).[8]

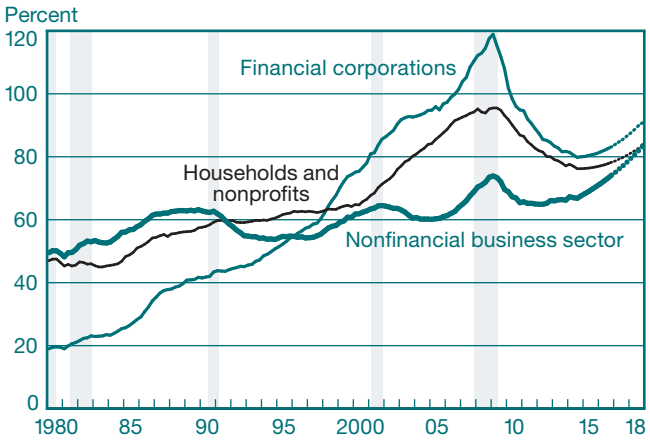
2.3 Hypothetical Evolution of Leverage

Leverage in the nonfinancial business sector rises substantially by late 2016 and is projected to increase well above its trend by late 2018, measured as either the debt-to-GDP ratio (Chart 9) or the debt-to-assets ratio (Chart 10). The increase in leverage reflects the issuance of corporate bonds and leveraged loans, especially for riskier firms, which are facilitated by an environment of low risk premia, high risk

[8] In our scenario, commercial property prices rise at about 7 percent per year in nominal terms during 2015-16, and are projected to continue at the same rate through 2018. Residential property prices rise at a rate of 4 percent per year during the same interval.

Chart 9

Leverage in the Private Sector: Debt to GDP

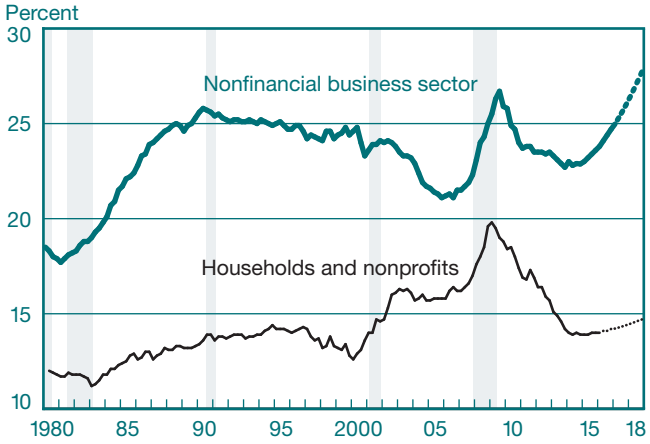


Source: Federal Reserve Board. Source accessed through Haver Analytics.

Notes: Leverage is computed as the ratio of outstanding debt by sector to seasonally adjusted annualized nominal GDP. The shaded areas indicate periods designated recessions by the National Bureau of Economic Research.

Chart 10

Leverage in the Private Nonfinancial Sector: Debt to Assets

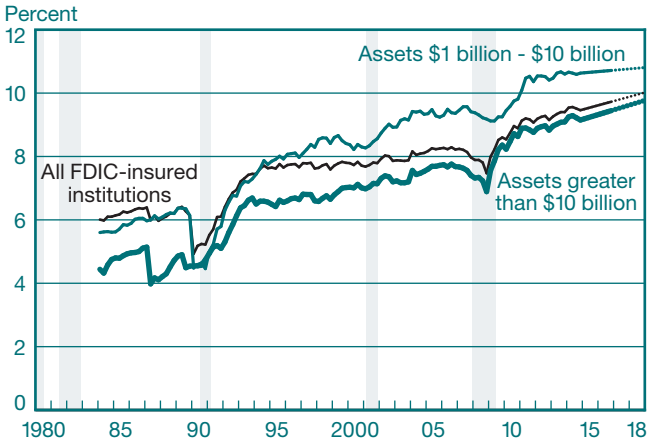


Source: Federal Reserve Board, Financial Accounts of the United States. Source accessed through Haver Analytics.

Note: The shaded areas indicate periods designated recessions by the National Bureau of Economic Research.

Chart 11

Bank Leverage: Core Capital to Assets



Source: Federal Deposit Insurance Corporation Banking Statistics. Source accessed through Haver Analytics.

Note: The shaded areas indicate periods designated recessions by the National Bureau of Economic Research.

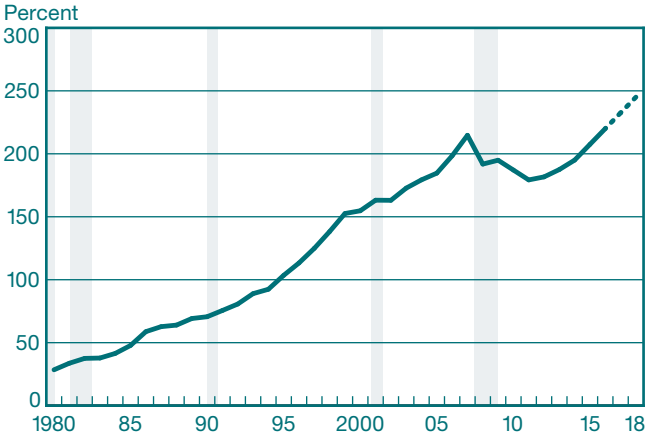
appetite, reach for yield, and a continuation of high demand for collateralized loan obligations (CLOs).

Leverage in the household sector rises more slowly than for nonfinancial firms (Charts 9 and 10), reflecting the reluctance of bank holding companies (BHCs) to ease underwriting standards and the relatively slower growth of residential property lending. Following the fast rise and sharp correction around the 2008 crisis, household leverage remains below its long-term trend as measured by either the debt-to-GDP or the debt-to-assets ratio.

Banks purchase part of the new corporate debt and issue leveraged loans to nonfinancial businesses, increasing their exposure to risk in response to narrower term and credit risk premia. As regulatory capital requirements are phased in, banks raise more capital and strengthen their ratios of core capital to assets further (Chart 11). However, there is concern that the ratios of core capital to risk-weighted assets (not shown) remain flat as banks increase their exposure to risk.

Nonbank financial institutions, such as mutual funds, private equity funds, hedge funds, and other shadow bank intermediaries, increase their market shares of high-risk corporate debt, CLOs, asset-backed securities (ABS), and CMBS. As a result, they grow in size and increase their leverage. As shown in Chart 12, shadow banking liabilities (as a percentage of GDP) rise above pre-crisis levels starting in 2016.

Chart 12
Shadow Banking Liabilities as a Percentage of GDP



Sources: Federal Reserve Board, Financial Accounts of the United States; Adrian and Ashcraft (2012).

Note: The shaded areas indicate periods designated recessions by the National Bureau of Economic Research.

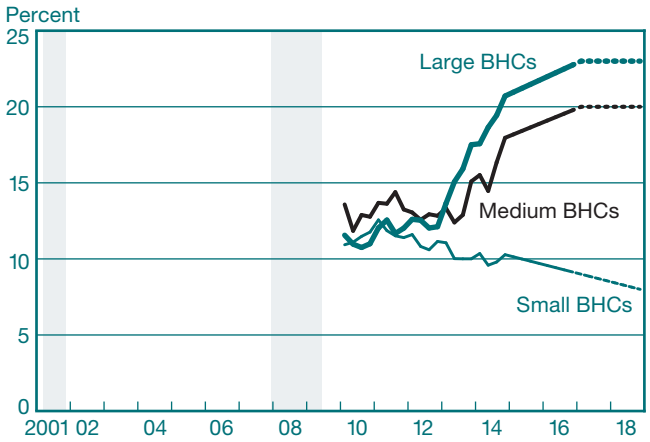
2.4 Hypothetical Liquidity and Maturity Transformation

In the scenario, liquidity ratios improve at large and medium-size banks (those with assets above $250 billion and $50 billion, respectively), reflecting the phasing in of the Basel III liquidity coverage ratios (LCR) and net stable funding ratios (NSFR). However, small banks are not subject to such regulations and they increase their exposures to long-term corporate debt and commercial mortgage loans. As a result, small banks suffer continued deterioration in the share of high-quality liquid assets (Chart 13) and widening duration gaps between assets and liabilities (Chart 14).

Money market funds (MMFs) grow in size and increase funding to nonfinancial firms, banks, and broker-dealers, leading to an expansion of their size that approaches the pre-crisis peak (Chart 15). Their maturity and liquidity mismatches continue to raise concern.[9] MMF growth stems from a move by households and nonfinancial corporations to reallocate funds from bank deposits to MMFs. In turn, MMFs finance nonfinancial corporations through commercial paper and banks and broker-dealers through repo as well as

[9] Despite the compliance date of October 2016 for new reforms, concerns about the MMFs' maturity and liquidity mismatches persist, since the floating net asset value (NAV) in itself may not entirely eliminate the risk of investor runs, and the prime retail funds are still exempt from the floating NAV.

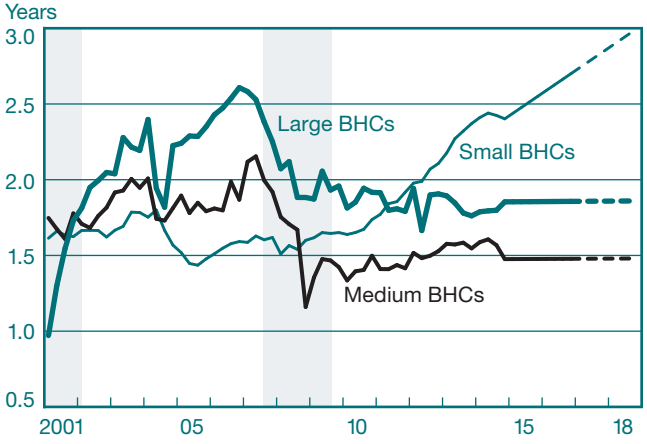
Chart 13
Liquidity at BHCs: High-Quality Liquid Assets as a Percentage of Total Assets



Sources: Federal Reserve Board, *Consolidated Financial Statements of Bank Holding Companies* (FR Y-9C data) and *Report of Transaction Accounts, Other Deposits, and Vault Cash* (FR-2400).

Notes: BHC is bank holding company. Shaded areas indicate periods designated recessions by the National Bureau of Economic Research.

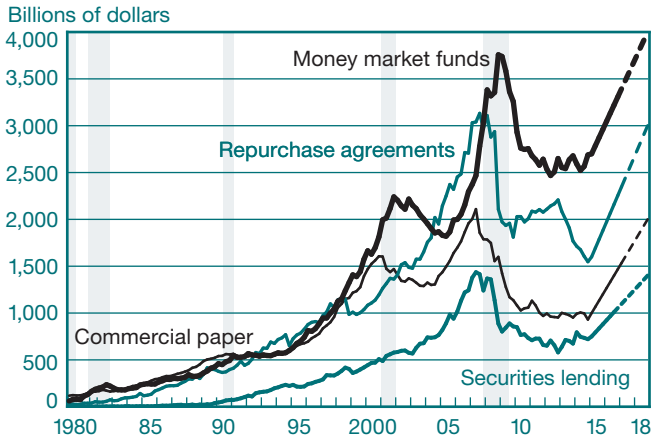
Chart 14
Maturity Transformation at BHCs: Duration Gap, Assets versus Liabilities



Source: Federal Financial Institutions Examination Council, *Consolidated Reports of Condition and Income*.

Notes: The data through 2014:Q4 include both bank holding companies (BHCs) and commercial banks without a BHC. For commercial banks without a BHC, the bank is treated like a BHC. The shaded areas indicate periods designated recessions by the National Bureau of Economic Research.

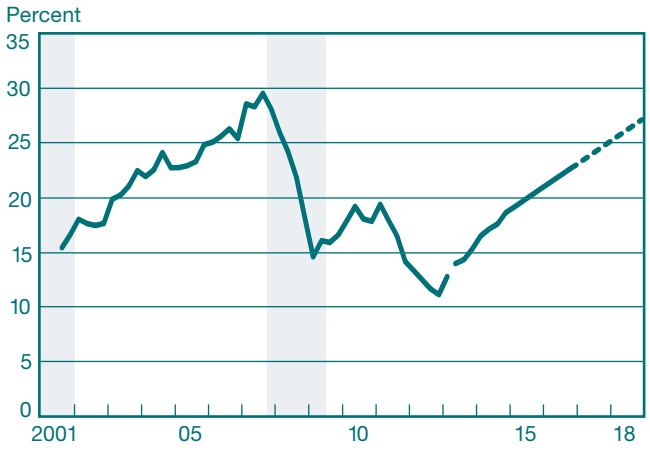
Chart 15
Short-Term Funding



Source: Federal Reserve Board, Financial Accounts of the United States. Source accessed through Haver Analytics.

Note: The shaded areas indicate periods designated recessions by the National Bureau of Economic Research.

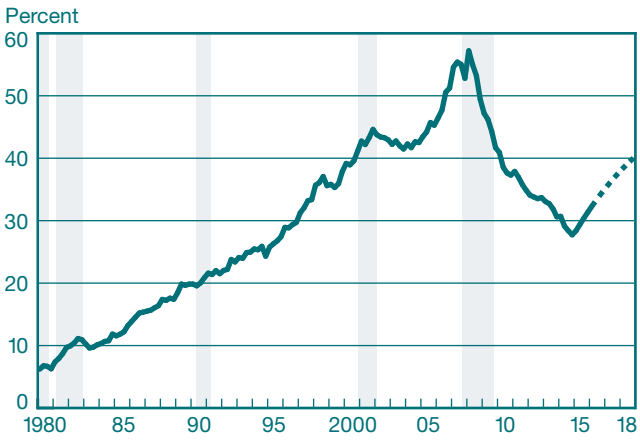
Chart 16
Share of Corporate Debt and Equities in Repo and Securities Lending by Primary U.S. Government Securities Dealers



Source: Federal Reserve Bank of New York, FR 2004, Government Securities Dealers Reports. Source accessed through Haver Analytics.

Notes: For periods prior 2013:Q2, the chart shows the share of corporate securities in the total of federal agency and government-sponsored enterprise (GSE) securities, federal agency mortgage-backed securities (MBS), and corporate securities. Starting in 2013:Q2, the chart shows the share of corporate "debt, equities, and other" in the total of U.S. Treasury securities, federal agency and GSE securities, federal agency MBS, corporate debt, equities, and other, for repurchase agreements (repos) and securities lent. The shaded areas indicate periods designated recessions by the National Bureau of Economic Research.

Chart 17
Short-Term Funding as a Percentage of GDP



Source: Federal Reserve Board, Financial Accounts of the United States. Source accessed through Haver Analytics.

Note: The shaded areas indicate periods designated recessions by the National Bureau of Economic Research.

securities-lending transactions. Repo transactions increasingly use risky corporate debt as collateral (Chart 16).

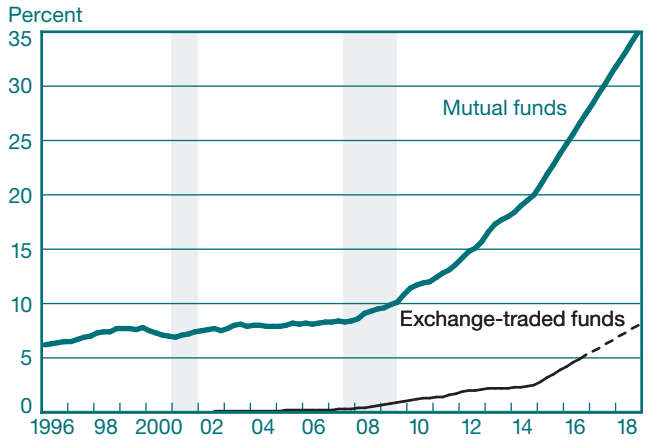
As a result, short-term wholesale funding as a fraction of GDP rises from 28 percent in early 2015 to 35 percent by the end of 2016, though that figure is far below the pre-crisis peak of 57 percent (Chart 17). The rise in short-term funding reflects repo, commercial paper, securities lending, and other forms of money market funding. Short-term funding is expected to rise slightly above 40 percent of GDP by the end of 2018.

Mutual funds and exchange-traded funds increasingly shift their portfolios away from highly liquid Treasury securities and agency debt and toward corporate and sovereign debt, acquiring increasing shares of the total amount outstanding in the market (Chart 18). While the risk of fire sales by banks, broker-dealers, and insurance companies is mitigated as a result of stricter regulations, the greater importance of mutual funds among corporate bond investors generates new sources of risk.[10] Mutual funds are potentially subject to sudden

[10] The Investment Company Act of 1940, enforced by the Securities and Exchange Commission, prohibits open-ended mutual funds from holding more than 15 percent of net assets in illiquid securities. Although the rule aims to limit the mutual funds' holdings of illiquid corporate debt, in practice the SEC defines "illiquid securities" only broadly—as securities that "may not be sold or disposed of in the ordinary course of business within seven days at approximately the value at which the mutual fund has valued the investment on its books."

Chart 18

Mutual Fund and Exchange-Traded Fund Holdings of Corporate and Foreign Bonds as a Percentage of the Total Market Outstanding



Source: Federal Reserve Board, Financial Accounts of the United States. Source accessed through Haver Analytics.

Notes: The total market outstanding is computed as all sectors' liabilities of corporate and foreign bonds held by U.S. residents, available under category L.213 in the Financial Accounts of the United States. The shaded areas indicate periods designated recessions by the National Bureau of Economic Research.

redemptions that can lower bond liquidity and widen credit spreads, thus leading to a deterioration of financing conditions for corporate borrowers.

2.5 Hypothetical Vulnerabilities

As detailed above, the scenario highlights three key risks in financial markets. First, the possibility exists of disruptions in the corporate debt market, such as a corporate default cycle, market overreaction to U.S. monetary policy normalization, or a jump in the pricing of credit risk that could result from a sudden reversal in risk appetite or foreign capital flows.

Second, to the extent that these shocks hit the commercial mortgage market, they amplify the risk of a sharp correction in commercial property prices. Disruptions to the corporate debt and commercial mortgage markets would affect the real economy directly, as nonfinancial firms lose access to financing and reduce their investment, and also indirectly, as lenders suffer valuation losses and cut lending further. The cost to the real economy increases with the size of the markets affected and the range of institutions involved (see Charts 19 and 20).[11]

Third, the increased reliance on short-term wholesale funding leaves banks and nonbank financial intermediaries vulnerable to the risk of runs on their short-term liabilities. In particular, as repo funding increasingly uses risky corporate bonds as collateral (Chart 16), disruptions in the long-term corporate bond market would impair short-term funding. Consequently, given the increasing extent of maturity transformation at financial intermediaries, disruptions in short-term funding would have additional negative consequences on the long-term debt markets as well. In particular, owing to increased concentration in illiquid corporate debt, hedge funds and bond mutual funds would become increasingly vulnerable to large redemptions in the event of adverse shocks to the corporate bond market, which would cause fire sales and exacerbate the downward pressure on asset prices.

3. Prudential Tools to Address Financial Stability Risks

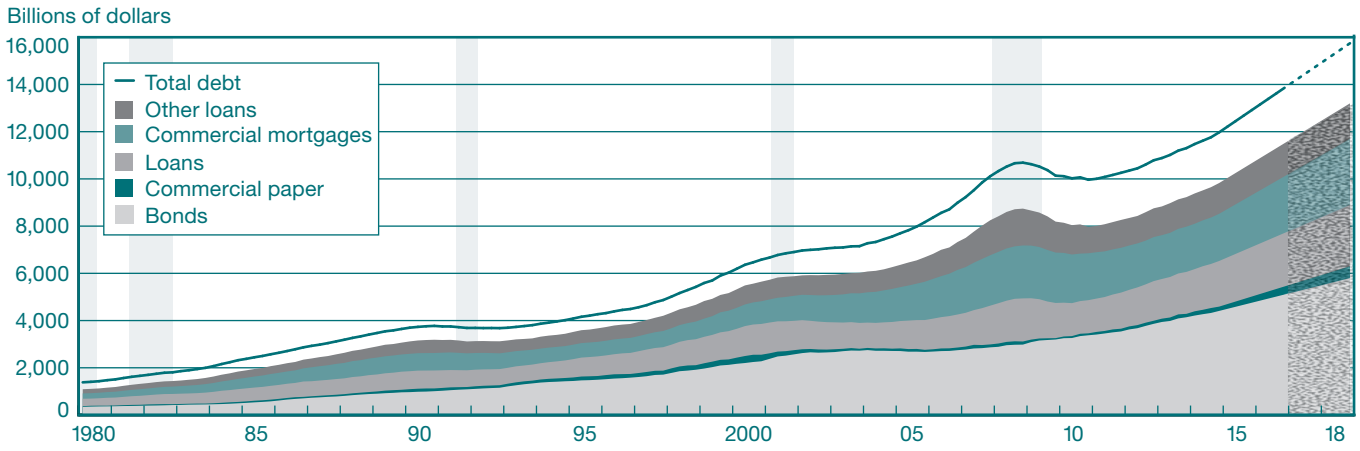
In this section, we outline the range of regulatory and supervisory tools that the Board of Governors of the Federal Reserve System can potentially use to mitigate the impact of cyclical variations in financial stability risks—those that arise only at certain times during the financial cycle, such as in booms or busts. These variations can result from overheating or the realization of stress scenarios. Note that the utilization of some tools will need to be coordinated with other banking regulators.

There are six broad categories of tools: (1) capital regulation, (2) liquidity regulation, (3) credit regulation, (4) supervisory stress tests, (5) supervisory guidance, and (6) moral suasion. The purpose of the exercise is for COP subcommittee members to gain a better understanding of the practicalities involved in applying macroprudential tools; it is not to opine on which tools would be applicable in the current economic environment.

[11] U.S. banks had little exposure to bonds, holding only about 6 percent of the total outstanding in late 2014. By contrast, U.S. shadow banking institutions, U.S. insurance companies, and foreign entities each held about one quarter of the total outstanding. U.S. banks had larger exposures to commercial mortgages, holding 56 percent of the total, while issuers of asset-backed securities, life insurers, and real estate investment trusts held 15, 13, and 8 percent, respectively. Finally, U.S. banks and credit unions held the majority of loans other than mortgages—87 percent of the total. These statistics are based on the Financial Accounts of the United States, published by the Board of Governors of the Federal Reserve System.

Chart 19

Nonfinancial Business Sector Debt by Instrument

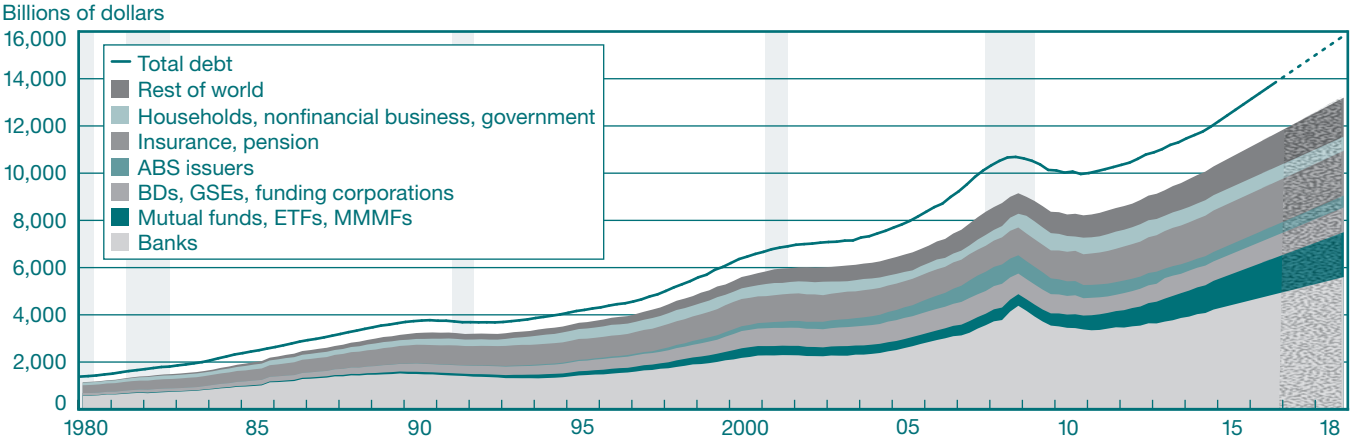


Sources: Federal Reserve Board, Financial Accounts of the United States; authors' calculations. Financial Accounts accessed through Haver Analytics.

Note: The shaded areas indicate periods designated recessions by the National Bureau of Economic Research.

Chart 20

Nonfinancial Business Sector Debt by Holder



Sources: Federal Reserve Board, Financial Accounts of the United States; authors' calculations. Financial Accounts accessed through Haver Analytics.

Notes: ABS is asset-backed securities. BD is broker-dealer. GSE is government-sponsored enterprise. ETF is exchange-traded fund. MMMF is money market mutual fund. The shaded areas indicate periods designated recessions by the National Bureau of Economic Research.

We describe each tool, its scope of application, whether it applies to downturn or overheating scenarios (or both), and its associated implementation challenges or limitations. Several broad themes emerge across the tools considered in the exercise:

- Prudential tools can be used to build resilience against shocks, in addition to "leaning against" emerging risks to financial stability.[12] This is an advantage over monetary policy, which would address financial stability concerns only by "leaning against the wind."

[12] For example, capital regulation can be used to build resilience, as the capital buffer serves to absorb unexpected losses at individual firms. To the extent that increased capital requirements discourage lending activity in the affected sector(s), capital regulation can also be used to "lean against the wind."

- Many (though not all) tools can be used to target specific exposures. This ability to target exposures is a potential advantage relative to monetary policy tools in cases where policymakers are concerned only about a specific sector.
- Most of the tools are subject to a lag between the time policymakers decide to apply the tool and the time the tool actually becomes effective. In many instances, this lag may arise as a result of administrative processes.
- Several tools are more effective in the run-up to a crisis or recession than they are during the crisis or recession.[13] This characteristic proved relevant during the exercise because the scenario under consideration involved overheating.
- Many tools are subject to limitations in their scope of application, with most applying only to banking organizations rather than to the full range of entities engaged in financial intermediation.

The set of prudential tools together with their limitations is further outlined in Table 2.

3.1 Capital Regulation

Leverage Ratios[14]

The Federal Reserve Board's minimum leverage ratios require banking organizations to hold at least a minimum amount of capital relative to their exposures. The U.S. regulatory capital rules include two leverage ratios: the leverage ratio and the supplementary leverage ratio (SLR).

- The leverage ratio applies to all banking organizations subject to the Federal Reserve Board's regulatory capital rules.[15] It is measured as tier 1 capital divided by average total consolidated assets.[16] The minimum leverage ratio requirement is 4 percent.[17]
- The SLR is effective January 1, 2018, and will apply only to banks deemed "advanced approaches banking organizations."[18] It will be measured as tier 1 capital divided by total leverage exposure, which equals the daily average total consolidated assets plus certain off-balance-sheet exposures. The minimum SLR requirement will be 3 percent.
- In addition, effective January 1, 2018, there will be an enhanced SLR requirement applicable to U.S. top-tier bank holding companies identified as globally systemically important banking organizations (G-SIBs). The enhanced requirement consists of a 2 percent leverage buffer above the minimum SLR requirement, for a total of 5 percent.[19]

Minimum leverage requirements may be used as a countercyclical tool in downturn or overheating scenarios in accordance with applicable administrative processes. For example, U.S. banking agencies have issued public notices in times of anticipated unusual and temporary asset growth (such as an influx of deposits that increased average total assets in the lead-up to the Year 2000 problem, or Y2K, and in the period following the terrorist attacks of September 11, 2001) that acknowledged the potential for declines in banking organizations' leverage ratios.[20] In addition, under the enhanced SLR, banking organizations' capital levels may fall below the leverage buffer amount without breaching the 3 percent regulatory minimum requirements, allowing banking organizations to continue lending activities during times of stress, albeit subject to restrictions on distributions and discretionary bonus payments.

Limitations and other considerations. Leverage ratios do not differentiate across exposure types—in other words, the same capital requirement generally applies to all assets. In addition, as noted above, the SLR standard only applies to a subset of the largest banking organizations. Moreover, any public notice that acknowledges temporary asset growth

[13] As we shall note, countercyclical capital buffers, loan-to-value ratios, margins, and supervisory guidance would apply in a downturn only under specific circumstances.

[14] See 12 CFR 217.10.

[15] It generally does not apply to bank holding companies or savings and loan holding companies with less than $1 billion in total consolidated assets.

[16] Tier 1 capital is a key regulatory measure of banks' capital, consisting primarily of common stock, noncumulative perpetual preferred stock, and retained earnings.

[17] All insured depository institutions are required to meet a 5 percent tier 1 leverage ratio requirement to be considered "well capitalized" under the Prompt Corrective Action (PCA) framework. The PCA framework is intended to ensure that problems at the insured depository institutions are addressed promptly and at the least cost to the FDIC's Depositor Insurance Fund. Insured depository institutions that fail to meet the capital measures under the PCA framework are subject to increasingly strict limits on their activities, including their ability to make capital distributions, pay management fees, grow their balance sheets, and take other actions.

[18] Advanced approaches banking organizations are those with at least $250 billion in total consolidated assets or at least $10 billion in consolidated on-balance-sheet foreign exposures.

[19] Organizations that maintain an SLR of 5 percent or less are subject to restrictions on distributions and certain discretionary bonus payments (though not in the form of a PCA requirement, because BHCs are not subject to PCA requirements). Insured depository institutions of G-SIBs are required to meet a 6 percent SLR in order to be considered "well capitalized" under the PCA framework.

[20] Given that such declines had the potential to result in consequences for the banks under PCA, banking organizations were encouraged to inform the banking agencies if capital ratios fell and to discuss options to address any temporary breach of capital ratio minimum requirements.

Table 2

Prudential Tools to Address Cyclical Changes in Financial Conditions

Prudential Tool Categories	Tools	Risks Addressed[a]	Applicable Scenarios		Can Target Specific Exposures?	Applicable Banks/ BHCs	Requires Interagency Agreement?	Considerations[b]
			Boom	Bust				
Capital regulation	Leverage ratios	Lev	X	X	No	Minimum leverage ratio (LR) to all, supplementary leverage ratio (SLR) to advanced approaches[c]	Yes	Assume SLR is effective by the fourth quarter of 2016 for the purposes of the tabletop exercise.
	Countercyclical buffers (CCyB)	Val, Lev	X	X[d]	No	$250 billion or more in assets[e]	Yes	Increases are effective twelve months after announcement, sooner in emergencies; decreases are effective immediately.
	Sectoral risk weights	Val, Lev	X	X	Yes	All	Yes	
Liquidity regulation	Liquidity coverage ratio (LCR)	Liq	X	X[f]	No	$50 billion or more in assets[g]	Yes	
	Net stable funding ratio (NSFR)[h]	Liq	X	X	No	TBD	Yes	
Credit regulation	Loan-to-value ratio (LTV)	Val, Lev	X		Yes	All	Yes	LTVs have been implemented through guidance that can be changed more expeditiously.
	Margins	Val, Lev	X		Yes	All and nonbanks	No	Implement using the Federal Reserve's authority under the Securities Exchange Act of 1934.
Supervisory stress test	Comprehensive Capital Analysis and Review (CCAR)	Val, Lev	X	X	Yes	BHCs with $50 billion or more in assets	No	Annual frequency creates challenges. Targeting specific exposures requires preannouncing and/or repeating the scenario.
	Comprehensive Liquidity Assessment and Review (CLAR)	Liq	X	X	Yes	BHCs in LISCC portfolio[i]	No	Potential delayed impact owing to CLAR messages being delivered annually.
Supervisory guidance		Val, Lev, Liq	X	X	Yes	All	No	
Moral suasion		Val, Lev, Liq	X	X	Yes	All	No	

[a]The risks are valuation (val), leverage (lev), and maturity and liquidity (liq).
[b]Most of the tools in this table are subject to a lag between the time policymakers decide to apply the tool and the time the tool becomes effective. In many instances, this lag may arise from administrative processes.
[c]Does not apply to bank holding companies with pro forma consolidated assets of less than $1 billion that meet several criteria. SLR applies to banks with $250 billion or more in assets or $10 billion or more in foreign exposures and enhanced SLR applies to U.S. top-tier holding companies identified as globally systemically important banking organizations (G-SIBs).
[d]The CCyB can be applied in downturn scenarios only if it has previously been activated to a nonzero level.
[e]Also applies to banks with $10 billion or more in foreign exposures.
[f]Supervisors have discretion in determining the timeframe for remediating an LCR shortfall. For the purposes of the tabletop exercise, assume that the NSFR rule allows similar discretion.
[g]LCR applies to banks with $250 billion or more in assets or $10 billion or more in foreign exposures. Modified LCR applies to banks with $50 billion or more in assets.
[h]For purposes of the tabletop exercise, assume that the NSFR is implemented similarly to the LCR in the United States and is effective by the fourth quarter of 2016.
[i]See www.federalreserve.gov/bankinforeg/large-institution-supervision.htm for a list of firms in the Large Institution Supervision Coordinating Committee (LISCC) portfolio.

resulting from exogenous factors that might adversely affect banking organizations' minimum leverage ratios would require timely interagency agreement, which would need to be balanced against concerns that a poorly timed message might signal a potential crisis.

Countercyclical Capital Buffer[21]

As part of Basel III regulatory reform, banking organizations are required to hold a capital conservation buffer (CCB) in an amount greater than 2.5 percent of total risk-weighted assets (RWAs). The CCB is composed of common equity tier 1 capital, and is in addition to the minimum risk-based capital requirements. The capital conservation buffer may be expanded, up to an additional 2.5 percent of total RWAs for a maximum buffer of 5 percent, for advanced approaches banking organizations (defined above). The additional CCB (above 2.5 percent) is referred to as the countercyclical capital buffer (CCyB). The CCyB amount in the U.S. rule is currently 0 percent.[22] When a banking organization does not maintain its CCB (plus any relevant CCyB), it is subject to dividend and discretionary bonus payment restrictions.

The U.S. banking agencies can adjust the buffer from 0 percent to 2.5 percent based on a range of macroeconomic, financial, and supervisory information indicating an increase in systemic risk.[23] Increases to the CCyB would be effective twelve months from the date of announcement or earlier if the agencies articulate the reasons why an earlier effective date is needed. Decreases to the CCyB would be effective on the day following the announcement of the final determination. Unless extended, the CCyB would return to 0 percent twelve months after the effective date.

Given that the CCyB could be activated prior to a period of stress, it could require banking organizations to raise capital when capital is relatively cheap and the system is not under stress. In addition to serving the prudential objective of achieving better capitalized banking organizations, the CCyB might further restrain the buildup of financial system vulnerabilities by influencing the amount and terms of credit conditions. Likewise, the CCyB could allow capital requirements to decrease in a stress period or enable banking organizations to withstand greater losses than if they did not have a buffer before their solvency is called into question. Thus, the CCyB can be applied to both downturn and overheating scenarios, although it can only be applied in downturn scenarios after the CCyB has been activated.

Limitations and other considerations. The CCyB does not differentiate across exposure types. While it could be activated and de-activated based on vulnerabilities identified for specific exposures, the CCyB would be applied at the overall bank level, and not at the targeted exposure level. In addition, there is a twelve-month lag for any increase in the CCyB to become effective (with the possibility of exceptions). Finally, adjustments to the CCyB will be based on a determination made jointly by the banking agencies. Because the CCyB amount would be linked to the condition of the overall U.S. financial system and not the characteristics of an individual banking organization, the banking agencies expect that the CCyB amount would be the same at the depository institution and BHC level.

Sectoral Risk Weights

Apart from the Basel III-based CCyB, countries such as the United Kingdom, Switzerland, and Israel have utilized sectoral capital requirements, which apply additional capital requirements on exposures to specific sectors judged to pose a risk to the system. Sectoral risk weights might also be used to reduce capital requirements on safer sectors during a downturn.

Limitations and other considerations. Sectoral risk weights could be applied to both downturn and overheating scenarios in accordance with applicable administrative processes. The weights could differentiate across exposure types. However, banking organizations may choose to meet the additional capital requirements for the targeted sector by reducing other exposures in other sectors.

3.2 Liquidity Regulation

Liquidity Coverage Ratio[24]

The liquidity coverage ratio (LCR) requires that banking organizations hold a minimum amount of unencumbered high-quality liquid assets (the numerator of the ratio) to withstand net cash outflows (the denominator) over a

[21] See 12 CFR 217.11.

[22] Under the reciprocity agreement reached by the United States and other member countries at the Basel Committee, a U.S. banking organization's CCyB amount can be affected by the setting of the CCyB in all jurisdictions where it maintains private sector credit exposures.

[23] Such information includes the ratio of credit to GDP, a variety of asset prices, other factors indicative of relative credit and liquidity expansion or contraction, funding spreads, credit condition surveys, indexes based on credit default swap spreads, options-implied volatility, and measures of systemic risk.

[24] See 12 CFR 249.

thirty-day stress period characterized by simultaneous idiosyncratic and marketwide shocks.

Beginning in January 2017,[25] banking organizations with assets equal to or greater than $250 billion or with foreign exposure equal to or greater than $10 billion must meet a 100 percent LCR on a daily basis.[26] Banking organizations with assets between $50 billion and $250 billion with foreign exposure less than $10 billion will be subject to a modified LCR, which will be measured monthly.

The U.S. LCR requires banking organizations that are subject to daily compliance and that fall below the minimum threshold for a period of three consecutive business days to promptly submit a remediation plan to their primary regulator. The rule does not impose a fixed requirement on BHCs that are subject to monthly U.S. LCR compliance, but rather allows for supervisory discretion when determining if a remediation plan is necessary. In both cases, the rule does not mandate a specific timeframe for returning to full compliance. The allowance for supervisory discretion in determining the timeframe for remediating an LCR shortfall should enable banking organizations to appropriately utilize their liquidity resources during a period of stress, mitigating the effects of idiosyncratic and marketwide shocks.

Limitations and other considerations. The LCR could be applied to downturn scenarios, via supervisory discretion, and to overheating scenarios in accordance with applicable administrative processes. The LCR does not differentiate exposure types and only applies to a subset of banking organizations, as described earlier. Banking organizations may be reluctant to draw down their high-quality liquid assets buffer, particularly in an idiosyncratic stress event that does not immediately affect other market participants, if the usage of these resources could be perceived as a negative signal. In addition, there will be need for coordination across U.S. banking agencies in determining the response to an LCR breach as well as assessing the appropriate timeframe for returning to compliance.

Net Stable Funding Ratio[27]

The net stable funding ratio (NSFR) measures a banking organization's sources of stable funding relative to its on- and off-balance-sheet exposures, weighted by factors reflective of the exposures' inherent liquidity characteristics. The Basel III NSFR was finalized in October 2014. The U.S. regulatory agencies have not yet issued a domestic rule to implement the NSFR.

The Basel NSFR standard does not contain any prescriptive measures regarding enforcement of an NSFR breach or remediation of a shortfall. If the U.S. agencies implement an approach similar to the LCR, banking organizations may be able to fall below the NSFR threshold during periods of stress or credit contraction, when market funding is scarcest.

Limitations and other considerations. The NSFR does not differentiate across exposure types. The flexibility of U.S. policymakers to allow for and respond to temporary NSFR shortfalls will not be known until the U.S. NSFR rule is finalized; any flexibility likely will require coordination across the banking agencies. In addition, the NSFR, like the LCR, may only apply to a subset of banking organizations.

3.3 Credit-Related Tools

Caps on Loan-to-Value Ratios

Credit-related tools are another macroprudential approach being used in countries such as Canada, Norway, and Korea. These tools include caps on loan-to-value (LTV) ratios, which restrict credit based on the value of the underlying collateral and hence dampen demand for a specific lending activity. These tools can increase the resilience of the banking system by decreasing both the probability of default and losses, given default.[28]

The U.S. banking agencies have the authority to issue rules applicable to insured depository institutions' real-estate-related lending activity. The U.S. banking agencies have issued supervisory guidance on prudent underwriting practices that includes maximums for LTV ratios that vary by real estate loan type, derived at the time of loan origination. The Federal Reserve Board could amend the guidance to increase the LTV standards. In addition, the Federal Reserve Board's regulatory capital rules incentivize banks to have prudent underwriting standards by differentiating capital requirements among exposures based on whether or not they were underwritten in compliance with the guidance.[29] Under

[25] January 2017 marks the end of the LCR phase-in period, which began in January 2015 for banking organizations subject to the full LCR, and in January 2016 for banks subject to the modified LCR.

[26] All subsidiaries of these institutions that are insured depositories with assets greater than or equal to $10 billion are also independently subject to the U.S. LCR requirement.

[27] See http://www.bis.org/bcbs/publ/d295.htm.

[28] Credit-related tools also include caps on debt-to-income (DTI) ratios, which are similar in many aspects to the caps on LTV ratios. The caps on DTI ratios can restrict certain types of loans based on the borrower's income. Hence, lower DTI caps can reduce banks' exposure to certain assets, thus addressing overheating concerns in specific sectors and enhancing banks' resilience to shocks.

[29] See 12 CFR 217.32.

the regulatory capital rules, the Federal Reserve Board could increase the capital that must be held against exposures that were not underwritten in compliance with the guidance.

Limitations and other considerations. Lower LTV ratios can be attained during overheating scenarios by tightening the caps. However, this tool would likely not be effective in downturn scenarios. While the LTV caps could be relaxed to increase credit demand, banking organizations might steer away from such loans in downturn scenarios. Therefore, supervisors generally would be relaxing a nonbinding constraint. LTV ratio caps can differentiate exposure types based on the type of collateral. Another limitation of the caps on LTV ratios is that they will only impact a subset of lenders and, therefore, may not substantially affect lending activity in a particular segment of the U.S. economy as long as banking organizations hold only a small portion of newly originated mortgages.

Margin Requirements for Securities Financing Transactions

Setting minimum initial and variation margins for securities financing transactions can constrain excess leverage in the financial system and dampen demand for the assets being financed.[30] Margin requirements can vary based on credit conditions; the minimum requirement can be increased in an overheating scenario to reduce the leverage available to borrowers, and it can be reduced in a time of stress to lower the pressure on borrowers to post additional margin or face fire sale risk.

Under the Securities Exchange Act of 1934, the Federal Reserve Board has the authority to set initial and variation margin requirements for financing that is collateralized by securities extended by broker-dealers, banks, and other nonbank lenders. Although the Federal Reserve Board used this tool between 1934 and 1974 to adjust the initial margin requirements for the equity markets and thus limit excess leverage used by investors, it has not used the tool since.

The Federal Reserve Board could consider using this authority to set and change the minimum initial and variation margin requirements for securities financing transactions, such as reverse repurchase agreements, across the financial system. The minimum margin requirements could be based on what the Financial Stability Board has recommended, as described in the section below. However, its authority under the Securities Exchange Act of 1934 to impose minimum margin requirements for securities financing transactions is limited in certain ways. The statute does not include the authority to impose minimum margin requirements for credit extended on U.S. government and agency securities by all lenders (whether broker-dealers, banks, or nonbank lenders).

The Financial Stability Board has recently finalized a framework of minimum haircuts on non-centrally cleared securities financing transactions in which financing against collateral other than government securities is provided to entities other than banks and broker-dealers.[31] In addition, non-centrally cleared securities financing transactions performed in any operations with central banks are also outside the scope of application.

Securities financing transactions provided by regulated or unregulated lenders to unregulated borrowers (such as hedge funds) will be within the scope of the Financial Stability Board framework to limit the buildup of excessive leverage outside the banking system and maintain a level playing field between regulated and unregulated securities financing lenders. Financing provided to banks and broker-dealers subject to adequate capital and liquidity regulation on a consolidated basis is excluded because applying numerical haircut floors to these transactions may duplicate existing regulations.

Limitations and other considerations. Regulators can apply margin requirements to overheating scenarios by raising the minimum margin requirements. However, this tool would likely not be effective in stress scenarios for the same reason that the LTV cap would not be effective in such scenarios. Regulators can also differentiate exposure types based on the type of collateral. However, for margin requirements to be effective, coordinated responses from other jurisdictions are needed (both for introducing the initial margin requirements and for subsequent adjusting). Otherwise, borrowers might circumvent the minimum margin requirements if they are able to borrow from an overseas market in a manner not subject to the scope of the margin requirements. The Federal Reserve Board will need to issue a notice of proposed rulemaking to impose margin requirements.

3.4 Supervisory Stress Tests

CCAR[32]

The Federal Reserve Board's annual Comprehensive Capital Analysis and Review (CCAR) applies to bank holding

[30] Variation margin is part of the margin agreement between clients and brokers that varies as a function of market conditions.

[31] See http://www.financialstabilityboard.org/wp-content/uploads/SFT_haircuts_framework.pdf.

[32] See 12. CFR 225.8.

companies with assets of $50 billion or more.[33] It includes both a qualitative review of a banking organization's capital planning process and a quantitative assessment of the banking organization's ability to maintain capital ratios above the required minimums under stressful scenarios. The Federal Reserve Board can object to a bank's capital plan and capital distributions for qualitative reasons, quantitative reasons, or both. The scenarios and outcomes are disclosed to the public.

When identified vulnerabilities rise to prominence in the months before CCAR scenarios are issued, the Federal Reserve Board could adapt the supervisory scenarios to stress these vulnerabilities in a timely fashion. If the Federal Reserve Board preannounced supervisory scenarios targeting specific exposures before the stress test "as of date" (in other words, before December 31) and also signaled that those scenarios would be repeated for future CCAR cycles until the concerns are addressed, then banks (especially those whose capital ratios under the scenario fall below the required minimums) might be motivated to adjust their holdings accordingly over time.[34]

Limitations and other considerations. CCAR could be applied as a macroprudential tool in both downturn and overheating scenarios. It can also differentiate exposure types based on the design of stressed scenarios. As noted above, CCAR applies only to a subset of banking organizations and is an annual exercise, making it less timely than other tools. When identified macrofinancial vulnerabilities occur between two annual CCAR cycles, the Capital Plan Rule, which governs CCAR, allows the Federal Reserve Board to require a single banking organization, a subset of banking organizations, or all banking organizations to resubmit their capital plans. Resubmission is required if the Federal Reserve Board determines that changes in financial markets or the macroeconomic outlook that could have a material impact on the BHC's risk profile and financial condition require the use of updated scenarios.[35] In addition, certain vulnerabilities, such as the origination of loans destined to be sold to nonbanks, may be difficult to stress through a macroeconomic or market scenario, requiring a change to the stress test framework.

[33] In addition, intermediate holding companies of foreign banking organizations will become subject to the capital plan rule starting in 2017.

[34] If the Federal Reserve Board did not signal that the scenarios would be repeated in future CCAR cycles, then the impact might be limited because banks could understate stress outcomes by temporarily exiting those exposures and buying them back after the "as of date."

[35] The Board could require banks to resubmit capital plans within thirty calendar days of certain events, including changes in financial markets or the macroeconomic outlook that could have a material impact on a bank's risk profile or financial condition that would require the use of updated scenarios.

CLAR

The Federal Reserve Board's annual supervisory Comprehensive Liquidity Assessment and Review (CLAR) exercise aims to improve banking organizations' liquidity resilience by assessing the adequacy of each firm's liquidity position in light of the firm's own risks and by evaluating the strength of the firm's liquidity risk management.[36] CLAR involves evaluation of a banking organization's liquidity positions through a range of supervisory liquidity analyses such as funding concentrations, longer funding horizons, and limits on short-term wholesale funding. It also involves the evaluation of each firm's own internal stress tests, such as the firm's assumptions regarding liquidity needs for its prime brokerage services and derivatives trading in stress scenarios.

The qualitative and quantitative review of stress testing and liquidity management and measurement practices can influence a banking organization's internal view of its ability to withstand shocks, and consequently its decision making around taking liquidity risks and reserving against these risks.

Limitations and other considerations. CLAR could be applied as a macroprudential tool in both downturn and overheating scenarios. It can also differentiate exposure types based on the scope of supervisory analysis and review. CLAR is under the sole purview of the Federal Reserve Board.

CLAR applies to a subset of banking organizations that are in the Federal Reserve's Large Institution Supervision Coordinating Committee (LISCC) portfolio.[37] In addition, although CLAR is structured as a continuous monitoring process over the year, supervisory evaluations are delivered annually, and thus delays may arise between supervisory assessments and banking organizations' reactions or implementation. Finally, supervisory stress scenarios and outcomes from CLAR are not currently disclosed to the public because they are deemed "confidential supervisory information." Therefore, modifications to this supervisory approach may have a limited impact on market expectations because the market will not know what changes are introduced by the Federal Reserve Board in a given CLAR.

3.5 Supervisory Guidance

The Federal Reserve Board and other bank regulators can address potential risks arising from a particular activity by

[36] These objectives reflect the enhanced prudential requirements of Section 165 of the Dodd-Frank Act.

[37] See www.federalreserve.gov/bankinforeg/large-institution-supervision.htm for a current list of firms in the LISCC portfolio.

issuing supervisory guidance. Supervisory guidance can be effective in establishing expectations for banks and banking organizations related to governance, risk management and measurement, stress testing, valuation, and disclosure. For example, the U.S. banking agencies issued SR 13-3, "Interagency Guidance on Leveraged Lending," to address concerns over the deterioration of underwriting practices.[38]

Limitations and other considerations. Supervisory guidance could be applied to overheating scenarios. It could be applied to downturn scenarios to the extent that supervisors find it appropriate to clarify their expectations. Supervisory guidance can differentiate across exposure types by targeting a specific activity. The Federal Reserve Board can issue guidance that applies solely to BHCs without interagency coordination but would need the agreement of the other U.S. banking agencies to issue guidance that is more broadly applicable. Although it can be more expeditious to issue guidance than to issue a notice of rulemaking, doing so in coordination with other bank regulatory agencies can still take time.

3.6 Moral Suasion

Federal Reserve policymakers could appeal to banks to address risks arising from a particular activity. This approach could also be used to influence other market participants. Moral suasion might take the form of public speeches or interviews by senior policymakers, discussions with the executives of supervised banks, and industry-wide meetings involving all market participants. For example, the Federal Reserve Board played a key role in organizing meetings between Long-Term Capital Management L.P. and a consortium of fourteen large bank and nonbank financial institutions that ultimately resolved the troubled hedge fund in 1998 (see Greenspan [1998]).

Limitations and other considerations. This approach can be implemented quickly. In addition, it can be applied to both downturn and overheating scenarios and can differentiate exposure types by targeting a specific activity. The Federal Reserve Board can seek to influence nonbank market participants but cannot require them to make changes.

[38] SR 13-3 requires a bank that purchases leveraged loans to apply the same standards of prudence, credit assessment techniques, and in-house limits that would apply if the bank originated the loans; sets expectation on underwriting and risk management standards for leveraged loans; encourages originating institutions to be mindful of the reputational risk associated with poorly underwritten leveraged transactions; and requires the banks to conduct periodic stress testing.

4. Monetary Policy Tools to Address Financial Stability Risks

This section outlines the range of monetary policy tools that the Federal Reserve can potentially use to mitigate the risks to financial stability arising from either the overheating of financial markets or the realization of adverse outcomes in the hypothetical scenario.

For the purpose of financial stability objectives in the tabletop exercise, monetary policy tools can be classified into five broad categories: (1) tools targeting interest rates, (2) forward guidance, (3) reserve requirements, (4) discount window lending, and (5) tools used for reserves management and securities lending. The tools in each of these categories and their main characteristics are outlined in Table 3. The remainder of this section presents the tools and discusses their potential to address risks to financial stability, their applicability during boom and bust scenarios, their potential to affect specific markets and institutions, and the challenges or limitations in their implementation.

Several broad themes emerge from our review of monetary policy tools. These themes highlight both the advantages and the limitations of deploying monetary policy tools to achieve financial stability objectives:

- In general, monetary policy tools can lean against risks to financial stability arising from valuation pressures, excessive leverage, and liquidity and maturity transformation.
- Monetary policy tools can be implemented quickly once the policy decision is made—an advantage not shared by macroprudential tools, which frequently involve implementation lags.
- Most monetary policy tools apply symmetrically during booms and busts. (The discount window and emergency lending facilities are exceptions, because they help mostly during busts.)
- Monetary policy tools have a broad reach; they can affect financial conditions in both the banking and nonbanking financial sectors.
- However, monetary policy tools are blunt: Unlike many macroprudential tools, they cannot target specific asset classes. (A possible exception is threshold-based forward guidance.)
- Using monetary policy tools to address risks to financial stability could lead to conflicts between policy objectives; for example, monetary tightening may reduce the risks of overheating in specific sectors at the cost of slowing economic growth more broadly.

Table 3

Monetary Policy Tools

Monetary Policy Tool Categories[a]	Tools	Risks Addressed[b]	Applicable Scenarios		Target Specific Exposures?	Applicable Institutions	Considerations
			Boom	Bust			
Targeting the federal funds rate	IOER, ON RRPs, outright purchases/ sales of Treasury securities	Val, Lev, Liq	X	X	No	IOER is with depository institutions; ON RRPs are with primary dealers, money market funds, and GSEs; outright purchases/ sales are with primary dealers; the federal funds rate applies to all	Implementation is immediate for most tools described in this table.
Targeting long-term interest rates	Outright purchases/sales of Treasury securities, agency debt, agency MBS (for example, LSAPs)	Val, Lev, Liq	X	X	No	Outright purchases/sales are with primary dealers; long-term rates apply to all	Buy (sell) long-term assets to reduce (increase) long-term interest rates.
	Extending/ contracting the maturity profile of Fed balance sheet (for example, MEP)	Val, Lev, Liq	X	X	No	Outright purchases/sales are with primary dealers; the yield curve applies to all	Increase (reduce) the maturity profile to lower (raise) the slope of the yield curve of the underlying securities.
Forward guidance	Public statements and releases	Val, Lev	X	X	Yes	All	Signal the intended path of monetary policy conditional on macrofinancial variables.
Reserve requirements	Reserve ratios	Val, Lev, Liq	X	X	No	Depository institutions	The Federal Reserve Banks have paid interest on required and excess reserves since October 2008.
Discount window lending	Discount window rate, collateral requirements	Val, Lev, Liq		X	No	Depository institutions	Provides liquidity to depository institutions against collateral, considering the market value of the underlying asset minus a haircut.
Securities lending	Regular securities lending	Liq	X	X	No	Primary dealers	The Fed offers securities lending to ensure smooth clearing of Treasury and agency securities.
Reserves management	Repos	Liq	X	X	No	Primary dealers	The Fed uses repos to fulfill reserve needs deemed transitory.
	Term Deposit Facility	Liq	X	X	No	Depository institutions	The Fed offers term deposits to manage the quantity of reserves held by depository institutions, particularly to support monetary tightening.

Note: IOER is interest on excess reserves; ON RRPs are overnight reverse repos; GSEs are government-sponsored enterprises; MBS are mortgage-backed securities; LSAP is large-scale asset purchase; MEP is maturity extension program.

[a]See Board of Governors of the Federal Reserve System, Monetary Policy Tools, http://www.federalreserve.gov/monetarypolicy/policytools.htm.

[b]The risks are valuation (val), leverage (lev), and maturity and liquidity (liq).

4.1 Tools Targeting Interest Rates

The Federal Reserve can choose from a mix of tools, with the selection depending on the type of interest rate targeted:

- *To bring the federal funds rate (the interest rate at which depository institutions trade reserves with each other overnight) into line with the target* set by the FOMC, the Federal Reserve engages in permanent open market operations (OMOs). That is, the Federal Reserve purchases (or sells) Treasury securities to inject reserves into (or drain reserves from) the market, and thus to lower (or raise) the federal funds rate. In recent years, the Federal Reserve has also used the interest on excess reserves (IOER) and the overnight reverse repo (ON RRP) facility to help control the federal funds rate. Each of these tools is discussed below.
- *To influence longer-term interest rates,* the Federal Reserve can also trade longer-term securities, such as agency debt, agency mortgage-backed securities (MBS), and longer-term Treasury securities.[39]
- *To influence term premia,* the Federal Reserve engages in simultaneous but opposite transactions with short-term and long-term securities, thus affecting the slope of the yield curve of the underlying asset.[40]

The permanent OMOs consist of outright purchases (or sales) of securities by the Federal Reserve in pursuit of longer-term goals, such as increasing (or decreasing) the amount of reserves available to banks. Under Section 14 of the Federal Reserve Act, the Federal Reserve has the authority to purchase or sell a range of assets that include Treasury securities, agency debt, and agency MBS—transactions that result in changes in the size of the Federal Reserve balance sheet and the supply of reserve balances.[41] The permanent OMOs follow decisions by the FOMC and are implemented by the Trading Desk at the Federal Reserve Bank of New York, which trades with qualified primary dealers.

In addition to using permanent OMOs, the Federal Reserve has deployed the IOER rate and the ON RRP facility to help manage the federal funds rate and maintain it within the target range.[42] By setting the IOER rate, the Federal Reserve can influence the federal funds rate, since depository institutions (DIs) have little incentive to lend to each other at rates below the IOER.[43] However, the IOER has not served as a hard floor for the federal funds rate, since institutions other than DIs can also lend in the federal funds market, but are not eligible to receive IOER. Such institutions—including government-sponsored enterprises (GSEs), primary dealers, and money market mutual funds—have tended to lend to DIs at rates below the IOER. Therefore, the Federal Reserve has used the ON RRP facility, to which the aforementioned institutions are eligible counterparties, as a supplementary policy tool to influence the federal funds rate. Since the ON RRP offering rate is the maximum interest rate that the Federal Reserve agrees to pay on the counterparties' reverse repos (arrangements in which the Federal Reserve sells securities and repurchases them the next day), the counterparties have little incentive to lend in the federal funds market at below the ON RRP rate. As a result, the IOER and ON RRP rates have served as the top and bottom of the target range of the federal funds rate.

Overall, the tools targeting interest rates can serve financial stability goals in a number of ways. For instance, monetary tightening can curb valuation pressures and excess leverage by limiting credit growth (for example, either by restraining credit demand through the interest rate channel, or by reducing credit supply through the bank lending and bank capital channels).[44] Monetary tightening can also enhance liquidity by increasing the amount of liquid assets (other than cash) available in the market

[39] After the federal funds target rate was effectively reduced to the zero lower bound in late 2008 (in other words, a target range between zero and 25 basis points), the Federal Reserve implemented three large-scale asset purchase (LSAP) programs between December 2008 and October 2014 by purchasing longer-term securities (agency debt, agency MBS, and Treasury securities), with the goal of putting downward pressure on longer-term interest rates. For a summary of LSAPs, see http://www.federalreserve.gov/monetarypolicy/bst_openmarketops.htm. Although the purchases were discontinued in October 2014, the Federal Reserve still purchases MBS under a policy in which principal payments from its holdings of agency debt and agency MBS are reinvested in agency MBS.

[40] For instance, under the maturity extension program (MEP) from late 2011 to the end of 2012, the Federal Reserve extended the average maturity of its holdings of Treasury securities in order to decrease longer-term interest rates, by purchasing securities with remaining maturities of six years to thirty years and selling an equal par amount of securities with remaining maturities of three years or less. For details on the MEP, see http://www.federalreserve.gov/newsevents/press/monetary/20110921a.htm and http://www.newyorkfed.org/markets/opolicy/operating_policy_110921.html.

[41] Agency debt refers to the debt of government-sponsored enterprises such as Fannie Mae, Freddie Mac, and Ginnie Mae. Agency MBS refers to MBS guaranteed by the aforementioned government-sponsored enterprises.

[42] See https://www.federalreserve.gov/monetarypolicy/reqresbalances.htm and https://www.federalreserve.gov/monetarypolicy/overnight-reverse-repurchase-agreements.htm.

[43] Since October 2008, the Federal Reserve has paid IOER on the reserve balances that depository institutions hold at Federal Reserve Banks in excess of the minimum required, in addition to interest on required reserves.

[44] The transmission channels of monetary policy are explained in the next section. Transmission channels include the interest rate channel, the balance sheet channel, the bank lending channel, the bank capital channel, and the risk-taking channel.

as the Federal Reserve sells liquid Treasury securities, and can reduce the incentive for risk taking by increasing the yields of safe assets. These tools can be applied immediately, can work during booms and busts, and can affect financial conditions in sectors that macroprudential tools generally cannot reach, such as the nonbank financial sector. However, targeting interest rates cannot address concerns related to specific sectors (for example, selling Treasury securities tightens financial conditions throughout the economy, not only in targeted sectors with overheating concerns). Finally, targeting interest rates for financial stability may lead to conflicts among policy objectives (for example, they may curb the growth in commercial real estate prices and corporate leverage, but at the cost of dampening inflation pressures even more and pushing unemployment above the hypothetical scenario-specific NAIRU).

4.2 Forward Guidance

With the federal funds rate at the zero lower bound, the Federal Reserve has increasingly used forward guidance to signal the future path of monetary policy as a way to affect longer-term interest rates. Since December 2008, FOMC press releases have included language suggesting that the federal funds target rate would remain exceptionally low "for some time," "for an extended period," at least until a specific date, or at least as long as unemployment and inflation do not breach certain thresholds ("threshold-based forward guidance"). Announcing that the federal funds rate would remain low for longer than previously anticipated may provide monetary stimulus by reducing long-run interest rates (see Del Negro, Giannoni, and Patterson [2015]; Harrison, Körber, and Waldron [2015]; McKay, Nakamura, and Steinsson [2015]).

In principle, a form of threshold-based forward guidance could be deployed for financial stability purposes. For example, the Federal Reserve might signal a future increase in the federal funds rate (monetary tightening) unless specific financial variables return to desirable parameters by a certain date (such as if the rate of growth of commercial property prices were to fall below 5 percent per annum within six months). Such forward guidance could condition monetary tightening on the evolution of financial variables in specific sectors, which in turn would prompt investors to reduce their exposures to those sectors. As such, forward guidance could potentially have a more targeted effect than other types of monetary policy tools.

4.3 Required Reserves

Reserve requirements represent funds that depository institutions must hold in deposits at the Federal Reserve against certain types of liabilities. The Federal Reserve has the authority to set the minimum ratio of liabilities for which depository institutions must hold required reserves at the Federal Reserve, and also the interest rate that the depository institutions receive (since October 2008) for the required reserves and excess reserves held at the Federal Reserve. Although the required reserves apply only to depository institutions, the tool affects the total supply of credit in the economy, and thus it can address risks to financial stability arising from excess valuation, leverage, and liquidity and maturity transformation (in other words, reserves in Federal Reserve deposits constitute liquid assets). The tool has the same advantages and limitations as the tools targeting interest rates.

4.4 Discount Window Lending

Through discount window lending, the Federal Reserve provides funding to individual depository institutions in times of need. By providing funds to banks in need during bad times, the tool can help arrest a fall in asset prices (preventing fire sales) and can offset a sudden stop in banks' external funding (allowing banks to roll over their debt). The Federal Reserve has the authority to decide the discount window interest rate, the collateral that banks must post to obtain such funding, and also the haircut that applies to the market value of the collateral to determine the amount of the loan. Thus, the tool differs from other monetary policy tools by being more targeted to the banking sector and by serving financial stability objectives mostly during busts.

4.5 Reserves Management and Securities Lending

The Federal Reserve can conduct temporary OMOs to address transitory market needs for reserve balances and

securities held on its balance sheet. Since temporary OMOs address transitory liquidity needs, they are not the primary tool to address financial stability concerns related to valuation pressures or excess leverage.[45] However, temporary OMOs can address risks arising from liquidity and maturity mismatches, because they affect the supply of short-term funding and the liquidity of underlying collateral securities. There are three main types of temporary OMOs: (1) securities lending serves to address market pressures and smooth the clearing of specific securities, such as Treasury securities or agency debt; (2) repos and reverse repos, equivalent to collateralized lending or borrowing, are used by the Federal Reserve to temporarily inject reserves into or drain reserves from the market; and (3) interest-bearing term deposits via the Term Deposit Facility are used to drain reserve balances from the banking system, and thus to control the short-term interest rate.

5. Transmission Channels of Macroprudential and Monetary Policies

This section provides a brief overview of macroprudential transmission mechanisms as laid out in the Committee on the Global Financial System's report "Operationalizing the Selection and Application of Macroprudential Instruments" (CGFS 2012), and an overview of monetary policy transmission as laid out in the committee's report "Regulatory Change and Monetary Policy" (CGFS 2015).[46]

5.1 Transmission Mechanisms for Capital-Based Macroprudential Instruments

Raising capital requirements serves both goals of macroprudential policy—resilience and preemption. It enhances the resilience of the banking system in a direct fashion, because the additional capital buffers enable banks to weather losses of a greater magnitude before their solvency is called into question, thus reducing the severity of disruptions to the supply of credit and other financial intermediation services during crises.

Raising capital requirements serves the goal of preemption by moderating the credit cycle. Banks have four broad options to respond to a shortfall in capital: (1) increase lending spreads, (2) decrease dividends and bonuses, (3) issue new capital, and (4) reduce asset holdings. The first three options may negatively affect credit demand, because lending spreads obviously increase in the first case and they are likely to increase in the second and third cases; higher lending spreads are a common response to increased funding costs, as implied by both a reduction in dividends and the issuance of new equity. The fourth option leads to a reduction in credit supply, because banks may respond to tighter macroprudential instruments by rationing the overall quantity of credit.

The impact on credit conditions of tightening sectoral capital requirements is similar to the tightening of general capital requirements, although more targeted. Thus, higher sectoral capital requirements increase the relative cost for banks of lending to the specified sector, providing sharper incentives to reduce activity there. Furthermore, banks with exposure to sectors singled out by regulators as particularly risky may find it hard to raise external equity, which increases the pressure on them to build up capital through retained earnings or by reducing the supply of credit. In either case, the measure has a more targeted effect on credit cycles and asset prices in specific sectors.

Tighter prudential requirements could be subject to leakages or regulatory arbitrage. The tightening of a capital-based instrument may be ineffective if banks reduce voluntary buffers. Through regulatory arbitrage, some of the reduction in bank credit is expected to be taken up by nonbank intermediaries or internationally active banks that are not subject to the increased requirement. Furthermore, large borrowers in developed markets may be able to replace bank credit with the issuance of bonds and similar instruments.

[45] As an exception, the Federal Reserve has used the ON RRP facility to help control the federal funds rate since September 2014. The FOMC has stated that it will use the facility only to the extent necessary and will phase it out when it is no longer needed to control the funds rate.

[46] For empirical evidence on the effectiveness of macroprudential tools in foreign economies, see Akinci and Olmstead-Rumsey (2015), CGFS (2012), and International Monetary Fund (2012).

5.2 Transmission Mechanisms for Macroprudential Capital Stress Tests

Macroprudential capital stress tests are conducted through the use of a stress scenario. This scenario is fed into a model to forecast banks' income and thus determine net profits. The projected profits and losses, in turn, determine expected bank capital in the stress scenario. To the extent that a bank's capital ratios under the scenario fall below the required minimums, the test can be considered "binding" and the bank will have to adjust its capital plan by reducing payouts in order to build capital. The stress test will be more or less binding over time depending on the interaction of two channels: changes in bank portfolios and changes in the stress scenario. The latter channel could be considered a form of tightening regulatory capital requirements, as specific assets on banks' portfolios become subject to more or less pessimistic assumptions under the stress scenario. In this case, stress tests would have a similar transmission mechanism to the capital-based instruments discussed in the previous section.

Conceptually, stress tests can be tailored to address various sources of systemic risk. For example, asset prices in specific sectors—such as residential or commercial real estate—can increase rapidly in buoyant times and present a common source of downside risk. To reflect such "salient risks," the scenario can be tailored to assume sharp declines in real estate prices, leading to higher capital needs for banks with exposures to the targeted sectors (in other words, the resilience goal).[47] If the scenario is repeated over time, the stress test may even prompt banks to proactively reduce exposure to the targeted sectors (the preemptive goal).

[47] See the Federal Reserve's "Policy Statement on the Scenario Design Framework for Stress Testing," available at http://www.federalreserve.gov/bankinforeg/bcreg20131107a1.pdf. This document introduces the concept of salient risks, which are "specific risks to the economic and financial outlook that are especially salient but will feature minimally in the scenario if the Board were only to use approaches that looked to past recessions or relied on historical relationships between variables." The document notes that "There are some important instances when it will be appropriate to augment the recession approach with salient risks. For example, if an asset price were especially elevated and thus potentially vulnerable to an abrupt and potentially destabilizing decline, it would be appropriate to include such a decline in the scenario even if such a large drop were not typical in a severe recession."

5.3 Transmission Mechanisms for Liquidity-Based Macroprudential Instruments

Raising liquidity requirements serves both the preemptive and resilience objectives of macroprudential policy. It serves the preemptive objective through its impact on the credit cycle or expectations, which, in turn, may lead to a tightening of banks' risk management standards. It also serves the resilience objective by enhancing the ability of banks to weather periods of liquidity stress more easily, because it forces them to retain liquid assets whose prices remain stable during fire sales and to become less reliant on fragile short-term funding.

Banks will tend to respond to a rise in generic liquidity requirements by adjusting the profile of their assets and liabilities, using one or more of the following broad options: (1) replace short-term with long-term funding, (2) replace unsecured with secured funding, (3) replace illiquid with liquid assets, (4) shorten maturities of the loan book, and (5) decrease (illiquid) asset holdings that require stable funding. On the one hand, replacing short-term with longer-term funding or shifting from unsecured to secured funding will tend to increase funding costs. Replacing illiquid with liquid assets or shortening the average maturity of the loan book, on the other hand, will tend to reduce banks' earnings. All these cases might lead to an increase in lending spreads or a lowering of profits, which in turn would result in a higher price of loans and thus reduced credit flow. Banks can also reduce holdings of asset classes that require stable funding, which would result in reduced credit supply. In either case, tighter liquidity requirements could decrease the overall volume of credit in the economy, with illiquid lending likely to be most affected.

5.4 Transmission Mechanisms for Credit-Related Macroprudential Instruments

Credit-related macroprudential instruments strengthen the ability of the banking system to weather a crisis (the resilience goal) by reducing both the probability of default (PD) and the loss-given-default (LGD) of loans. First, by restricting the amount that can be borrowed against the given value of a property or collateral, caps on LTV ratios and margin requirements on security financing transactions reduce leverage and, in doing so, reduce the PD. Second, caps on LTV ratios and margin requirements enable lenders to recover

higher portions of their loans in the event that collateral values decline, which reduces the LGD. In addition, because higher margins reduce borrowers' reliance on short-term funding, margins lower the risk of fire sales that borrowers would conduct—and the resulting losses—in the event that short-term funding becomes difficult to roll over.

Tighter LTV and DTI ratio caps can also restrict the quantity of credit to specific sectors (the preemption goal) by limiting the funding available for certain borrowers. For instance, by restricting the amount of mortgage lending, the measures may also reduce home purchases and increase savings. In principle, house prices will tend to ease, an outcome that in turn reduces households' ability to obtain credit and withdraw equity more generally. Margin requirements could also serve the preemption goal. For example, they might limit the amount of short-term funding that borrowers use to finance assets in certain sectors, such as CMBS and ABS.

There are at least three distinct channels through which leakages can occur. First, there may be leakages to the unregulated sector and foreign banks. Second, arbitrage through nonmortgage (unsecured) top-up loans is a possibility. Uncollateralized top-up loans (such as those from real estate companies) could also facilitate home ownership if LTV ratio caps are overly restrictive when creditworthiness is assessed on a broader range of indicators. Third, if households are constrained by asset-side macroprudential instruments, the structure of the housing market could evolve in ways countering the intended effect (for example, through the emergence of part-purchase, part-rent models of home ownership).

5.5 Transmission Mechanisms of Monetary Policy

Interest Rate Channel: The interest rate channel of monetary policy refers to the impact of changes in short-term interest rates set by the central bank on longer-term borrowing rates, through expectations about the future path of policy. Longer-term rates affect output by influencing savings and investment decisions. Changes in central bank policy rates will also affect broader financial conditions. For instance, certain contracts, such as floating-rate mortgages and some corporate bonds, link rates faced by firms and households to short-term benchmark rates, giving rise to a direct transmission of short-term rates to long-term borrowers' cost of funding.

Balance Sheet Channel: The other channels of policy transmission focus on the role played by banks and other intermediaries in the financial system. One important role of financial intermediaries is to overcome frictions within financial markets that arise from information asymmetries and incomplete contracts. As a way of mitigating these frictions, some loans to firms and households are secured by assets, or are otherwise dependent on borrower attributes such as cash flow, liquid assets, or net worth. As a result of these frictions, a "financial accelerator" effect arises, whereby adverse economic shocks lower collateral values and further worsen economic activity, thus leading to excessive tightening of credit conditions in bad times. To break this cycle, monetary policy may curb the deterioration in collateral values by reducing interest rates. The potency of the balance sheet channel depends upon the extent to which borrowers are dependent on collateralized credit.

Bank Lending Channel: The bank lending channel operates primarily through the impact of monetary policy on the supply of reserve balances available to banks, which in turn affects banks' cost of funding. For instance, during monetary tightening, banks' cost of funds increases, since the different forms of bank funding are imperfect substitutes and accessing alternative sources of funding may require higher costs (such as replacing regular deposits with certificates of deposit). In turn, changes in the cost of funding impact the supply of loanable funds from banks. Even if changes in the stance of monetary policy do not affect the supply of reserves, the bank lending channel can impact the supply of credit by changing the amount of relatively cheap deposit funding that banks receive. For borrowers that have limited access to capital markets and therefore cannot readily substitute between bank loans and other forms of credit, the bank lending channel reinforces the interest rate channel.

Bank Capital Channel: The bank capital channel refers to the impact of monetary policy on banks' net worth. Tighter monetary policy may reduce the value of bank assets by reducing the capacity of borrowers to repay bank loans and by lowering the value of assets pledged as collateral on those loans. The change in net worth in turn impacts banks' willingness to supply credit.

Risk-Taking Channel: Monetary policy affects incentives for risk taking and, therefore, the risk premia component of interest rates. A protracted period of easier monetary policy can increase the amount of risk that intermediaries are prepared to tolerate through a "reach for yield" process, and also through the impact of interest rates on asset valuation, income, and cash flows, which can affect banks' measurements of risk. However, threshold-based forward guidance—whereby the FOMC announces that it will tighten monetary policy unless the growth of asset prices declines below a certain threshold—could limit the impact of low interest rates on asset prices.

The specific mechanisms through which the risk-taking channel operates include the pricing of risk; leverage; maturity and liquidity transformation; and interconnectedness and complexity. These mechanisms in turn operate across different sectors:

- In financial asset markets, monetary policy affects financial conditions not only through the risk-free term structure but also through risk premia. Monetary tightening generates negative stock returns through increases in risk premia, while the easing of monetary policy tends to reduce risk premia on corporate bonds owing to increased risk taking by financial institutions.
- In the banking sector, looser monetary policy increases banks' incentive to use short-term funding while increasing the share of risky assets and potentially loosening underwriting standards. To the extent that banks try to maintain a relatively stable leverage ratio over the cycle, and that risk-weighted assets drop when asset prices boom, banks will tilt their balance sheets toward riskier assets.
- In the nonbank financial sector, the same forces are at work as in the banking sector, but to a greater degree. The nonbank financial system is less constrained by regulation, leading to a greater transmission of monetary policy to financial conditions through a larger degree of endogenous risk taking. Such increased risk taking may be evident in higher leverage and greater maturity and liquidity transformation.

6. Summary of the Tabletop Exercise

The five members of the Financial Stability Subcommittee of the Conference of Presidents (henceforth "committee members") shared their views on the key risks to financial stability under the scenario and potential options to address these risks. These options included monetary policy as well as the set of macroprudential tools presented in Section 3.

6.1 Risks to Financial Stability

Committee members discussed which factors they believed posed the most immediate risks to financial stability in the scenario. Most stated that financial conditions are too loose relative to the macroeconomic conditions in the scenario, despite the monetary tightening that occurs in the scenario. In particular, both risk and term premia under the scenario are very narrow. Members also cited the risk of hitting the zero lower bound again in the event of a crisis, given the relatively low target federal funds rate under the scenario. A sharp reversal in the pricing of risk would disrupt the corporate debt market, with potentially adverse consequences for the real economy.

Among the macroprudential tools that were considered, stress testing, margins on repo funding, and supervisory guidance were preferred over capital-based, liquidity-based, or credit-based macroprudential tools.

Committee members also noted that commercial real estate (CRE) prices are elevated in the scenario and that a sharp decline would have adverse consequences at the macroeconomic level. The adverse consequences would result mainly from losses in the financial system, since CRE represents a large share of banks' collateral, and only to a lesser extent from a slowdown in construction investment, which makes a relatively small contribution to GDP growth. Committee members also noted that, depending on the nature of the CRE investments being made, actions aimed at CRE valuation could be unpopular.

Members expressed concern that under the scenario, reliance on short-term wholesale funding (STWF) provided by nonbank financial institutions is high. Although some institutions providing short-term wholesale funding are affiliated with bank holding companies (broker-dealers, for example), a considerable portion of STWF providers are not subject to Federal Reserve supervision. As a result, it would be difficult to directly address this concern.

Maturity mismatches at small banks are high in the scenario, because the banks' investments in illiquid CRE are funded by short-term liabilities. Some committee members argued that the risk of runs is low for individual banks, since their deposits are insured. However, others argued that to the extent that these institutions are exposed to similar risks, a more pronounced decline in CRE prices could trigger broader runs on these banks as a group, which could pose a threat to financial stability.

6.2 Potential Actions to Address Risks to Financial Stability

Committee members discussed a range of monetary and macroprudential actions that may be appropriate responses to the risks to financial stability identified in the hypothetical scenario.

Some members favored the use of macroprudential tools, while others favored monetary policy actions. Among the macroprudential tools that were considered, stress testing, margins on repo funding, and supervisory guidance were preferred over capital-based, liquidity-based, or credit-based macroprudential tools. This preference was expressed in light of the implementation challenges associated with the latter group of tools (including implementation lags, coordination among regulatory bodies, and limited scope of application, as discussed below).

All committee members mentioned the possibility of using a tailored stress test as a macroprudential tool, where the stress test scenario could potentially include a component aimed at the nonfinancial business sector. In the context of the tabletop exercise, one member specifically raised the possibility of an adverse scenario that assumes a sharp decline in CRE prices and a run on short-term wholesale funding.[48] Stress test implementation options discussed included preannouncing and repeating the supervisory scenario over time as ways to alter banks' portfolio decisions, applying the existing CCAR exercise outside of its usual annual cycle, and implementing some form of stress test to cover smaller banks.

The committee also discussed using margin requirements for repo funding based on the authority granted to the Federal Reserve Board under the Securities Exchange Act of 1934. The Federal Reserve Board used this tool by changing margin requirements for the equities market between 1934 and 1974, but it has not used it since then. There was also some hesitation regarding this approach, because it would represent a significant expansion in the scope of Federal Reserve Board influence over financial markets.

Most committee members also envisioned the continued use of supervisory guidance and discussions with industry participants, as well as public statements. In the context of the hypothetical scenario, they discussed new guidance to tighten underwriting standards in CRE lending. Several advocated beginning with "soft" macroprudential tools such as supervisory guidance before considering other tools such as stress testing or margin requirements. Other members seemed to prioritize stress testing and margin requirements ahead of supervisory guidance. Although these members did not specify a reason for the prioritization of stress testing and margin requirements, they may have perceived guidance as being less binding than the other tools.

In considering the various macroprudential tools, committee members identified several concerns that could potentially make the use of these tools less attractive. One concern was that many of the tools require coordination among different regulators in order to be effective, and that achieving such coordination would slow the implementation process. Another concern was that many of the tools have additional implementation lags, which may be explicit or may arise from administrative processes.[49] Committee members also pointed to the limited scope of application of some macroprudential tools (for example, those that apply only to regulated banking organizations). Broadly speaking, the various implementation lags cited during the exercise steered committee members away from many macroprudential tools and toward monetary policy, as well as toward those macroprudential tools (such as tailored stress tests) that could be implemented more expeditiously.

In light of . . . concerns regarding macroprudential tools, some members favored monetary policy . . . to address risks in the hypothetical scenario; others advocated beginning with the macroprudential tools but using monetary policy at a later date if macroprudential actions were not effective.

In light of these concerns regarding macroprudential tools, some members favored monetary policy over macroprudential tools to address risks in the hypothetical scenario; others advocated beginning with the macroprudential tools but using monetary policy at a later date if macroprudential actions were not effective. Some also suggested that implementation of macroprudential tools could be accompanied by a public signal on the possibility of deploying monetary policy at some future date, thus leveraging the expectations channel of monetary policy.

[48] The suggestion was for a decline in CRE prices greater than that which was incorporated in the 2015 CCAR stress scenario.

[49] For an example of explicit lags, see the earlier discussion regarding CCyB implementation.

7. Conclusion

This article examines a macroprudential tabletop exercise that was conducted by members of the Financial Stability Subcommittee of the Conference of Presidents of the Federal Reserve in June 2015. The tabletop exercise presented participants with a plausible, albeit hypothetical, macrofinancial scenario that would lend itself to macroprudential considerations. The scenario featured a compression of U.S. term and risk premia through the fourth quarter of 2016—projected to continue thereafter—which keeps financial conditions loose and fuels valuation pressures in U.S. financial markets. The compression of risk premia also encourages the issuance of corporate debt and leveraged loans, which boosts leverage in the nonfinancial business sector. In addition, valuation pressures also arise in the commercial property market. At the same time, the nonbank financial sector, including money market mutual funds, expands in size and provides short-term wholesale funding to the nonfinancial business sector. These developments occur while the Federal Reserve is assumed to gradually tighten monetary policy in 2015 and 2016, as inflation is assumed to persist at its target rate and unemployment to persist at the hypothetical scenario-specific NAIRU. Consequently, monetary policy is constrained from tightening further, and the looser-than-desired financial conditions give rise to a rationale for macroprudential tools.

Committee members shared their thoughts about the most immediate risks to financial stability present in the hypothetical scenario, viewing financial conditions as being too loose relative to the macroeconomic conditions, despite the monetary tightening. Committee members also noted that commercial real estate prices were elevated in the hypothetical scenario, and that a sharp decline would have adverse consequences at the macroeconomic level. Members expressed concern regarding the reliance on short-term wholesale funding provided by nonbank financial institutions in the scenario. Maturity mismatches at small banks were also judged to be high in the hypothetical scenario, because the banks' investments in illiquid commercial real estate were funded by short-term liabilities.

Committee members discussed a range of monetary and macroprudential actions that may be appropriate responses to the financial stability risks identified in the hypothetical scenario, recognizing that the purpose of the discussion was not to opine on which tools (if any) would be applicable in the current economic environment. Of the full range of tools considered, many of the prudential tools were found to be less attractive owing to implementation lags and limited scope of application. The prudential tools most favored by participants were those deemed to pose fewer implementation challenges, in particular stress testing, margins on repo funding, and supervisory guidance. Nonetheless, monetary policy came more quickly to the fore as a financial stability tool than might have been thought before the exercise.

Editor's note:
This article has been updated since its initial publication on the Bank's website in March 2016. The updates primarily affect Section 4 and Table 3; the article's conclusions remain the same.

—February 2017

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Ravi Bhalla, Rajashri Chakrabarti, and Max Livingston

A Tale of Two States: The Recession's Impact on N.Y. and N.J. School Finances

- Despite the importance of schools to economic growth, little research exists on the effects of recessions on school finances.
- This study compares the experiences of school districts in New York and New Jersey in the wake of the 2007-09 recession.
- In 2009 and 2010, New Jersey's total per pupil funding fell sharply compared with pre-recession trends, while New York's stayed on trend. New Jersey's bigger cuts in state aid and smaller increases in federal funding drove the split. Spending, meanwhile, decreased in New Jersey but remained on trend in New York.
- The states' differing demographics, budget laws, and state tax revenue experiences all contributed to these divergent outcomes.

1. Introduction

It is important, from both a scholarly and a policy perspective, to understand the impact of the Great Recession and the subsequent federal stimulus program on school finances. To this end, previous articles in the *Economic Policy Review* have studied the effects of these developments on school district finances in New York (Chakrabarti, Livingston, and Setren 2015) and New Jersey (Chakrabarti and Sutherland 2013) and uncovered some important patterns. While both states faced declining revenues and widening budget gaps, their education finance experiences exhibited meaningful differences. These differences were evident both on the funding side and in the spending decisions of the states' school districts. The objective of this article is to present and study these differences, drawing from the two articles mentioned above. Such a comparative analysis promises to deepen our understanding of the experiences of school districts across our region, and may also help inform policymakers about appropriate responses to fiscal duress. To the best of our knowledge, this is the

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To view the authors' disclosure statements, visit https://www.newyorkfed.org/research/author_disclosure/ad_epr_2017_school-funding-nynj_chakrabarti.html.

first article that seeks to understand how the impact of the Great Recession on school finances varied across states.[1]

Our study reveals some interesting contrasts between districts in New York and New Jersey. In the two post-recession years we consider (2009 and 2010), New Jersey's total per pupil funding sustained deep cuts relative to trend, while New York's remained on trend. The composition of district funding also changed in different ways in the two states. Although both states experienced large increases in federal funding as a result of the stimulus, New York saw its per pupil federal aid more than double—a substantially larger increase than that in New Jersey. Additionally, while both states saw reductions in state funding, New Jersey districts experienced markedly larger cuts in state aid relative to their counterparts in New York. Total expenditures, meanwhile, followed a pattern similar to that of total funding, remaining on trend in New York and falling significantly in New Jersey.[2]

To further understand the differences in school finance patterns between the two states, we take a detailed look at factors influencing the components of aid. Our analysis reveals that differences in demographic composition, in how state tax revenues fared, and in budget laws were important factors behind the patterns noted above. New Jersey's declines in state tax revenue and its strict budget laws combined to create particularly tough fiscal circumstances.

We begin our analysis by exploring the funding differences between New York and New Jersey in detail.

2. Contrasting School Funding Impacts: New York and New Jersey

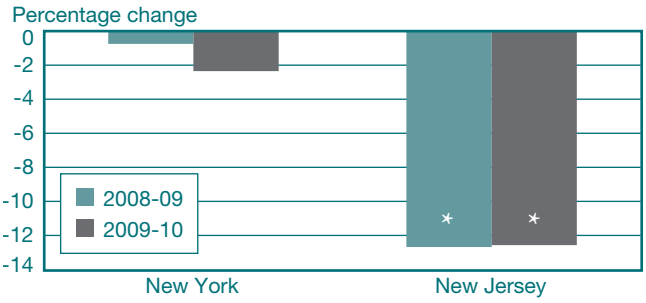
In this section, we use trend shift analysis to identify the changes in education financing in New York and New Jersey brought about by the Great Recession and the federal stimulus program (see the box on the next page for details on our methodology and data). In Charts 1 through 8, the green bar represents the 2009 shift for each state and the gray bar represents the 2010 shift. Each of the charts shows values for both New York and New Jersey. We refer to school years by the year corresponding to the spring semester (for example, 2009 refers to the 2008-09 school year).

Chart 1 shows the shifts in per pupil funding for both states, relative to the corresponding pre-recession trends. While per pupil funding remained on trend in New York, funding in New Jersey fell sharply. New York disrticts experienced only small declines, and they were not statistically significant. New Jersey experienced large declines of around 12 percent in both years, and each shift was statistically significant.

In addition to differences in how overall funding changed, there were also important variations in how the composition of that funding changed. Most public school funding comes from three government sources: the federal government, the state government, and local government. Historically, school districts rely most heavily on local and state aid. The former is raised by school districts and comes mostly from property taxes, while the latter is funded largely through state income taxes and sales taxes. In the pre-recession period (2008), New York districts received 3 percent of financing from federal aid, 40 percent from state aid, and 56 percent from local funding. Meanwhile, New Jersey districts received approximately 2.5 percent of financing from federal aid, 34 percent from state aid, and 63 percent from local funding.

The recession and stimulus resulted in significant changes in the composition of district funding, but these shifts look different for New York and New Jersey. Relative to pre-recession trends, both states experienced a statistically significant boost in per pupil federal aid in 2010 from

Chart 1
Total Funding per Pupil



Sources: New York Office of the State Comptroller; New Jersey Department of Education; National Center for Education Statistics.

* Significant at the 10, 5, or 1 percent level.

[1] This article belongs to the literature on school district funding. Stiefel and Schwartz (2011) find evidence that large increases in per pupil funding occurred in New York City during 2002-08. Rubenstein et al. (2007) find that, in general, higher-poverty schools received more funding per student. Baker (2009) finds that for schools in Texas and Ohio, resources vary according to student needs within districts. On the expenditure side, Bedard and Brown (2000) study the impacts of various within-district allocation strategies.

[2] This study pertains solely to school finances in these districts. Educational outcomes (or any other outcomes) in these districts are beyond the scope of this article.

Data and Methodology

As noted in the text, this article draws on two previous studies of school financing.[a] Our New York and New Jersey studies employed a trend shift analysis using school finance data obtained from the New York Office of the State Comptroller and the New Jersey Department of Education Finance Office, respectively.[b] The specification estimated in both studies is as follows:

$$Y_{it} = \alpha_1 t + \alpha_2 v_1 + \alpha_3 v_2 + \alpha_4 X_{it} + f_i + \mathcal{E}_{it},$$

where Y_{it} is a financial indicator for school district i in year t; t is a time trend variable that equals 0 in the immediate pre-recession year (2008) and increases by 1 for each subsequent year and decreases by 1 for each previous year; v_1 is a dummy representing the recession, $v_1 = 1$ if year > 2008 and 0 otherwise; v_2 is the stimulus dummy, $v_2 = 1$ if year > 2009 and 0 otherwise; X_{it} represents the demographic characteristics of the school district (racial composition and percentage of students eligible for free or reduced-price lunches); and f_i denotes district fixed effects.

All financial variables are inflation-adjusted to 2009 dollars. All regressions include district fixed effects and demographic controls. The results are robust to the inclusion or exclusion of covariates.

The coefficient on the time trend variable, α_1, denotes the overall trend in the financial indicator in the pre-recession period. The intercept shift coefficient, α_2, denotes whether there was an intercept shift (from the pre-recession trend) in the first year after recession. And α_3 captures any additional shift in 2009-10, the year the stimulus was implemented and school districts received an infusion of funds. The intuition driving this estimation strategy is as follows: Had there been no recession, we would expect school finances to continue growing at their pre-recession trend. The post-recession effects (α_2 and ($\alpha_2 + \alpha_3$)) are captured by shifts from this trend in the post-recession period (2009 and 2010). To quantify the relative change in each financial variable, we compute the percentage shifts obtained by expressing the shifts α_2 and $\alpha_2 + \alpha_3$ from the specification as percentages of the pre-recession (2008) base of the corresponding financial variable (Y_{it}). This pre-recession base is simply the average across school districts of each Y_{it} in the 2008 school year. Percentage effects are easily interpreted and compared between states and are thus more informative than simply looking at the coefficients (α_2 and α_3).

For this article, we report just the two percentage shifts; corresponding results for the regression coefficients are reported in Chakrabarti, Livingston, and Setren (2015) and Chakrabarti and Sutherland (2013). First, we report the 2009 percentage shift immediately following the recession, calculated as $\frac{\alpha_2}{\text{pre-recession base}}$ for each finance variable (Y_{it}). Second, we report the percentage shift in 2010, calculated as $\frac{\alpha_2 + \alpha_3}{\text{pre-recession base}}$ for each finance variable (Y_{it}). The first percentage shift captures the effect of the recession in 2009 and the latter captures the combined effect of the recession and the federal stimulus in 2010. In Charts 1 through 8, these percentage shifts are plotted. Bars labeled "Percentage shift in 2008-09" reflect $\frac{\alpha_2}{\text{pre-recession base}}$ and bars labeled "Percentage shift in 2009-10" reflect $\frac{\alpha_2 + \alpha_3}{\text{pre-recession base}}$.

[a] For more details on the data and empirical methodology, see Chakrabarti, Livingston, and Setren (2015) and Chakrabarti and Sutherland (2013).

[b] Data for the analysis come from multiple sources. For New York, we use school district financial report data from the New York Office of the State Comptroller, which cover all school districts in New York for the 2005 to 2010 school years. The report includes information on funding, expenditure, enrollment, and various components of funding and expenditure. New Jersey data are obtained largely from the New Jersey Department of Education's Office of School Finance and cover the same period. Like the New York data, the New Jersey data cover funding and expenditure and the components of each, as well as enrollment information. Components of expenditure include instructional expenditures, instructional support, student services, utilities and maintenance, transportation, and student activities. See the table in this box for a more detailed breakdown. We also use data from the National Center for Education Statistics to supplement finance and demographic figures.

Definitions of Expenditure Components

Instruction	
Instructional expenditures	All expenditures associated with direct classroom instruction, including teacher salaries and benefits, classroom supplies, and instructional training
Noninstruction	
Instructional support	All support service expenditures designed to assess and improve students' well-being, including food services, educational television, library, and computer costs
Student services	Psychological, social work, guidance, and health services
Utilities and maintenance	Heating, lighting, water, and sewage; operation and maintenance
Transportation	Total expenditures on student transportation services
Student activities	Extracurricular activities, including physical education, publications, clubs, and band

Data and Methodology *(Continued)*

Interpretation of the Post-Recession Effects

There is an important caveat to this strategy. The estimates from the specification capture shifts from the pre-existing trend of the corresponding financial variables. However, the specification does not control for any other relevant shocks that might have taken place in the two years following the recession and affected these financial variables. To the extent that there were such shocks that affected our outcomes, our estimates will be biased. As a result, we would not like to portray these estimates as causal effects, but as effects that are strongly suggestive of the effects of recession and stimulus on various school finance variables. Moreover, we did extensive research to assess the presence of shocks (such as policy changes) that might affect our outcome variables of interest independently of the recession and stimulus, and we found no evidence of such bias. For a more detailed discussion, see Chakrabarti, Livingston, and Setren (2015) and Chakrabarti and Sutherland (2013).

the stimulus, but New York's was an order of magnitude larger than New Jersey's (roughly 120 percent versus 13 percent), as shown in Chart 2.

This differential impact of the federal stimulus is also clearly visible in the maps presented in Exhibit 1, which demonstrate a few key points. Within each state there is a great deal of variation in the amount of federal aid districts receive, but despite these heterogeneities the stimulus' impact is clearly visible across almost all districts in each state. When we compare the two states, however, it is clear that New Jersey districts relied less on federal aid both before and after the stimulus. The maps also show that not only was the effect of the stimulus much larger in New York, it was also more widespread.

State finances were severely constricted during this period. As a result, both New York and New Jersey cut spending on K-12 education. However, New Jersey districts experienced

Chart 2

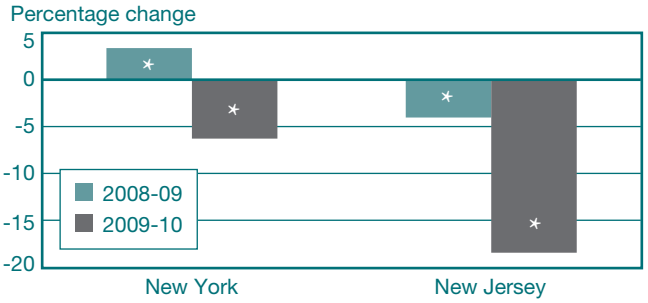
Federal Funding per Pupil

Sources: New York Office of the State Comptroller; New Jersey Department of Education; National Center for Education Statistics.

* Significant at the 10, 5, or 1 percent level.

Chart 3

State Funding per Pupil

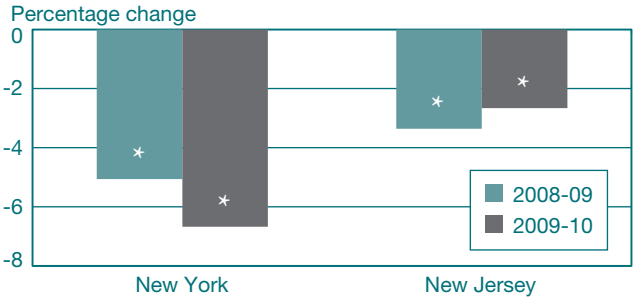


Sources: New York Office of the State Comptroller; New Jersey Department of Education; National Center for Education Statistics.

* Significant at the 10, 5, or 1 percent level.

Chart 4

Local Funding per Pupil

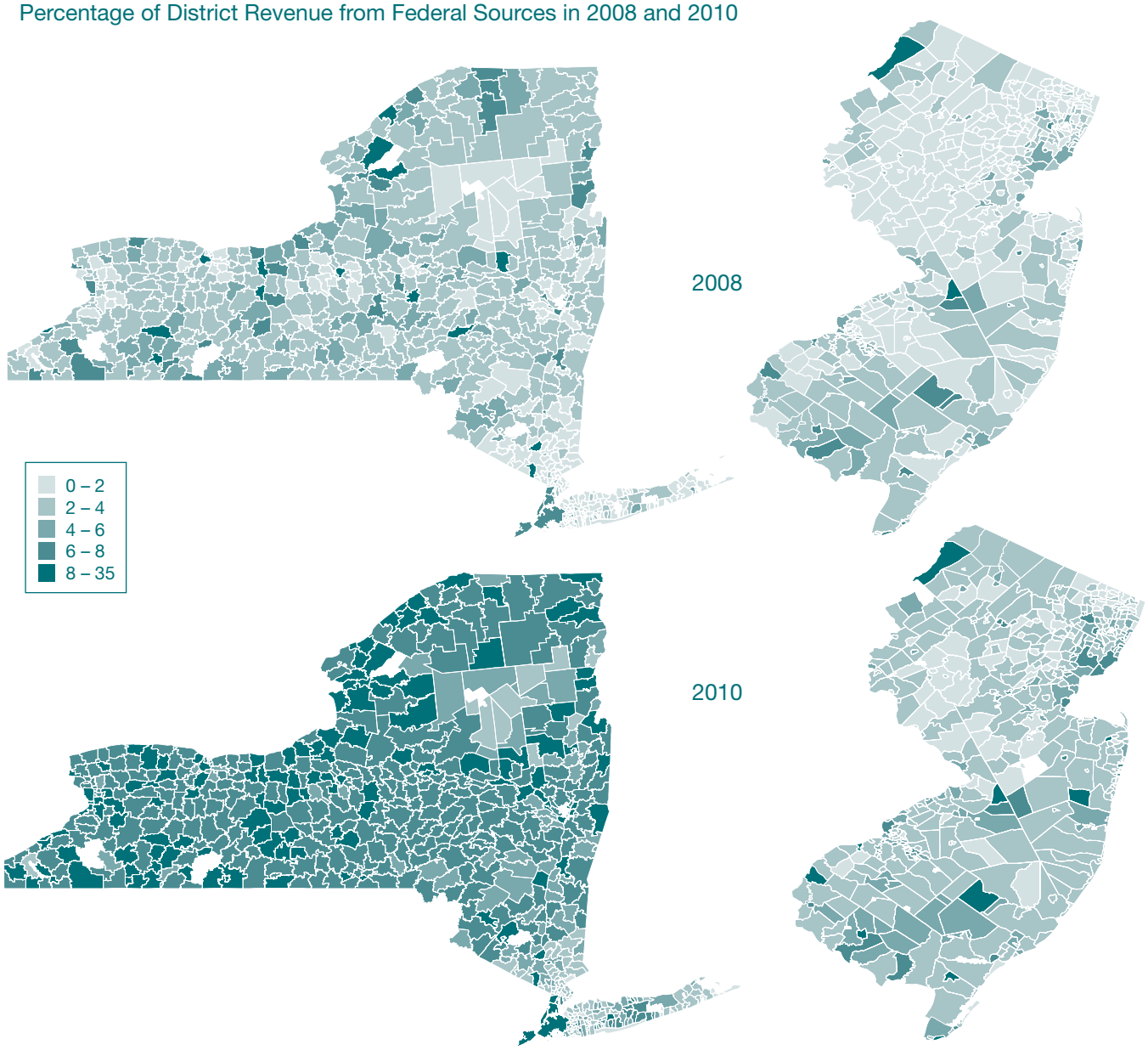


Sources: New York Office of the State Comptroller; New Jersey Department of Education; National Center for Education Statistics.

* Significant at the 10, 5, or 1 percent level.

Exhibit 1

Percentage of District Revenue from Federal Sources in 2008 and 2010



Sources: New York Office of the State Comptroller; New Jersey Department of Education; authors' calculations using U.S. Census Bureau shape files.

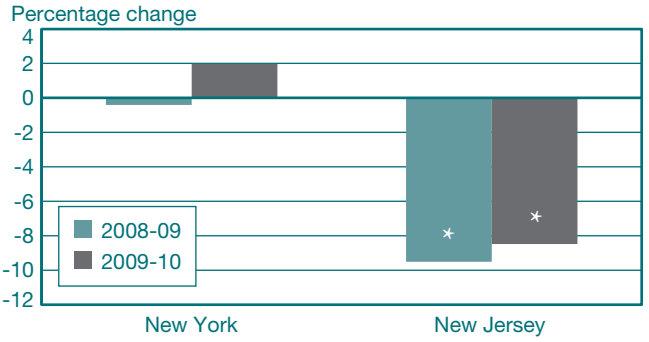
much larger cuts than New York's did, as demonstrated in Chart 3. In the first year after the recession, New York districts actually experienced a small, statistically significant increase in state aid while New Jersey districts experienced a small, statistically significant decline. In 2010, the situation worsened for both states, with New York districts seeing a statistically significant decrease in state funding of about 5 percent while New Jersey districts' state funding dropped by almost 20 percent.

Turning to local financing, we find that school districts in New York saw larger cuts to local funding than New Jersey's did in both post-recession years (Chart 4). Nevertheless, compared with the differences in state and federal aid shifts, the differences are quite small. As a result, when we address the overall differences between New York and New Jersey in Section 4, we focus our attention on factors that drove the federal and state aid patterns in the two states.

3. Contrasting School Expenditure Impacts: New York and New Jersey

The disparity in total funding patterns between the two states is reflected in the states' spending patterns. On the one hand, New York districts experienced no statistically significant shift from trend in total expenditure per pupil (see Chart 5). New Jersey districts, on the other hand, experienced large and statistically significant cuts to expenditure in both post-recession years.

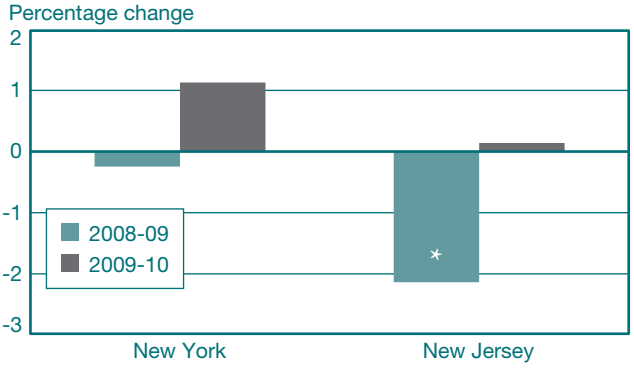
Chart 5
Total Expenditure per Pupil



Sources: New York Office of the State Comptroller; New Jersey Department of Education; National Center for Education Statistics.

* Significant at the 10, 5, or 1 percent level.

Chart 6
Instructional Expenditure per Pupil



Sources: New York Office of the State Comptroller; New Jersey Department of Education; National Center for Education Statistics.

* Significant at the 10, 5, or 1 percent level.

Digging deeper, we find that the two states allocated their expenditures quite differently. Instructional expenditure—the category considered to have the most direct impact on student learning—remained on trend in New York during both years (Chart 6). In New Jersey, districts cut instructional expenditure in the first year after the recession but then made no significant reductions in the second year, likely owing to the impact of the stimulus, which sought to preserve teacher salaries and employment.

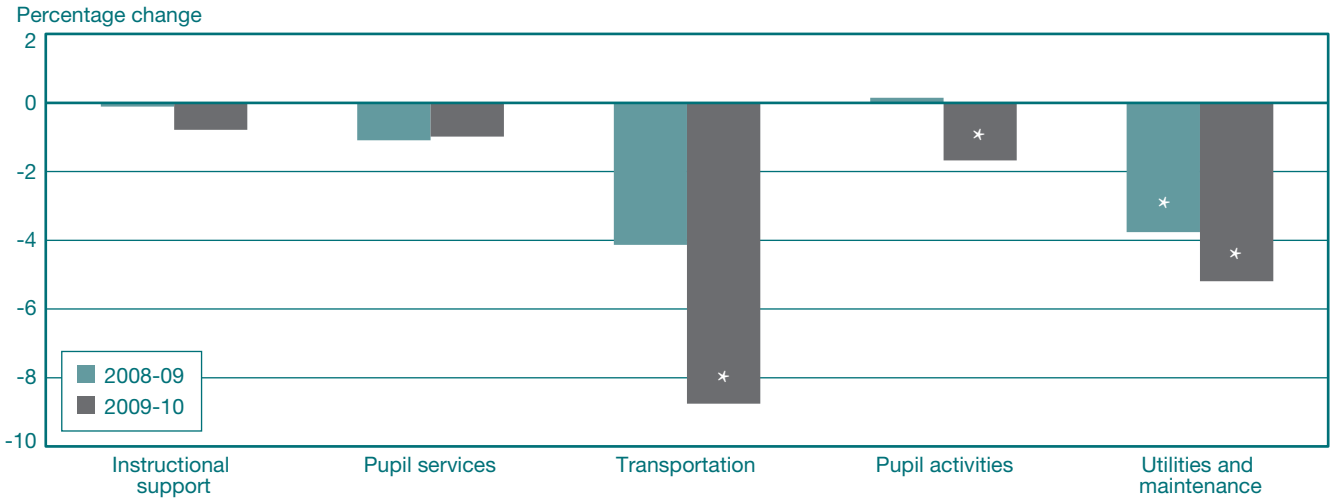
The components of noninstructional expenditure were also affected differently in New York than in New Jersey. In general, New York districts made fewer and smaller cuts. Spending on instructional support and pupil services did not deviate significantly from trend in New York, while in New Jersey expenditures on both components fell in 2009 (see Charts 7 and 8). Student activities were cut in New York in 2010 but remained on trend in New Jersey. Transportation received the biggest reductions in both states, and these cuts were statistically different from zero in 2009 for New Jersey and in 2010 for New York. Both states cut utilities and maintenance ("utilities") significantly in both years. In the categories of student activities, transportation, and utilities, the decreases were larger in New York than in New Jersey—a reversal of other patterns (such as that for instructional spending), in which New Jersey districts experienced larger declines than New York districts.

4. Understanding the Contrast

Our overview of education funding and expenditures reveals that, relative to the pre-recession trend, education finance fared perceptibly better in New York in the post-recession period than in New Jersey. Why might this have been the case? In this section, we consider the two funding channels that show the greatest differences: federal and state aid. To investigate these disparities, we will consider federal allocation formulae and revenue trends at the state level. Further, we will discuss some of the legal pressures surrounding budget decisions. As we will show, an interaction of both funding and budget-related issues created a fiscal situation for New Jersey that was noticeably tighter than that for New York.

Chart 7

Noninstructional Expenditure in New York

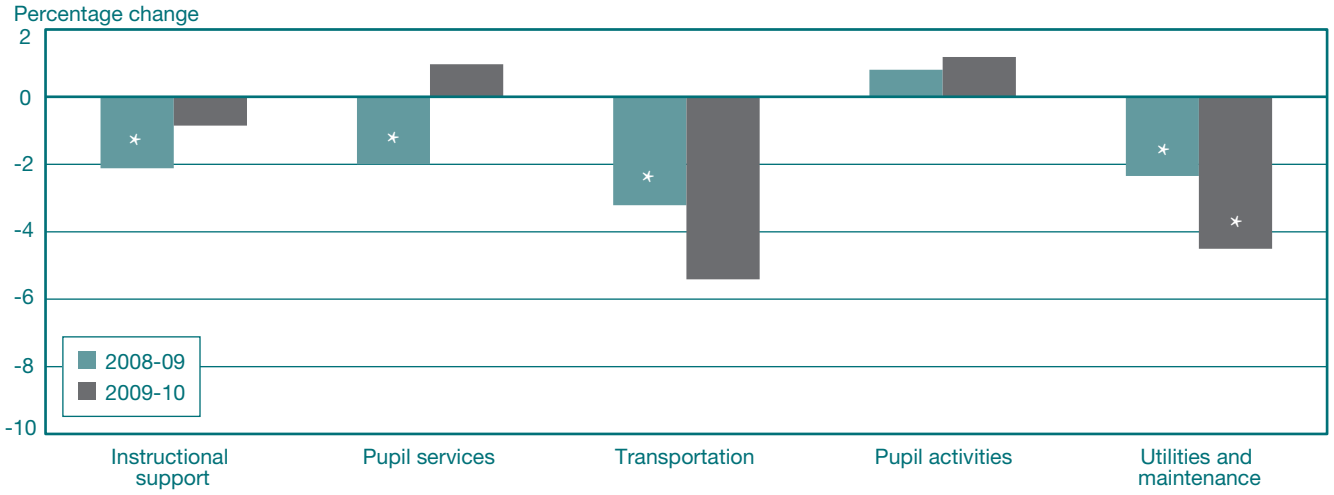


Sources: New York Office of the State Comptroller; New Jersey Department of Education; National Center for Education Statistics.

* Significant at the 10, 5, or 1 percent level.

Chart 8

Noninstructional Expenditure in New Jersey



Sources: New York Office of the State Comptroller; New Jersey Department of Education; National Center for Education Statistics.

* Significant at the 10, 5, or 1 percent level.

Allocation of ARRA Funds in New York and New Jersey

	New York (Millions of Dollars)	New Jersey (Millions of Dollars)	United States (Millions of Dollars)	N.Y.–N.J. Ratio
State Fiscal Stabilization Funds	3,799	1,330	53,600	2.86
Pell Grants	1,127	354	17,100	—
IDEA Grants, Parts B and C (special education)	821	385	12,200	2.13
Title I, Part A (low-income schools)	907	183	10,000	4.96
Race to the Top (competitively awarded)	700	0	3,325	—
Education technology grants	56	12	650	4.65
Vocational rehabilitation funds	26	9	540	2.72
Work-study funds	20	4	200	—
Independent Living Services fund	9	4	140	2.23
McKinney-Vento Homeless Assistance Grants	6	1	70	6.75
Total	7,470	2,282	97,825	—

Source: U.S. Department of Education.

Note: ARRA is the American Recovery and Reinvestment Act of 2009; IDEA is the Individuals with Disabilities Education Act.

4.1 Federal Aid

During the recession, significant shortfalls emerged in state budgets owing to sharp declines in property values and weakening state tax revenues as unemployment rose. In response, the federal government injected billions of dollars into state budgets nationwide through the American Recovery and Reinvestment Act (ARRA) of 2009. One hundred billion dollars of this injection was targeted for education, to lessen the impact of expected cuts to state and local education aid.

The largest portions of this aid were allocated through State Fiscal Stabilization Fund (SFSF) grants ($53.6 billion), Title I funding ($10 billion), Individuals with Disabilities Education Act (IDEA) grants ($12.2 billion), and Pell Grants ($17.1 billion). The table above shows how these and other ARRA funds were allocated within New York and New Jersey. Note that Pell Grants (as well as Federal Work-Study funds, also listed in the table) are allocated to postsecondary education and thus are not under consideration in this article.

Stark differences exist in the aggregate measures, with New York receiving $4.4 billion more in aid than New Jersey. Some of these differences can be explained by demographic disparities in the two states. The SFSF allocation formula favors states with populations weighted toward the 5- to 24-year-old age cohort.[3] In other words, a state with mostly young people would receive more funding than a state of similar size but with an older population. At the time of allocation, the age distributions in New York and New Jersey were comparable, with about 26 percent of each state's population consisting of people aged 5-24, but New York's population exceeded New Jersey's by a factor of 2.2 to 1. New York had 6.2 percent of the nation's population in age group 5-24, while New Jersey had only 2.7 percent. With a significantly smaller population in age group 5-24, New Jersey was simply eligible for less funding under the SFSF formula.

The differences in Title I funding, which is targeted toward low-income areas, also reflected demographic differences between the two states. Funding for each school is based on the proportion of students in that school who come from low-income families. Between 2008 and 2010, approximately 46 percent of New York's students were eligible for free or reduced-price lunches (an approximation of the proportion of low-income students), while only 31 percent of New Jersey students were eligible for free or reduced-price lunches.

[3] Sixty-one percent of the allocation was determined by the ratio of the state's population aged 5-24 to the national population aged 5-24. The remainder depended on the ratio of the state's total population to the national population. For more information, visit the State Finance Stabilization Fund of the U.S. Department of Education website (http://www2.ed.gov/policy/gen/leg/recovery/factsheet/stabilization-fund.html).

IDEA grants, the third-largest category of ARRA funds,[4] are distributed based on a formula that considers the number, age range, and poverty level of special education students. New York's larger allocation reflects its larger number of special needs students.

A significant portion of federal aid was also funneled to many states through Race to the Top (RTT), a program designed to reward states with high-performing schools. To receive this aid, states were required to submit an application and, based on a point system, the top ten were awarded funding commensurate with current needs and educational improvements made over the preceding year. In RTT's Round Two (held in mid-2010), New Jersey placed eleventh, after losing critical points for a minor application error.[5] New York, which placed second, was awarded $700 million.[6]

In summary, many of the discrepancies in federal aid between New York and New Jersey are explained, at least in part, by demographic requirements of that funding (in other words, New York was granted more money to cover greater need). Given New York's high proportion of low-income students—those who are likely to be among the hardest-hit by the recession—we can begin to make some sense of the patterns in federal aid.

4.2 State Aid

Turning to state aid, we see some important differences between New York and New Jersey. While New Jersey experienced a clear decline in state tax revenues through 2010, New York's tax revenues were nearly flat (see Charts 9 and 10). From 2008 to 2010, tax revenues in New York declined by only a little more than 2 percent, while New Jersey revenues saw a 15 percent decline.

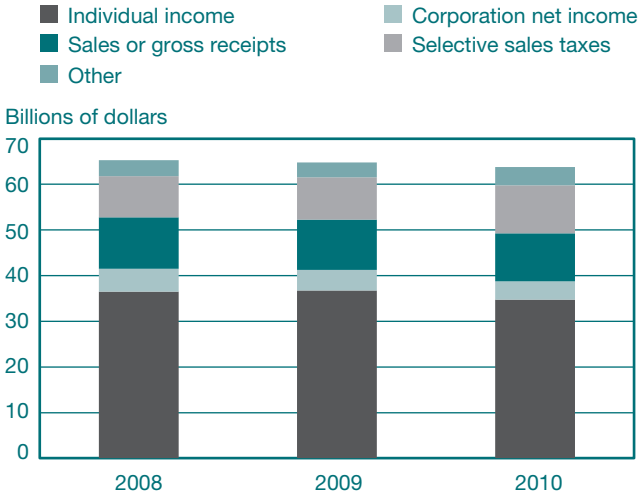
Adding to New Jersey's noticeably more difficult funding situation is a budgetary rule prohibiting the carryover of deficits across fiscal years. As a result of this rule, which is

[4] We recognize that differences exist in smaller categories as well (education technology grants, for example), but because the amounts are so small, their impact is likely dwarfed by the larger categories. Thus, we focus on the top three.

[5] New Jersey lost to Ohio by 3 points. The application error cost the state 4.8 points. Ohio received $400 million in funding. For more information, see "Error on 'Race to the Top' Application Costs N.J. $400M in Federal Funds," *The Star-Ledger*, August 24, 2010.

[6] The disparity in Race to the Top awards for New York and New Jersey constitutes a rather large difference in funding between the two states, but it is not reflected in the figures we provide in this article. Since these funds were awarded in August 2010, they did not appear in the data until the 2010-11 school year.

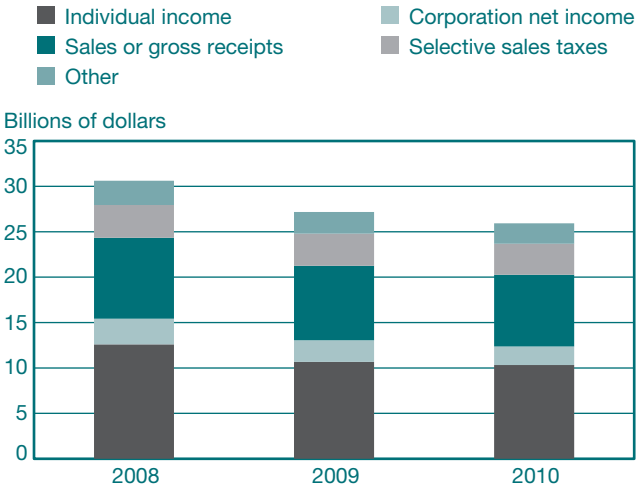
Chart 9
New York State Tax Revenue



Source: *Governing Magazine* data, http://www.governing.com/gov-data/state-tax-revenue-data.html.

Note: Selective sales taxes are those applied to a single commodity, such as tobacco, gasoline, or food.

Chart 10
New Jersey State Tax Revenue

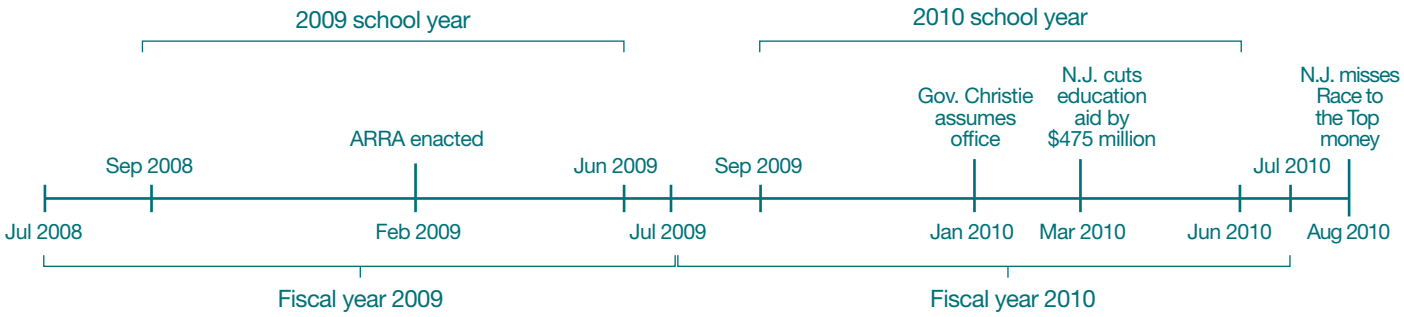


Source: *Governing Magazine* data, http://www.governing.com/gov-data/state-tax-revenue-data.html.

Note: Selective sales taxes are those applied to a single commodity, such as tobacco, gasoline, or food.

Exhibit 2

Timeline of Events



Note: ARRA is American Recovery and Reinvestment Act of 2009.

widely considered to be the most stringent among state budget requirements, aggressive action is often needed to close intra-fiscal-year deficits. States that have this requirement in place tend to rely more heavily on spending cuts to close intra-year budget gaps than states that do not, such as New York.[7] Thus, New Jersey not only faced steeper revenue declines than New York but it was also left with few options outside of spending cuts to cover those declines. As a result, we would expect deviations from state funding trends to be sharper in New Jersey than in New York.

Looking at the actual budgetary actions over this period, we see evidence of this discrepancy. New York's and New Jersey's fiscal years begin on April 1 and July 1, respectively. Fiscal years (FY) are named for the year in which they end, so New Jersey's FY 2010 began on July 1, 2009, and ended on June 30, 2010. Chris Christie was elected governor at the end of 2009 and came into office in January 2010, midway through the FY 2010 budget, which had been set by his predecessor, Jon Corzine. The state had dealt with that year's budget gap largely by reducing operating costs (such as by freezing pay and forcing furloughs), temporarily raising income taxes, paring back property tax rebates, applying for federal aid, and boosting revenue collection through a tax amnesty program. Governor Christie, tasked with closing an emerging gap in the 2010 budget *before the fiscal year's end*, cut $475 million in state aid to schools in January 2010.[8] See Exhibit 2 above for a timeline of events. This sharp decline in state aid, clearly reflected in Chart 3, is likely a direct result of New Jersey's limited funding and tough budget laws.

[7] See Deitz, Haughwout, and Steindel (2010).

[8] Robert Gebeloff and Winnie Hu, "Details Given on Cuts by Christie to Schools," *The New York Times*, March 17, 2010.

4.3 Summary

Over the 2008-10 period, New Jersey saw a decline in total funding per pupil, while total funding per pupil in New York increased. This difference was largely driven by the sharp cuts to state aid in New Jersey and stark differences in federal aid. We can account for these differences through student demographics and New Jersey's budget laws.

New Jersey faced declines in state revenues and strict budget laws that simply made the state's overall funding situation difficult in comparison to New York's. As a result, New Jersey had to make cuts to deal with its funding issues, and education was hit with a big portion of those cuts.

5. Conclusion

How did school financing in New York and New Jersey fare following the onset of the Great Recession and the ensuing federal stimulus? In this article, the first to compare the impact of the recession and stimulus on school finance across states, we contrast key findings from our earlier research on New York and New Jersey. In doing so, we reveal some stark differences in school district finances between the two states. On the funding side, New Jersey districts experienced a much sharper decline in total funding per pupil than did New York districts. New York districts received a much larger boost (relative to trend) from the stimulus than New Jersey districts did. While both states experienced a negative shift in state aid over the two years after the recession, New Jersey's decline was markedly steeper. Local funding fell by a greater amount in New York, but the difference pales in comparison to the federal and state aid discrepancies.

Examining the differences in how districts in the two states changed the composition of their expenditures, we find that New Jersey districts cut instruction a great deal more than their New York counterparts, while New York districts made greater cuts in transportation, student activities, and utilities.

To help explain the funding differences, we explore the factors that drive each of the main sources of aid. Demographic differences (including the total number of students, the number of economically disadvantaged students, and the number of special education students) are cited as a key reason New York received a significantly larger amount of federal aid than New Jersey, while New Jersey's large state aid cuts were primarily driven by budget laws and steep declines in tax revenue. The analysis in this article demonstrates how a recession's impact can turn on a few key demographics, as New York and New Jersey, two states with a great deal in common, had very different experiences. Perhaps more importantly, our analysis yields a better understanding of the roles that state budget laws and large funding injections can play in shaping the effects of recessions on school finances.

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Paul Glasserman, Amit Sirohi, and Allen Zhang

The Effect of "Regular and Predictable" Issuance on Treasury Bill Financing

- To meet the nation's financing needs at the lowest cost over time, the U.S. Treasury issues its Treasury securities using a "regular and predictable" approach.
- But by doing so, does it forgo the short-term gains that might be achieved by issuing debt "opportunistically"—that is, when market conditions are most advantageous?
- This study compares financing costs under a strict cost-minimization strategy with those of alternative strategies that focus instead on "smoothness" considerations—interpreted here as variations of the "regular and predictable" principle.
- The additional cost of such strategies in terms of average auction yield is likely less than one basis point. Adding the flexibility to use cash management bills narrows the gap further.

1. Introduction

In a speech in 2002, Peter Fisher, then under-secretary of the Treasury for domestic finance, stated that "the overarching objective for the management of the Treasury's marketable debt is to achieve the lowest borrowing cost, over time, for the federal government's financing needs" (Fisher 2002). Treasury officials have followed Fisher's agenda ever since.

In pursuit of financing at least cost over time, the Treasury adheres to a "regular and predictable" issuance program. As reported in Garbade (2007), the Treasury initially moved toward regular issuance of short-term notes in 1972 and fully embraced the practice in 1975 after rapid growth of the deficit. In 1982, Mark Stalnecker, then Treasury deputy assistant secretary for federal finance, testified that "regularity of debt management removes a major source of market uncertainty, and assures that Treasury debt can be sold at the lowest possible interest rate consistent with market conditions at the time of sale." In 1998, Gary Gensler, at the time the Treasury assistant secretary for financial markets, reinforced that principal, stating that "Treasury does not seek to time markets; that is, we do not act opportunistically to issue debt when market conditions appear favorable."

This article is based in part on work done while Paul Glasserman, the Jack R. Anderson Professor of Business at Columbia University, was a consultant to the U.S. Department of the Treasury through the Sapient Corporation; Amit Sirohi was a senior associate at Sapient; and Allen Zhang was deputy director of the Office of Debt Management at the U.S. Treasury Department.

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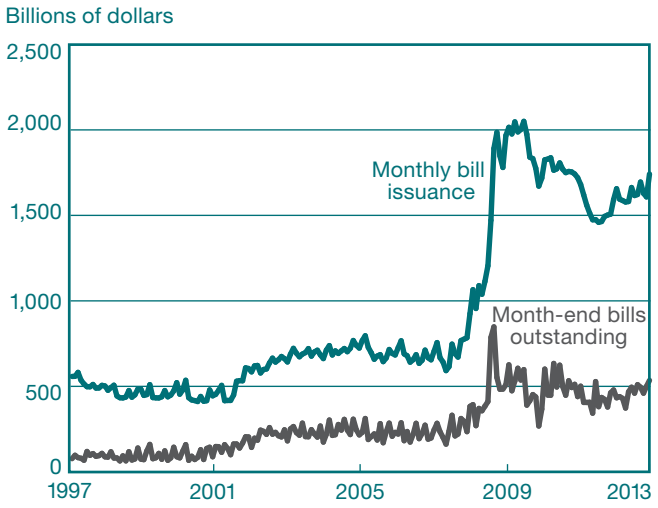
To view the authors' disclosure statements, visit https://www.newyorkfed.org/research/author_disclosure/ad_epr_2017_treasury_glasserman.html.

Chart 1
Historical Issuance of Treasury Bills



Source: U.S. Department of the Treasury Office of Debt Management (ODM).

Note: The chart reflects issuance and bills outstanding for privately held Treasury bills (excluding System Open Market Account holdings and Supplementary Financing Program bills) from January 1997 to February 2013.

In practice, regular and predictable issuance entails prior announcement of the issuance schedule and gradual adjustment of issuance sizes. Of course, taking a regular and predictable approach does not mean that debt management practices never vary. Borrowing requirements change frequently and the Treasury constantly reevaluates issuance strategies and occasionally revises them to best serve the debt management mission. The process requires the definition of objectives and constraints, recognizing that, given multiple ways of satisfying financing needs, some approaches are better than others.

This article focuses on the potential impact of regular and predictable issuance on the short-run cost of issuing Treasury bills. As an issuer of both Treasury bills and coupon-bearing securities (including fixed-rate and inflated-protected securities), and given a coupon issuance schedule, the Treasury uses the bills in part for short-term financing and in part for cash management. The overriding constraint is to raise enough cash to satisfy the government's financing needs. In addition, cash balances need to be in an appropriate range—large enough to provide the Treasury with a buffer against unexpected events, but not so large as to create inefficiencies through over-borrowing. In addition, since Treasury bills are used extensively in the global financial system, it is desirable to maintain a steady supply for investors.

The historical bill issuance and amounts outstanding during the past fifteen years are shown in Chart 1. The figures reflect private issues only, and exclude rollovers in the Federal Reserve's System Open Market Account (SOMA) and sales of Supplementary Financing Program (SFP) bills.[1] Because of the short maturity of bills, the gross auction amount is astonishingly large, reaching a peak of almost $6.7 trillion in fiscal 2009 amid the turbulence of the financial crisis. Issuance subsequently decreased when the Treasury moved to extend the weighted average maturity of debt to reduce "rollover risk"—the risk of facing unfavorable interest rates when rolling over matured debt in the future—and to take advantage of historically low term premia.

A key question—which is simple, yet has important policy implications—is whether regular and predictable issuance raises the Treasury's borrowing costs. Relevant studies in the literature are scarce. Garbade (2007) relies on a "natural experiment" in which he compares nominal coupon issuance in 1971-75 (when bills were sold on a "tactical" basis) with that in 1981-86 (when they were offered on a "regular and predictable" schedule). Using the root-mean-square change in yields over the interval from the close of business one business day before an auction announcement to the close of business one business day after the announcement, Garbade finds that most changes in yield are statistically significant in the tactical period while all changes in yield are insignificant in the regular period. He concludes that "the move to regular and predictable issuance helps to reduce market uncertainty, facilitate investor planning, and lower the Treasury's borrowing cost." However, the drawbacks of a natural experiment are that it is difficult to control for differences in environment, and it does not allow for counterfactual policy analysis or scenario analysis.

In this article, we quantify the potential cost of a regular and predictable approach to bill issuance by examining alternative issuance strategies in an optimization framework.[2] An issuance strategy describes offerings over a period of time; throughout

[1] The Supplementary Financing Program was initiated in September 2008 for the purpose of draining reserves from the banking system. Proceeds from those auctions were maintained at the Federal Reserve Bank of New York. SFP balances declined to zero in July 2011 and the Treasury has not yet resumed auctioning SFP bills. In this article, because we focus on the net cash raised in the private market to satisfy the government's financing needs, SOMA and SFP holdings are excluded.

[2] Mathematical optimization, or simply, optimization, is commonly understood as the selection of a best element with regard to some criterion from some set of available alternatives. In our case, we minimize a real function (the "objective function") by systematically choosing input values from within an allowed set (the "constraints").

the article, we will refer to this period of time as the "projection horizon." In choosing a sequence of issuance sizes, we optimize alternative objectives subject to financing and issuance constraints. All of the objectives are quadratic functions of the issuance amount and all of the constraints are linear, so we can formulate the optimization as a constrained quadratic programming problem. Each optimal solution—corresponding to a particular objective function—is characterized by variability and cost metrics. The analysis ignores the ancillary benefits of reducing market uncertainty and facilitating investor planning, both of which could be expected to promote auction participation; the analysis may, therefore, understate the overall benefit of regular and predictable issuance.

Our benchmark is a pure short-run cost-minimization strategy, which assumes that the Treasury seeks only to keep short-run financing costs as low as possible given a forecast of future interest rates. Such an objective may lead to opportunistic issuance, with the Treasury possibly appearing to be "timing the market." Alternatively, on an ex ante basis, the Treasury can choose to optimize on some regular and predictable behavior, rather than on cost-minimization. For example, it may try to smooth issuance by minimizing changes in offering sizes, resulting in higher short-run issuance costs as compared with the benchmark. The cost difference between the two approaches measures the trade-off between being regular and predictable and being "opportunistically" cost-minimizing. The Treasury could also employ other proxies for regular and predictable behavior, such as maintaining a low cash balance, not deviating from a baseline strategy, or targeting low gross issuance overall. By comparing the cost of an alternative strategy with the cost of the benchmark strategy, we determine what we give up to be regular and predictable.

We also extend our basic framework to include the option to issue cash management bills (CMBs). CMBs are securities with flexible (usually very short) maturities whose proceeds are used by the Treasury to meet temporary shortfalls. Modeling the decision to issue CMBs requires the introduction of binary variables, which substantially complicates the optimization problem. To mitigate this increased complexity, we develop a heuristic rule based on the shadow prices (the Lagrange multipliers) associated with the financing constraints to identify the timing of CMBs.[3] Use of such a rule allows us to bypass what would otherwise have been a far more complex calculation and saves significant computing time. We detail this methodology in Section 4.2.

[3] The multiplier measures the change in the objective function owing to a marginal change in the constraint. A high multiplier indicates a possibly high benefit of using a CMB.

Our examples indicate that cost tends to decrease with higher levels of week-to-week variability—that is, when allowing larger changes in consecutive issuances—until it reaches the global minimum cost (GMC). By definition, the GMC is the benchmark strategy. Alternative optimization objectives that are based on regular and predictable issuance lead to higher financing costs than the GMC strategy, though the flexibility to use a limited number of CMBs may help reduce those costs.[4]

Other optimization problems arising in national debt management have been addressed in recent work. These include Adamo et al. (2004) in Italy; Balibek and Köksalan (2010) in Turkey; Bolder (2008) in Canada; Date, Canepa, and Abdel-Jawad (2011) in the United Kingdom; and Hahm and Kim (2003) in Korea. However, none of these models considers the question of regular and predictable issuance.

The rest of the article proceeds as follows. In Section 2, we introduce an issuance optimization model for Treasury bills. In the third section, we solve for the "efficient frontier" (the combination of securities that offers the lowest risk for a given level of return or the best return for a given amount of risk) and illustrate differences in variability–cost profiles associated with different objectives. Section 4 considers the use of CMBs. In Section 5, we present our conclusions. The appendix offers a robustness check of our main results.

[4] Our optimization framework uses projected cash needs to set auction sizes. All of our strategies are ex ante in nature: (1) the optimization assumes that funding needs will unfold exactly as projected at the beginning of the planning period; and (2) our performance evaluation implicitly assumes that the issuance plan, once selected, is followed strictly throughout the planning period. In reality, both assumptions are questionable: Forecasts of funding needs are revised every week, and the Treasury will adapt to updates in funding needs and revise future issuance plans accordingly. Hence, the realized (ex post) issuance strategy likely differs from the ex ante optimal one, regardless of which objective function is used.

To capture the effect of new information over time, we developed a step-through simulation procedure to evaluate the ex post performance of an issuance strategy. In the simulation, the Treasury optimizes the issuance plan over the full planning horizon but locks in the auction sizes for the first week only. We then advance the simulation by a week, and revise the projected cash needs from a statistical model of fiscal revisions. The Treasury re-optimizes the issuance plan based on the new projections and the process repeats. We simulate a large number of such paths to compare the realized performance of alternative rules in the face of forecast revisions and unanticipated changes in fiscal flows. Technically, we solve an "open-loop" problem, but then we implement it "closed-loop" because we lock in only the first step and then re-solve the problem to respond to the new environment—a procedure known as "model predictive control" in the control literature.

We do not detail the step-through procedure in this article because it is not essential to understanding the trade-off between variability and cost. It may suffice to note that the actual realized issuance based on the step-through optimization may result in further narrowing of the cost difference. In other words, part of the short-term cost advantage of the GMC is lost once we recognize changes in projected cash needs over time.

2. Issuance Optimization

The Treasury has a fixed auction calendar of bills, nominal fixed-rate notes and bonds, floating-rate notes, and inflation-protected notes and bonds; a detailed description of Treasury securities and the auction process can be found in Garbade and Ingber (2005). In its quarterly refunding announcement, the Treasury specifies the intended auction amounts of coupon-bearing securities for the upcoming quarter. Given a starting cash balance, fiscal flow forecasts, and cash flows from coupon securities, the Treasury issues bills to fund cash requirements and maintain a proper cash balance.

As opposed to coupon securities, which make semiannual (or quarterly, in the case of floating-rate notes) payments until maturity, bills are single-payment securities that are sold at a discount and pay a specified face value at maturity; their yields are floored at zero in primary market auctions. Regular offerings include four maturities: four weeks, thirteen weeks, twenty-six weeks, and fifty-two weeks, with the first three maturities auctioned weekly and the fourth every four weeks. CMBs, with maturities ranging from one day to a few months, are offered as needed.

Given the debt management objective of minimizing cost and the principle of regular and predictable issuance, it is natural to examine bill issuance strategies in an optimization framework. In particular, we want to solve for the optimal issuance program over a specified projection horizon, such that the net cash flow from bill issuance and redemption is sufficient to cover financing needs (resulting from net fiscal flows, coupon payments, and principal redemptions of coupon-bearing securities) and maintain an appropriate cash balance. (In Section 3, we take the projection horizon to be twenty-seven weeks, mainly because fiscal forecasts become less reliable beyond half a year. Additionally, the Treasury is only committed to the issuance sizes of coupon securities in the next quarter, so we may not be able to take coupon issuance amounts as given for a longer term.) Bills are the residual financing instrument in this short-term issuance model.

2.1 The Issuance Program

We outline here our optimization model. Let the N-dimensional column vector X denote the sequence of issuance amounts of regular bills before the end of the projection horizon, where N is the total number of offerings over the horizon. The components of X are the choice variables of the optimization problem. We denote the issuance amount in week i of a bill with a term to maturity of j weeks as $x_{i,j}$ for $i = 1, 2, \ldots, T$ (where $T = 27$ weeks) and $j = 4$, 13, 26, and 52. The vector X is formed by stacking up the $x_{i,j}$ terms.

2.2 Exogenous Inputs and Related Constructions

There are four exogenous inputs:

1. a T-dimensional column vector f of weekly cash needs resulting from net fiscal flows, coupon payments on notes and bonds, redemptions of previously issued bills, and issuance and redemption of coupon-bearing securities;
2. the Treasury's initial cash balance, denoted c_0;
3. the Treasury's last issues of 4-, 13-, 26-, and 52-week bills prior to the start of the projection horizon, denoted $x_{0,j}$ for $j = 4$, 13, 26, and 52; and
4. future bill auction rates.

We use these four inputs to compute bill auction prices, the Treasury's cumulative net cash requirements, the trajectory of Treasury cash balances associated with a given issuance program, and week-to-week changes in issuance.

Let $r_{i,j}$ denote the auction rate in week i for a bill with a term to maturity of j weeks, so that the issuance price of the bill per dollar payable at maturity, $p_{i,j}$, is given by $p_{i,j} = 1 - (j / 52) \times r_{i,j}$.[5] We assume that bill rates over the projection horizon are equal to the forward, or expected, rates implied by the on-the-run[6] curve at the beginning of the projection horizon. (We are not claiming that forward rates are the best forecasts of future spot rates; they have the obvious drawback of excluding term premia. They do, however, provide a reasonable forecast of future interest rates that allows us to focus on the consequences of varying the issuance objective.)

[5] Issuance decisions could feed back to auction rates. For example, Li and Wei (2012) suggest that the total supply of Treasury securities may affect Treasury yields through a term premium channel. In addition, as evidenced by the bid elasticity curve observed from bid-level data, deviation from the issuance size would affect the auction stop-out rate (the lowest accepted bid rate), suggesting a "funding mix effect." In this study, we ignore supply effects since we only consider bill issuance in the short term, which does not carry significant information about total debt outstanding. We also bypass the funding mix effect by imposing hard constraints on issuance sizes and changes in issuance sizes, allowing only marginal shifts.

[6] The on-the-run Treasury curve is derived from on-the-run securities—which currently refer to the most recently issued Treasury notes (2-year, 3-year, 5-year, 7-year, and 10-year) and bonds (30-year)—as opposed to "off-the-run" securities that were issued before the most recent issue and are still outstanding. On-the-run securities comprise more than half of total daily trading volumes, and are mainly traded in the interdealer market. It is commonly believed that on-the-run securities have better liquidity than off-the-run, and the on-the-run curve is the primary benchmark used in pricing fixed-income securities.

Denote the sequence of *cumulative* net cash requirements as the T-dimensional column vector b, where the ith element of b is weekly cash needs prior to and in week i, less the Treasury's initial cash balance:

$$b_i = \sum_{k=1}^{i} f_k - c_0 \qquad i = 1, 2, ..., T$$

Denote the contribution to weekly Treasury cash balances from a bill with a term to maturity of j weeks issued in week i, per dollar payable at maturity, as the T-dimensional column vector $a_{i,j}$. If $i + j$ is less than or equal to T, the first $i - 1$ elements of $a_{i,j}$ are equal to zero (because the bill is not issued until week i), the next j elements are equal to $p_{i,j}$ (because the bill is outstanding during those weeks), and the remaining elements are equal to $p_{i,j} - 1$ (because the bill is redeemed in week $i + j$). If $i + j$ is greater than T, the first $i - 1$ elements of $a_{i,j}$ are equal to zero and the remaining elements are equal to $p_{i,j}$. Ordering the $a_{i,j}$ column vectors into a T-by-N matrix A to match the order of the elements of X, we can express the sequence of weekly Treasury cash balances resulting from the bill issuance program X as $AX - b$.

Finally, consider the "gradient" of issuance—that is, the changes in issuance from one week to the next. The gradient of the first four 4-week issuances, when the last known issuance is $x_{0,4}$, is given by

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ -1 & 1 & 0 & 0 \\ 0 & -1 & 1 & 0 \\ 0 & 0 & -1 & 1 \end{bmatrix} \begin{bmatrix} x_{1,4} \\ x_{2,4} \\ x_{3,4} \\ x_{4,4} \end{bmatrix} - \begin{bmatrix} x_{0,4} \\ 0 \\ 0 \\ 0 \end{bmatrix}.$$

The indexation becomes more complicated when the issuance program X includes bills with a variety of maturities and different issuance frequencies, but the gradient is nevertheless linear in X and can be written as $DX - d$, where D is an N-by-N matrix and d is an N-dimensional column vector with, at most, four nonzero elements, identified as $x_{0,4}$, $x_{0,13}$, $x_{0,26}$, and $x_{0,52}$.

2.3 Two Metrics

Given an issuance strategy X, we propose two metrics: one to assess short-run financing costs and the other to assess variability, or changes in issuance size from week to week.

The cost metric is straightforward. Bills are offered on a discount basis, so the cost of issuing a bill with a term to maturity of j weeks in week i, per dollar payable at maturity, is $(j / 52) \times r_{i,j}$ if $i + j$ is less than or equal to T, and a prorated amount of that quantity otherwise. Ordering these cost terms in an N-dimensional row vector h, we can express the total (undiscounted) financing cost over the projection horizon, denoted FC, as

$$FC = hX.$$

We define the variability metric AG as the root mean of the squared changes in consecutive issuances (weekly for 4-week, 13-week, and 26-week bills and once every four weeks for 52-week bills):

$$AG = \sqrt{\tfrac{1}{N}(DX - d)'(DX - d)}.$$

All else equal, if issuance size needs to be increased, the Treasury prefers a sequence of small changes to a single large increase in order to minimize disruption in the market.

2.4 Constraints and Objectives

We study the trade-off between short-run financing costs and variability in an optimization framework. Simply put, if being regular and predictable means lower variability, does that always lead to higher short-run costs? And if so, by how much?

Our choice variable is X, the issuance program. We impose three constraints on the choice of X:

$$(1) \qquad \underline{c} \le AX - b \le \bar{c}$$

$$(2) \qquad L \le X \le U$$

$$(3) \qquad -\delta \le DX - d \le \delta$$

Constraint (1) is a financing constraint: After satisfying weekly cash needs, the weekly cash balances, $AX - b$, must be within a specified range $[\underline{c}, \bar{c}]$. The Treasury picks the range to maintain a cash buffer sufficient to safeguard against forecasting errors and unanticipated, sudden loss of market access. Both the floor ($\underline{c}$) and ceiling ($\bar{c}$) are vectors of dimension T, so the allowable range of cash balances can vary from week to week.

The next two constraints relate to issuance. Constraint (2) sets lower and upper bounds L and U, respectively, on offering amounts. These are vectors of dimension N, so the bounds can vary over time and across bill maturities. Constraint (3) limits the change in offering amounts between consecutive auctions. The choices of δ, L, and U

follow from the Treasury's understanding of market reaction to changes in offering amounts and the need to maintain a deep and liquid market.

We consider five alternative objective functions:

(4a) $$minCost: hX$$

(4b) $$minCB: (AX - b)'(AX - b)$$

(4c) $$minGrossIss: (AX - b)'(AX - b) + \omega X'X$$

(4d) $$minDevBase: (AX - b)'(AX - b) + \omega(X - \widetilde{X})'(X - \widetilde{X})$$

(4e) $$minGrad: (AX - b)'(AX - b) + \omega(DX - d)'(DX - d)$$

where the scaling factor ω is a scalar.

The *minCost* objective function minimizes financing costs and is used to identify the benchmark strategy, global minimum cost.

None of the other four functions explicitly minimizes cost. Rather, each reflects the Treasury's degree of aversion to a high level of cash balances and preference for "smoothness" in issuance—which involves the predictability of issuance given the auction calendar. The *minCB* objective reflects only a concern with high cash balances, owing to the "negative carry" that usually occurs in funding such balances.[7] Moreover, maintaining a relatively constant cash balance at the lowest possible level produces a smooth cash-balance profile, which may be welcomed by the market as evidence of "predictable" behavior.

Objectives (4c), (4d), and (4e) continue to express an aversion to higher cash balances but add a second component to capture issuance predictability. The *minGrossIss* objective seeks to limit the gross issuance. Because shorter-maturity bills require more frequent rollover, *minGrossIss* tends to favor the use of longer-term securities. The *minDevBase* objective function tilts the strategy toward a desired baseline $\widetilde{X}$, an input to the optimization process, reflecting the Treasury's understanding of market conditions. And *minGrad* is meant to explicitly control the variability metric AG. The scaling factor ω controls the relative importance of the two components in each objective.

[7] By issuing Treasury securities to fund the cash balance, the Treasury incurs interest costs while not earning any yield, thus the "negative carry." Recently, domestic banks and foreign banking organizations became eligible to earn interest on excess reserves (IOER) on reserve balances held in their Federal Reserve accounts since 2008 (as part of an effort to stabilize the federal funds rate). When banks purchase Treasury securities and reduce reserve balances, they earn yields from holding the Treasury securities but receive no IOER. Hence, the "negative carry" to the Treasury could be partially offset by IOER in this broad context.

Table 1
Model Parameters and Exogenous Inputs

Parameters	
T	Projection horizon in weeks
N	Number of new bill issuances over the course of the projection horizon
$\underline{c}$	(Possibly time-varying) cash balance floor, a T-dimensional vector
$\overline{c}$	(Possibly time-varying) cash balance cap, a T-dimensional vector
δ	(Possibly time-varying and term-specific) maximum change between consecutive auctions, an N-dimensional vector
L	(Possibly time-varying and term-specific) lower boundary on issuance size, an N-dimensional vector
U	(Possibly time-varying and term-specific) upper boundary on issuance size, an N-dimensional vector
$\widetilde{X}$	The Treasury's desired or baseline issuance strategy, an N-dimensional vector
ω	Relative weight when there are two items in the objective function, a scalar
Exogenous Inputs	
$r_{i,j}$	Auction discount rate in week i for a bill with a term of j weeks
f	Projected weekly cash needs vector, a T-dimensional vector
c_0	Initial cash balance
$x_{0,j}$	Last issuance size of a j-week bill before the beginning of the projection horizon

Notes: The choice set consists of the issuance size in week i of a bill with a term of j weeks, $x_{i,j}$ for $i = 1, 2, ..., T$ and $j = 4, 13, 26,$ and 52. The N-dimensional vector X is formed by stacking up the $x_{i,j}$ terms.

We summarize the parameters and inputs needed to formulate and solve the optimization problem in Table 1.

3. An Efficient Frontier and Alternative Strategies

In this section, we introduce an efficient frontier describing the trade-off between the variability and cost metrics defined in section 2.3 given the constraints—equations (1), (2), and (3)—on issuance. We then analyze the five alternative strategies and contrast their variability and cost measures.

3.1 Model Parameters

For purposes of illustration, we use a twenty-seven-week horizon starting Thursday, November 12, 2009, (following issuance on that day of the 4-week, 13-week, and 26-week bills) to examine various bill issuance strategies. During this period, there were eighty-eight bill offerings. The Office of Fiscal Projections at the Treasury provides daily fiscal forecasts up to twenty-seven weeks in the future (at the time of this analysis). Adding to the net fiscal flows the scheduled coupon payments and issuances and redemptions of coupon-bearing securities, we have the weekly cash-need vector f. The Treasury ranged from needing $132 billion to having $85 billion over the twenty-seven-week period, as shown in Chart 2. The starting cash balance (c_0) is $66 billion and the latest issuance sizes are $30 billion, $30 billion, $31 billion, and $27 billion, for 4-week, 13-week, 26-week, and 52-week bills, respectively. For convenience, we also assume that the baseline issuance strategy $\bar{X}$ (required to formulate the *minDevBase* objective) maintains the latest issuance sizes.

We need additional parameters to complete the model formulation. Regular bills follow a fixed issuance calendar: every Thursday for 4-week, 13-week, and 26-week bills and once every four Thursdays for 52-week bills. We assume that all have a minimum issuance size of $10 billion, and maximum sizes of $45 billion, $40 billion, $40 billion, and $30 billion, respectively; this defines L and U in constraint (2). The maximum absolute change in issuance size for consecutive issuances is set at $8 billion, $2 billion, $2 billion, and $1 billion, respectively; this is the δ in constraint (3). As such, we are willing to accept larger changes in 4-week issuances than in longer-maturity bills. The cash balance has a floor ($\underline{c}$) of $25 billion and a cap ($\bar{c}$) of $1,000 billion, a total that essentially leaves the weekly balance uncapped.

For the three dual objectives in (4c), (4d), and (4e), the choice of the weight ω is relevant. All scenarios examined in this article have a setting of $\omega = 10$. In the extreme, we can set ω to be a very large number, making the cash balance component irrelevant. In fact, we experimented with values of ω from 10 to 100 and found no material change in our main conclusion that the potential short-run cost of a regular and predictable approach is not likely to be significant.

3.2 Efficient Frontier

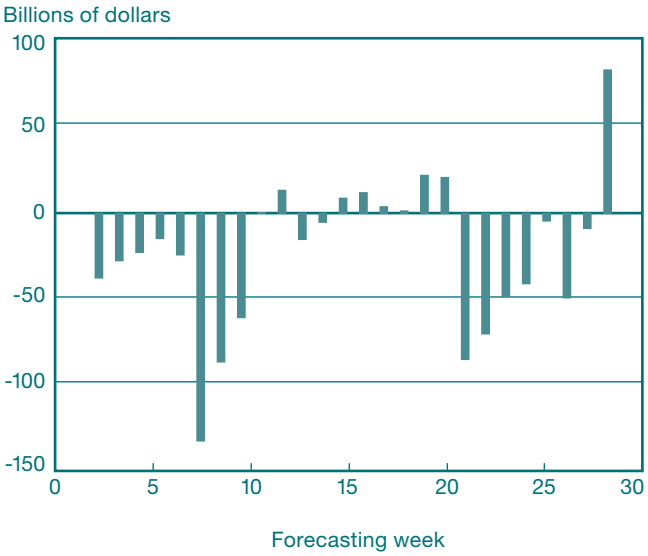
There are many issuance programs that satisfy constraints (1), (2), and (3). Among such "feasible" programs, we are interested in the subset of "efficient" programs that minimize short-run funding costs (FC) for a given level of variability (AG) and minimize variability for a given level of funding costs.

The first step in determining the set of efficient issuance programs is identifying the global minimum cost (GMC) program—the issuance strategy that minimizes short-run funding costs subject to constraints (1), (2), and (3) or that solves the problem:

$$\min_{x} \; hX \quad \text{subject to (1), (2), and (3).} \tag{5}$$

Given the inputs described in Section 3.1, the GMC issuance program has funding costs of $0.481 billion and variability of $3.82 billion.

Chart 2
Weekly Net Cash Need



Sources: U.S. Department of the Treasury Office of Fiscal Projections (OFP); authors' calculations.

Notes: The OFP provides fiscal flow forecasts and calculates total cash flows assuming projected issuances of bills and coupon-bearing securities. By backing out the bill issuances projected by OFP, we calculate the cash needs that must be satisfied from new bill issuances. A negative number indicates the net cash that must be raised through new bills (excluding the minimum cash balance requirement). A positive number indicates the net cash flow from fiscal flows, coupon securities, and previously issued bills, even with zero new bill issuances. The chart shows the weekly cash needs in the twenty-seven weeks starting November 12, 2009.

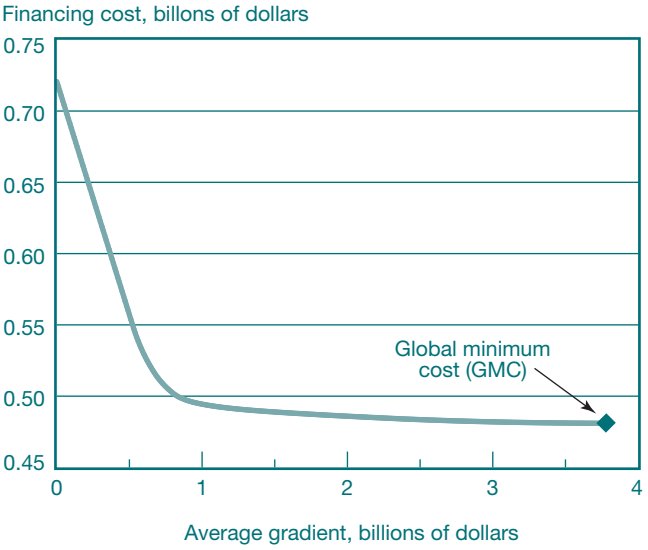
Consider next the interval, $[\underline{G},\overline{G}]$, where the gradient of issuance has a floor ($\underline{G}$) of $0.0 and a cap ($\overline{G}$) of $3.82 billion. A feasible strategy on the efficient frontier solves the problem

$$(6) \qquad \min_{x} \; hX$$
$$\text{subject to (1), (2), and (3) and } \sqrt{\frac{1}{N}(DX-d)'(DX-d)} = g$$

for some $g \in [\underline{G}, \overline{G}]$. We can trace the efficient frontier by solving (6) for different values of $g \in [\underline{G}, \overline{G}]$.[8] We illustrate the result in Chart 3, where the x-axis is the average gradient and the y-axis is the financing cost (both in billions of dollars).

The efficient frontier is downward sloping: The minimum attainable short-run funding cost falls when we allow larger week-to-week variations in issuance. At one extreme, when setting $g = 0$, we follow the latest realized issuance pattern, which in this example results in a large cost as a result of high cash balance.[9] As we allow the issuance strategy to become more flexible, we are able to identify programs with lower costs.

Chart 3
The Efficient Frontier



Source: Authors' calculations.

3.3 Alternative Strategies

The frontier clearly indicates a trade-off between short-run cost and variability. If an issuance strategy leads to a variability–cost pair that lies above the frontier, the indication is that, for the given level of variability, the strategy yields a cost that is higher than that of an efficient strategy. Hence, the vertical distance between the variability–cost pair and the frontier reflects the cost impact of including factors other than cost in the optimization objective. To find the optimal strategies associated with the five objectives (4a) to (4e), we solve the following quadratic programming problems:

$$(7) \qquad \min_{x} \; objective$$
$$\text{subject to (1), (2), and (3),}$$

where *objective* is one of the objective functions (4a) to (4e).

[8] To generate the efficient frontier, (6) cannot be solved with quadratic programming because of the quadratic constraint. We used a general nonlinear constrained optimization package ("fmincon" in Matlab). It is the main issuance optimization problem, as set up in (7), that is solved efficiently with quadratic or linear programming.

[9] It is possible that we could not satisfy the cash needs by sticking with the latest actual issuance sizes at the beginning of the projection period; in that case, $g = 0$ would not be attainable. As our objective is to understand the general shape of the efficient frontier, we use a case that can accommodate a wide range of possible gradients.

We summarize the results in Table 2, with the columns reflecting the five alternative criteria and the rows reflecting the objective function actually used in the optimization problem. Because the criteria expressed in (4b) to (4e) return "sum square dollar" numbers (the sum of squared terms), for ease of comparison we report the corresponding root mean values, which may be understood as weekly averages. Panel B reports gross and net issuance amounts associated with each strategy.

The first column in Panel A shows financing costs for each of the five objective functions. The smallest cost—obtained with the *minCost* objective—is about $481 million, on $1.892 trillion total issuance. That figure represents a savings of $49 million from the most expensive strategy, which turns out to be *minGrossIss* with a total issuance of $1.748 trillion. So, if our objective were to minimize a combination of excess cash and gross issuance instead of minimizing cost, the optimal strategy would incur about 10 percent more funding cost during the twenty-seven-week period. In terms of annualized average auction yield, *minCost* produces an issuance cost of 4.90 basis points [interest cost divided by total issuance, or (0.4810 / 1,892) × (52 / 27)], while *minGrossIss* incurs an annualized yield of 5.84 basis points, a difference of 0.94 basis points. As before, we stress that this result should be

Table 2
Values of Objectives

	Panel A: Values of Alternative Objective Functions (Billions of Dollars)					Panel B: Issuance (Billions of Dollars)	
Objective function used	(1)	$\sqrt{\frac{(2)}{27}}$	$\sqrt{\frac{(3)}{27}}$	$\sqrt{\frac{(4)}{27}}$	$\sqrt{\frac{(5)}{27}}$	Gross	Net
minCost	**0.4810**	81.740	157.623	81.975	84.599	1,892	(440.12)
minCB	0.5239	**69.868**	146.242	84.881	73.066	1,838	(439.93)
minGrossIss	0.5303	74.654	**141.581**	88.743	77.641	1,748	(439.95)
minDevBase	0.4918	73.042	149.155	**74.971**	76.181	1,862	(440.07)
minGrad	0.5240	69.868	146.142	84.718	**73.065**	1,836	(439.94)

Source: Authors' calculations.
Notes: The table reports the normalized objective-function values (columns) and issuance amounts associated with the five issuance strategies (rows) that result from minimizing (1) short-run financing cost, (2) cash balance, (3) cash balance plus gross issuance, (4) cash balance plus deviation, and (5) cash balance plus gradient, respectively, as defined in objectives (4a) to (4e). The scaling factor ω is set at 10 for the three dual objectives *minGrossIss*, *minDevBase*, and *minGrad*. Panel A reports the values of the objectives; Panel B reports the gross and net issuance amounts.

viewed as an upper bound on the additional cost, because it disregards changes in bidder behavior that would result from a more erratic issuance policy.

The second column of Panel A contains the average weekly cash balance, which differs by about $12 billion between the strategies that produce the highest cash balance (*minCost*) and the lowest cash balance (*minCB*). This outcome is interesting: It says that in order to minimize cost, we must efficiently explore relative cheapness across maturity terms and use the cheapest funding source as much as possible, likely resulting in occasional overfunding that will push up the Treasury's cash balance.

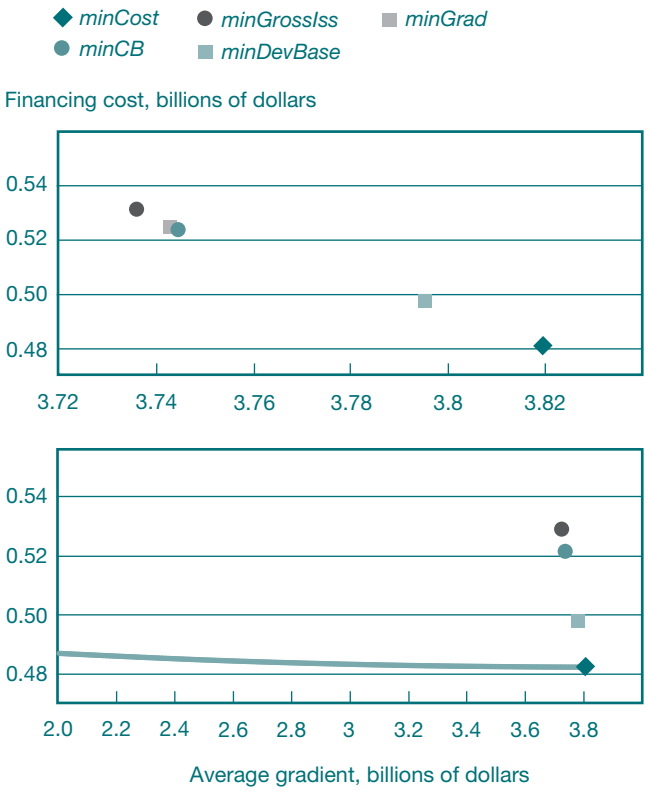
The bottom three rows contrast strategies with dual objectives, combining the desire for issuance smoothness (expressed in multiple ways) with the desire for low cash balances. The objective *minGrossIss* seeks to limit overall issuance amount, the *minDevBase* strategy attempts to follow the baseline trajectory, and *minGrad* looks to limit changes in issuance size. As expected, each of these strategies turns out to be more expensive than the pure cost-minimizing strategy, since they try to account both for issuance smoothness and cash balance smoothness. As mentioned above, *minGrossIss* is the most expensive strategy, incurring 94 basis points more in annualized auction yield than *minCost*.

Panel B reports the gross issuance amount of each strategy. Although cost is closely associated with gross issuance, the composition of the issuance is more important than its sheer size. For example, the *minGrossIss* strategy produces a total issuance of $1.748 trillion, or $88 billion less than the strategy with the second smallest gross issuance (*minGrad*) and $144 billion less than the one with the largest gross issuance (*minCost*). However, *minGrossIss* is also the most expensive strategy, with a financing cost of $530 million. On a net issuance basis, all five strategies result in roughly the same amounts and thus lead to a very similar end-of-period bill portfolio.

We show the variability–cost profiles of the five strategies relative to the efficient frontier in Chart 4. The *minCost* objective leads to the global minimum cost (GMC) represented in the chart by the blue diamond. The other four strategies turn out to be more costly, with lower issuance variability. As shown in the top panel, *minGrossIss* results in the highest cost and the lowest variability. The strategy has dual objectives, seeking to maintain a low (and by construction, smooth) cash-balance profile and low gross issuance. As such, it cannot effectively exploit relative pricing differentials across the yield curve; rather, it is forced to rely more on longer-term bills because they generate higher net cash than shorter-term bills for the same amount of gross issuance, owing to lower frequency of rollover. Relative to the pure cost-minimizing strategy, *minGrossIss* leads to a steadier issuance of longer-term bills, resulting in higher cost and lower variability.

The top panel also shows that when we try to stick with the baseline strategy with the objective *minDevBase*, we only incur $11 million more in cost than *minCost*, or less

Chart 4
Alternative Strategies and the Efficient Frontier



Source: Authors' calculations.

Notes: The top panel shows the variability–cost profiles of the five alternative strategies: minimizing financing cost (*minCost*), cash balance (*minCB*), cash balance plus gross issuance (*minGrossIss*), cash balance plus deviation (*minDevBase*), and cash balance plus gradient (*minGrad*). The bottom panel overlays these five points with a portion of the efficient frontier. Minimizing cash balance with or without consideration of gradient returns a very similar variability–cost profile (so *minGrad* partially overlaps *minCB*).

than 0.2 basis point in annualized auction yield. In fact, *minDevBase* is the least costly strategy among the four alternatives that target some form of predictability. This outcome suggests that stabilizing issuance at historical levels at each maturity point very nearly minimizes short-run costs.

The bottom panel shows the variability–cost profiles of the alternative strategies relative to a portion of the efficient frontier. Notice that these strategies all have fairly high *AG* values; compared with the feasible range of *AG*, the five alternatives are tightly clustered. (As shown at the end of Section 3.2, up to the GMC point, a higher *AG* is associated with a lower *FC*.) While the cost-minimizing strategy leads to the GMC point on the frontier, the other strategies are all above the frontier. The vertical distance between the alternative strategies and the efficient frontier thus measures the impact of factors other than cost in the objective function. In this example, a regular and predictable approach incurs an additional cost of $11 million to $49 million (or 0.19 to 0.94 basis point more in annualized auction yield) during a twenty-seven-week period. This estimate is subject to the same qualifications made earlier; it does not consider potential changes in bidder behavior that occur in response to changes in issuance strategies.

4. Improvement from Cash Management Bills

Various strategies using regular bills yield a spectrum of variability–cost trade-offs. In practice, the Treasury also has the option to use cash management bills (CMBs), which do not follow a fixed issuance calendar like other Treasury securities. Instead, the Treasury decides the auction time, issuance amount, and maturity for each CMB. In this section, we consider the advantages of using CMBs, propose a heuristic method to incorporate CMBs in issuance optimization, and examine the impact of CMBs on variability–cost trade-offs.

4.1 Rationale for Using CMBs

CMBs are useful for two reasons. First, the net cash flow from regular bills might be insufficient to meet the Treasury's cash need in a given week, even after the regular bill issuances are taken to the highest levels allowed by the size (2) and gradient (3) constraints. In this case, there would be no feasible issuance program using only regular bills, and we would need *feasibility* CMBs.

The other use of CMBs enables marginal improvements in a funding plan; we refer to these as *transitory* CMBs. As an illustration, the Treasury may anticipate a spike in cash needs in week i that is scheduled to be offset by a trough in week $i + 1$ through projected inflows. The Treasury may then choose to issue a 1-week CMB in week i to fill the gap, effectively shifting cash from the excess at week $i + 1$ to the shortfall at week i. CMBs command higher yields than regular bills; however, a short-term CMB may nevertheless have lower total cost, as measured by the product of yield and term. In addition, employing CMBs helps reduce the need to change regular issuance

sizes and thus limits issuance variability. (We do not include CMBs in the calculation of AG variability because they are already penalized through a higher yield.)

4.2 A Heuristic CMB Algorithm

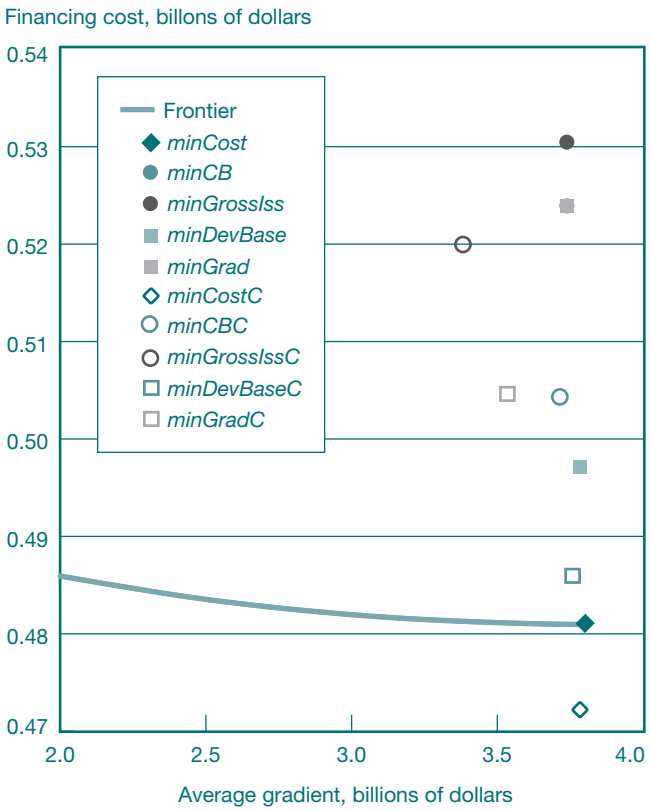
Before we include CMBs in the optimization procedure, we need to specify some model parameters in addition to those laid out in Section 3.1. Substantial evidence exists that CMBs are more expensive than regular bills of similar maturities. Simon (1991) finds that segmentation in the Treasury bill market is widespread and causes CMB yields to be higher than yields on adjacent-maturity bills. Seligman (2006) confirms the relative expensiveness of CMBs under the current uniform-price auction format and with off-cycle schedules (in other words, not necessarily conforming to the Thursday-to-Thursday issuance-to-maturity cycle). In our study, using CMBs in 2011, we find the average difference between the CMB yield and the implied yield based on the Treasury bill curve at the same maturity to be 4.57 basis points. Hence, to find the auction yield of a future CMB issuance, we use the bill curve to calculate the yield for the intended maturity, and then add 4.57 basis points. We also limit the term of a CMB to either one or two weeks, consistent with the actual usage of these securities since the introduction of 4-week bills. In addition, we limit the size of a CMB to between $10 billion and $40 billion.

Strictly speaking, incorporating CMBs in our issuance optimization turns the problem into a mixed-integer quadratic programming problem: For each week within the projection horizon, we need a binary variable that turns CMB issuance on and off. In fact, we need a separate binary variable for each potential CMB maturity. Unlike the original quadratic programming problem, this optimization problem quickly becomes prohibitively time-consuming. Instead, we determine the timing of CMBs through a simple heuristic.

In reality, the Treasury may consider CMBs if there is an unusually high cost associated with satisfying a particular weekly cash need with regular bills. To incorporate this intuition in issuance decision making, we use the Lagrange multiplier associated with the financing constraint (1) in solving the original problem (6). The multiplier, or shadow price, measures the change in the objective function owing to a marginal change in the constraint. It is calculated automatically as a byproduct of the quadratic programming algorithm. A high shadow price associated with the financing constraint in a given week indicates significant pressure on cash flow in that week, and thus a high benefit to issuing a transitory CMB. With this thought, we adopt a heuristic procedure to determine the timing of CMBs:

1. Add feasibility CMBs if necessary. Update the weekly cash-needs vector.
2. Run optimization (6) without transitory CMBs.
3. Identify the week in which the Lagrange multiplier associated with (1) is the largest. Run (6) with a 1-week CMB or a 2-week CMB in that particular week. Pick the CMB with the smaller objective function value.

Chart 5
The Impact of Cash Management Bills



Source: Authors' calculations.

Notes: The chart shows three sets of results: the efficient frontier, five strategies using regular bills only, and five strategies using at most three cash management bills. The five strategies are minimizing financing cost (*minCost*), cash balance (*minCB*), cash balance plus gross issuance (*minGrossIss*), cash balance plus deviation (*minDevBase*), and cash balance plus gradient (*minGrad*). All CMB strategies exhibit better variability–cost trade-offs, positioned below and to the left of the same strategy using only regular bills. Note that *minGrad* overlaps *minCB*.

4. If multiple transitory CMBs are allowed, repeat step 3 until the maximum allowed number of CMBs is reached or until an additional CMB provides no material benefit.

Using CMBs improves the variability–cost trade-off, as shown in Chart 5 on page 11. We allow up to three CMBs in this example, erring on the conservative side of how the Treasury deploys CMBs in practice. The five objectives all return better variability–cost measures with the help of CMBs; they are below and to the left of those measures that use only regular Treasury bills. In addition, cost given a specific degree of variability no longer has a floor at the efficient frontier since we now have an expanded set of securities. Overall, using CMBs reduces cost by $8 million to $20 million, which equates to a 0.08-0.20 basis point reduction in annualized average auction yield.

5. Conclusion

Serving as collateral, hedging instruments, interest rate benchmarks, and safe and liquid investments, Treasury securities are essential to the functioning of the global financial system. In seeking to minimize its borrowing costs, the Treasury follows a principle of "regular and predictable" issuance of these securities. In this article, we attempt to quantify the short-term cost impact of forgoing opportunistic issuance of Treasury bills in favor of a regular and predictable approach. We do so by calculating the effect of including considerations other than short-term cost minimization when setting issuance sizes.

To overcome the practical obstacle of observing alternative strategies empirically, we use a model-based approach to compare tactical and regular issuance strategies. We quantify the cost impact of regular and predictable issuance as the cost difference, in dollars and in annualized auction yields, between a benchmark strategy focused on minimizing short-run costs and alternative strategies that include smoothness in the optimization objective function. To enable fast and efficient computation, we formulate the optimization problem as a quadratic program. We also examine how the inclusion of cash management bills would affect costs, using a heuristic approach based on shadow prices derived from the quadratic programming solution.

We find that taking a regular and predictable approach to issuance results in additional short-term costs. However, the additional cost is less than one basis point for most of the historical dates tested, and this increase is partially offset by using even a small number of 1-week or 2-week CMBs. Moreover, our analysis does not factor in changes in bidder behavior that would presumably result if a less regular and predictable issuance strategy were used; inclusion of those changes would likely further favor a regular and predictable approach. Thus, our overall conclusion is that the Treasury is not forgoing significant short-term gains by electing to follow a program of regular and predictable—rather than opportunistic—issuance of Treasury bills.

Appendix: Robustness Check

The analysis in this study, based on data as of November 12, 2009, suggests that various forms of regular and predictable issuance might effectively add 0.19-0.94 basis point in auction yield, but that introducing modest flexibility through limited issuance of cash management bills might drop the auction yield by 0.08-0.20 basis point, offsetting about a quarter of the cost impact of maintaining regular issuance. To check if these observations are robust, we examined a few dates since the beginning of the 2008 financial crisis. Each date roughly mirrors an important market development:

November 2007: pre-crisis
September 2008: crisis peak
March 2009: start of the first round of quantitative easing (QE1)
July 2009: total value of bills outstanding reaches a historic high
May 2010: a precipitous drop in bill amount outstanding
November 2010: QE2 begins
August 2011: fears of a breach in the debt limit and a downgrade of the U.S. government credit rating
October 2011: start of Operation Twist
March 2012: bill supply starts to increase
September 2012: QE4 begins

We use the fifteenth of each month (or the last business day before the fifteenth) for convenience.

We keep model parameters the same as described in Section 3.1. On each date, the yield curve and cash-need forecasts are the only differences. Interest rates changed substantially during the sample period; for example, the three-month rate dropped from around 3.4 percent in November 2007 to below 20 basis points in November 2008 and has stayed at the near-zero level ever since, reaching barely 10 basis points in September 2012. Financing needs varied as well; the gross bill issuance during the twenty-seven-week projection period was about $1.4 trillion in November 2007, climbed to $3.5 trillion in mid- and late 2010, and then ranged between $2.5 trillion and $3.1 trillion through 2011 and 2012.

We are interested in the cost of using objectives other than cost minimization and the advantage of using CMBs. The following table summarizes the cost and benefit, all in terms of effective auction yield changes in basis points. Column (I) is the maximum increase in auction yield (in basis points) from using objectives *minCB*, *minGrossIss*, *minDevBase*, and *minGrad*, while Column (II) is the minimum basis point decrease in auction yield when including CMBs with the same optimization objective. As before, for this exercise we only allow limited use of CMBs—at most three issuances in a twenty-seven-week period, each issuance having a maturity of one or two weeks.

Average Auction Yield Changes

Date	Maximum Increase in Yield Using *minCB*, *minGrossIss*, *minDevBase*, and *minGrad*	Minimum Decrease in Yield Using *minCB*, *minGrossIss*, *minDevBase*, and *minGrad* with CMBs
	(Basis Points)	
September 14, 2012	0.19	0.01
March 15, 2012	0.87	0.08
October 14, 2011	0.85	0.00
August 15, 2011	0.49	0.02
November 15, 2010	0.63	0.01
May 14, 2010	0.01	0.00
July 15, 2009	1.37	0.03
March 13, 2009	1.06	0.10
September 15, 2008	5.79	0.31
November 15, 2007	1.30	0.39

Source: Authors' calculations.
Notes: The table reports the changes in average auction yield attributable to using non-cost-minimizing objectives and CMBs (cash management bills) on ten historical dates around the time of the financial crisis. Relevant dates are given as the fifteenth of each month or the last business day before the fifteenth.

Consider September 14, 2012, for example. An issuance pattern that minimizes the cash balance while controlling for the gross issuance would effectively increase the annualized auction yield by about 0.19 basis point, or about $21 million in issuance cost, during the twenty-seven-week projection period. Other objectives also result in additional cost, though by smaller amounts. The flexibility of using CMBs generally leads to savings for the same objective, consistent with earlier observations that the option to use CMBs pushes the AG-FC trade-off down and to the left, as reflected in Chart 5. In this example, the smallest savings occur in *minGrad*, where the CMB option saves 0.01 basis point, or about $4 million.

Similar patterns hold for the other historical dates, though the maximum yield increase (additional issuance cost) or minimum yield decrease (issuance cost savings) do not always correspond to the same optimization objective. The magnitude of the additional cost or savings varies, with September 15, 2008, showing substantially larger values. The maximum yield increase, with *minGrad*, is about 5.79 basis points, or $120 million in additional issuance cost on a base of $5.74 billion. At the same time, using CMBs could save at least 0.31 basis point, or $38 million. These values are not inconsistent with the earlier results.

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Thomas Eisenbach, Andrew Haughwout, Beverly Hirtle, Anna Kovner, David Lucca, and Matthew Plosser

Supervising Large, Complex Financial Institutions: What Do Supervisors Do?

- The supervision of large, complex financial firms is a key component of the Federal Reserve's role in promoting financial stability.
- However, the process by which the Fed conducts supervision can be opaque to outsiders, in part because of the need to keep supervisory information confidential.
- A close look at how supervisory activities are structured, staffed, and implemented on a day-to-day basis at the New York Fed sheds light on the strategies adopted to achieve supervisory goals. The authors detail firm-specific and cross-firm monitoring activities, and identify the tools—such as ratings and enforcement actions—used by supervisors to ensure that firms correct unsafe practices.
- The authors also highlight changes introduced post-crisis, including increased specialization of firm-focused teams at individual banks and the addition of risk specialists to those teams.

1. Overview and Background

> An Act To provide for the establishment of Federal reserve banks, to furnish an elastic currency, to afford means of rediscounting commercial paper, to establish a more effective supervision of banking in the United States, and for other purposes.
>
> *Federal Reserve Act, Official Title*

The official title of the 1913 act that established the Federal Reserve reveals that the supervision of banks has been a key responsibility of the nation's central bank from the start. Today, the Federal Reserve carries out the prudential supervision of bank holding companies (BHCs) on a consolidated basis, as well as the supervision of a number of other financial institutions operating in the United States.[1]

[1] Consolidated oversight encompasses both the parent holding company and its subsidiaries. While state member bank subsidiaries are also directly supervised by the Federal Reserve, this article focuses on supervisory activities at the holding company level.

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To view the authors' disclosure statements, visit https://www.newyorkfed.org/research/author_disclosure/ad_epr_2017_what-do-supervisors-do_eisenbach.html.

Prudential supervision involves the monitoring and oversight of these firms to assess whether they are in compliance with law and regulation and whether they are engaged in unsafe or unsound practices; it also entails ensuring that firms are taking appropriate steps to correct such practices. Prudential supervision is interlinked with, but distinct from, regulation of these firms, which involves the development and promulgation of the rules under which BHCs and other regulated financial intermediaries operate. The distinction between supervision and regulation is sometimes blurred in discussions of the banking industry by academics, researchers, and analysts, and the terms "supervision" and "regulation" are often used somewhat interchangeably.[2] Moreover, while prudential supervision is a central responsibility of the Federal Reserve and consequently accounts for substantial resources, the responsibilities, powers, and day-to-day activities of Federal Reserve supervision staff are often somewhat opaque to those who are not directly involved.

This article aims to bring greater transparency to System supervisory activities by describing how they are structured, staffed, and implemented on a day-to-day basis at the Federal Reserve Bank of New York (New York Fed). The discussion focuses primarily on the supervision of large, complex bank holding companies and the largest foreign banking organizations (FBOs) and nonbank financial companies designated by the Financial Stability Oversight Council (FSOC) for supervision by the Federal Reserve. The article gives particular attention to oversight of these firms because they are the most systemically important banking and financial companies—a distinction that makes prudential supervision especially consequential for financial stability. Given their size and complexity, the approach to supervising them also differs from that taken with smaller and less complex firms. We note at the outset that supervision of these large, complex firms is conducted through a comprehensive Systemwide program governing supervisory policies, activities, and outcomes.[3] However, this article considers only supervisory staff located at the Federal Reserve Bank of New York, whose activities are carried out as part of this broader program.[4]

[2] See Mishkin (2001) and Masciandaro and Quintyn (2013) for surveys of the academic literature on supervision and regulation. See Board of Governors of the Federal Reserve System (2005) for a fuller discussion of the distinction between supervision and regulation.

[3] The structure of this program is described in Supervision and Regulation Letter 15-7 (SR 15-7), "Governance Structure of the Large Institution Supervision Coordinating Committee (LISCC) Supervisory Program" (Board of Governors of the Federal Reserve System 2015c).

[4] The article does not cover prudential supervision of financial market utilities, although these institutions are also large, complex, and systemically important. The activities of these organizations and the supervisory issues they present are distinct from those of the more traditional BHCs that are the focus of this article.

The article is based on information from three main sources. First, it draws on a series of discussions with staff of the New York Fed's Supervision Group (SG) involved in the day-to-day supervision of the large, complex banking and financial institutions. Second, it relies on various written materials describing the structure and goals of supervision at the New York Fed and in the Federal Reserve System, selected guidelines provided to supervisory staff, and Federal Reserve Supervisory and Regulation Letters (SR Letters) describing expectations and objectives of the Federal Reserve's supervisory program for large, complex banking companies. Third, the article pairs its descriptive analysis with SG management data about supervisory inputs—SG supervisory staff headcounts and hours by departments and activities—and outputs, namely supervisory actions.

Our overview of the structure and implementation of prudential supervision at the New York Fed is intended to provide insight into what supervisors do and how they do it, rather than to document every element in complete detail or to provide an "end-to-end" description of the supervisory process. Further, while we explain the stated rationale for the approaches taken, we do not assess whether the structure and implementation outlined are efficient or meet specific objectives. It is our view that understanding how prudential supervision works is a necessary precursor to determining how to measure its impact and effectiveness.

Our discussion begins in Section 2 with a description of the broad goals of prudential supervision and the primary strategies adopted to achieve those goals, as outlined in various Federal Reserve documents. The section then describes the structure of supervision in the Federal Reserve and provides an overview of the Supervision Group at the New York Fed. Section 3 discusses how the New York Fed's supervisory staff is organized into departments and teams, with particular emphasis on supervision of the largest and most complex financial institutions. Section 4 then describes the day-to-day activities of these supervisory teams, including monitoring, examinations, and broader supervisory programs, as well as the outcomes of that work. Section 5 presents a summary and conclusion.

2. Authority, Goals, and Structure of Supervision

2.1 Authority

The Federal Reserve's authority to conduct prudential supervision of BHCs is based on law and regulation, while the implementation of the Federal Reserve's prudential supervisory

authority—how supervisors monitor and assess BHCs' activities and take corrective action when needed—is based on a combination of law, regulation, and accepted practice.

The principal source of the Federal Reserve's authority to supervise BHCs is found in Section 5 of the Bank Holding Company Act of 1956, as amended (the BHC Act), which provides that all BHCs are to be supervised on a consolidated basis by the Federal Reserve (Board of Governors of the Federal Reserve System 2015a). The BHC Act authorizes the Federal Reserve to collect information and to issue regulations and orders as necessary to carry out the purposes of, and prevent evasions of, the BHC Act. The stated purposes of the BHC Act include supporting the safety and soundness of BHCs, the compliance of BHCs with applicable laws, and the stability of the U.S. financial system. In addition to the BHC Act, federal law gives the Federal Reserve authority to take action against a BHC "to prevent these entities [BHCs] from engaging in unsafe or unsound practices or to address violations of law in connection with their business operations" (Board of Governors of the Federal Reserve System 2015a). Federal law also specifies the kinds of steps supervisors may take to remedy violations of law, regulation, or agreements, or to intervene when a BHC is engaging (or is about to engage) in practices that the supervisor deems to be unsafe or unsound. Finally, the Dodd-Frank Wall Street Reform and Consumer Protection Act ("Dodd-Frank") further bolsters the Federal Reserve's prudential supervisory authority by adding the authority to establish enhanced prudential standards for the largest BHCs to ameliorate the risks they pose to the financial stability of the United States.

2.2 Goals and Strategy

The Federal Reserve's supervisory strategy combines a focus on the supervised firm's internal processes and governance with an independent supervisory assessment of its financial strength, especially capital and liquidity. With respect to internal processes and governance, emphasis is placed on the supervised firm's ability to identify and manage its risks, with subsequent supervisory actions intended to make the institution remediate any shortcomings. The motivation for this approach is to try to ensure that financial institutions, especially the largest and most complex, have financial and operational resiliency under a variety of potential stressful circumstances (Board of Governors of the Federal Reserve System 2012). A central theme in the supervisory strategy is that responsibility for risk identification and risk management rests with the supervised institution while the Federal Reserve's role is to ensure that the institution has strong processes for carrying out these tasks.

As various Federal Reserve System documents make clear, the broad goals of prudential supervision relate very closely to the Federal Reserve's financial stability responsibilities. For instance, the Bank Holding Company Supervision Manual states that "the Federal Reserve's consolidated supervision activities closely complement its other central bank responsibilities, including the objectives of fostering financial stability and deterring or managing crises" (Board of Governors of the Federal Reserve System 2015a), while the 2015 Dodd-Frank stress test report notes that "through its supervision, the Federal Reserve promotes a safe, sound, and stable banking system that supports the growth and stability of the U.S. economy" (Board of Governors of the Federal Reserve System 2015b). Similarly, the description of the Supervision Group on the New York Fed public website notes that "the objectives of supervision are to evaluate, and to promote, the overall safety and soundness of the supervised institutions (microprudential supervision), the stability of the financial system of the United States (macroprudential supervision), and compliance with relevant laws and regulations" (Federal Reserve Bank of New York 2016). In all these cases, the goals of supervision include the stability of the financial system in addition to the safety and soundness of individual financial institutions.

These goals are quite broad and could be implemented using a variety of supervisory strategies, but some implementation detail can be found in the documents just cited as well as other System documents. For instance, the Federal Reserve's policy statement about supervision of large financial institutions (SR 12-17) states,

> the consolidated supervision framework has two primary objectives: (1) Enhancing resiliency of a firm to lower the probability of its failure or inability to serve as a financial intermediary. . . . This requires financial resilience by maintaining sufficient capital and liquidity, and operational resilience by maintaining effective corporate governance, risk management, and recovery planning. (2) Reducing the impact on the financial system and the broader economy in the event of a firm's failure or material weakness. . . . This requires, among other things, effective resolution planning that addresses the complexity and the interconnectivity of the firm's operations.[5] (Board of Governors of the Federal Reserve System 2012)

[5] In this context, resolution refers to steps taken in the event of "material financial distress or failure" of a banking company to foster a rapid and orderly outcome in which the critical operations of the firm can continue. Critical operations "are those operations (including associated services, functions, and support) that if they were to fail or be discontinued could pose a threat to the financial stability of the United States" (Board of Governors of the Federal Reserve System 2012).

The Board of Governors' public website sheds additional light on implementation procedures, indicating that the Federal Reserve's approach to the supervision of systemically important financial institutions involves

> an interdisciplinary and cross-firm perspective. . . . This approach . . . fosters rigorous supervision of individual firms while formalizing the use of horizontal reviews and analyses of activities and risks across the portfolio. Further, the approach promotes the evaluation of systemic risks posed by firms . . . through the evaluation of macroeconomic and financial risks, and how those risks could affect individual firms and the financial system collectively. (Board of Governors of the Federal Reserve System 2016)

New York Fed documents also provide detail on the System's strategic approach to supervision:

> [In overseeing individual financial institutions,] the Supervision Group takes a risk-focused approach based on a supervisory plan that is customized to a firm's risk profile and organizational structure. Examiners look at key aspects of a supervised firm's businesses and risk management functions to assess the adequacy of the firm's systems and processes for identifying, measuring, monitoring, and controlling the risks the firm is taking. . . . In addition, the Supervision Group evaluates the adequacy of a firm's capital and liquidity. (Federal Reserve Bank of New York 2016)

The Board's *Purposes and Functions* document describes the Federal Reserve's approach to supervision in similar terms: "The goal of the risk-focused supervision process is to identify the greatest risks to a banking organization and assess the ability of the organization's management to identify, measure, monitor, and control those risks" (Board of Governors of the Federal Reserve System 2005).

Many of the passages quoted present an explicitly microprudential perspective in the sense that the focus is on individual firms, even if the standards for what constitutes sound practices are based, in part, on practices observed across the range of supervised institutions. However, the supervisory documents also suggest that macroprudential considerations are important. These macroprudential concerns could affect seemingly microprudential supervisory strategies by, for instance, focusing on common risk exposures across firms or risk management strategies that would protect an individual institution but potentially cause harm to others (fire-sale risk, for example).

The Federal Reserve's prudential supervisory activities are closely related to its role as a regulator of these firms. As noted above, prudential supervision is interlinked with, but distinct from, regulation of these firms, which involves the development and promulgation of the rules under which BHCs and other regulated financial intermediaries operate. The two activities are linked because an important part of prudential supervision is verifying compliance with regulation, although as much of the preceding discussion suggests, the scope of supervision is much broader than compliance alone. Beyond the link through compliance, the Federal Reserve's prudential supervisory activities are related to its regulatory role through the influence that supervision has on the regulatory agenda. In particular, information about industry practice and institutional activities that is gained through prudential supervision can be used in developing regulations governing those activities. Regulation based on in-depth knowledge of industry practice can better achieve desired policy outcomes while reducing unintended consequences. In addition, insights into emerging risks and new products and activities gained through supervision can help identify areas meriting new or amended regulation. In other words, regulation guides supervisory activities, and supervision in turn provides information that allows the Federal Reserve to develop and maintain regulations that more effectively address its public policy objectives.

2.3 Structure: Institutions and Portfolios

The Federal Reserve is responsible for prudential supervision of a large range of bank and nonbank financial institutions, including relatively small and noncomplex commercial banks and BHCs, the U.S. operations of foreign banks, and savings and loan holding companies, as well as the large, complex institutions that are the focus of this article. These institutions differ significantly in size, complexity, geographic reach, and business focus. Given this diversity, Federal Reserve supervision of these firms is organized by "portfolio," where portfolios are defined as groups of broadly similar financial institutions from across the Federal Reserve System. The portfolio approach helps ensure that the supervisory program is tailored to the size and complexity of individual firms, that oversight of similar firms is conducted in a consistent manner, and that supervision within each portfolio benefits from a cross-firm

perspective (Board of Governors of the Federal Reserve System 2015a).[6]

The Board of Governors has the authority and responsibility to carry out supervision of financial institutions, while the supervisory activities of the Reserve Banks are conducted under delegated authority from the Board. Within the Federal Reserve, each Reserve Bank supervises financial institutions that are located within its District; in the case of the New York Fed, this includes institutions located within the Second Federal Reserve District, which covers New York, northern New Jersey, southwestern Connecticut, Puerto Rico, and the U.S. Virgin Islands (Federal Reserve Bank of New York 2016). Interaction between staff at the Board of Governors and at the Reserve Banks is typically substantial, both on an ongoing basis and when concerns arise about a particular institution or group of institutions.

At the System level, the Large Institution Supervision Coordinating Committee (LISCC) coordinates supervision of the largest and most complex, systemically important BHCs, U.S. operations of foreign banks, and nonbank firms designated by the Financial Stability Oversight Council. As of February 2016, the LISCC portfolio comprised sixteen large, complex organizations, twelve of which were in the Second Federal Reserve District and thus subject to supervision by the New York Fed (Table 1).

Reflecting the systemic importance of the firms in its portfolio, the LISCC has a governance structure that is distinct from that in place for the supervision of smaller and less complex firms. The LISCC is chaired by the director of the Board of Governors' Division of Banking Supervision and Regulation and is composed of senior officials from across the Federal Reserve System. The membership is multidisciplinary, including representatives from the research, markets, credit risk management, and payments, clearing, and settlement areas of the Federal Reserve (Board of Governors of the Federal Reserve System 2010, 2015c; Yellen 2015). The goals of the LISCC are to provide strategic and policy direction for supervisory activities involving firms in the LISCC portfolio, to enhance the consistency and quality of supervision of these firms, and to incorporate systemic risk considerations in the supervisory program (Board of Governors of the Federal Reserve System 2015c, 2016).

Table 1
LISCC Portfolio Firms
February 2016

Firm	Federal Reserve District
American International Group, Inc.	New York
Bank of America Corporation	Richmond
The Bank of New York Mellon Corporation	New York
Barclays PLC	New York
Citigroup Inc.	New York
Credit Suisse Group AG	New York
Deutsche Bank AG	New York
General Electric Capital Corporation	New York
The Goldman Sachs Group, Inc.	New York
JP Morgan Chase and Co.	New York
MetLife, Inc.	New York
Morgan Stanley	New York
Prudential Financial, Inc.	Boston
State Street Corporation	Boston
UBS AG	New York
Wells Fargo and Company	San Francisco

Source: Board of Governors of the Federal Reserve System 2016.

Note: LISCC is Large Institution Supervision Coordinating Committee.

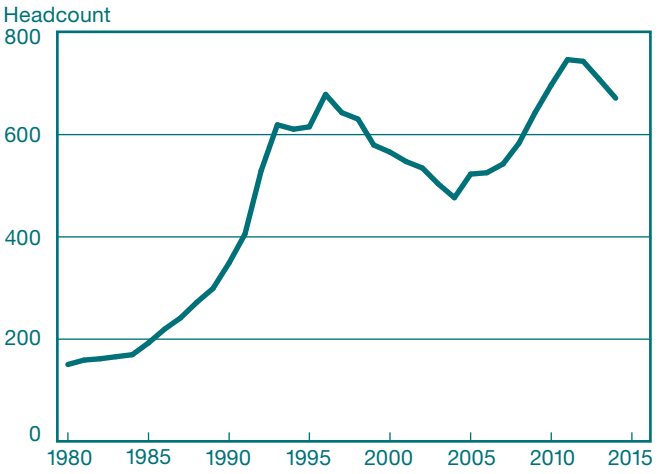
The primary operational arm of the LISCC is the Operating Committee (OC), which like the LISCC has a multidisciplinary membership from across the Federal Reserve System (Board of Governors of the Federal Reserve System 2010, 2015c). The OC, in consultation with the LISCC, establishes the most important areas for supervisory focus at individual firms and groups of firms, oversees supervisory activities for firms in the LISCC portfolio, identifies common risks facing firms in the portfolio, fosters deeper understanding of business strategies among the firms, and makes decisions about certain supervisory actions to address safety and soundness concerns at these institutions (Dudley 2014). The OC has various subcommittees that focus on current and emerging risks, operating performance, capital, and supervisory planning. Membership of the subcommittees consists of OC members as well as other staff from the Board of Governors and the Reserve Banks (Board of Governors of the Federal Reserve System 2015c).

The structure of the New York Fed's Supervision Group mirrors the portfolio structure discussed above to a large degree. As Chart 1 indicates, there were about 675 staff members in the SG at year-end 2014 (when our data end), about 75 below the peak reached at the end of 2011.

[6] Aside from the large, complex financial companies that are the primary focus of this article, the portfolios include the following: the large banking organization (LBO) portfolio, which includes BHCs with assets greater than $50 billion, other than the largest and most complex; the foreign banking organization (FBO) portfolio; the regional banking organization (RBO) portfolio, which includes regional banking companies; and the community banking organization (CBO) portfolio, which includes the smallest and least complex BHCs and banks. LISCC is Large Institution Supervision Coordinating Committee.

Chart 1

New York Fed Supervision Group Headcount

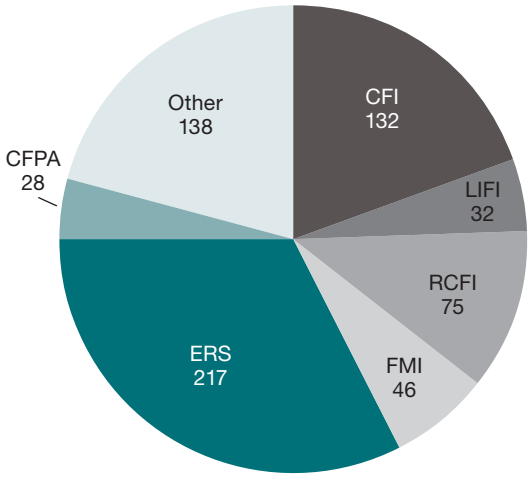


Source: Federal Reserve Bank of New York internal supervisory headcount data.

Note: The chart reflects the number of full-time-equivalent employees each year.

Chart 2

Department Allocation of FRBNY Supervision Group Staff in 2014, Based on Headcount



Source: Federal Reserve Bank of New York internal supervisory headcount data.

Notes: The firm-focused staff (represented by the gray areas) is divided into CFI (Complex Financial Institutions), LIFI (Large International Financial Institutions), RCFI (Regional, Community, and Foreign Institutions), and FMI (Financial Market Infrastructure). ERS is Enterprise Risk Supervision; CFPA is Cross-Firm Perspectives and Analytics. "Other" includes Executive Function (11 members), Group Operations (119 members), and Supervisory Policy (8 members).

The staff has grown since the 1980s, with a large increase during the early 1990s following the passage of legislation giving the Federal Reserve additional supervisory responsibility for foreign banking activities. This increase was followed by a gradual decline in the later 1990s reflecting staffing efficiencies from technological improvements (such as greater automation and advances in information processing that led to reductions in administrative staff), changes in the structure of firms in the District during the consolidation wave of the late 1990s, and the advent of risk-focused supervision. The SG staff is organized into departments that are responsible for different aspects of the supervision of large, complex financial institutions.

Chart 2 shows SG staff department allocations by headcount as of the end of 2014.[7] At that time, a set of these departments contained examiners assigned to specific financial institutions or groups of financial institutions. These departments were Complex Financial Institutions (CFI), Large International Financial Institutions (LIFI), Regional, Community, and Foreign Institutions (RCFI), and Financial Market Infrastructure (FMI). In addition, the Enterprise Risk Supervision (ERS) department housed analysts considering different facets of financial institution and banking industry risk and performance. Finally, the Cross-Firm Perspective and Analytics (CFPA) department pursued cross-firm analysis of performance and capital to provide industrywide insights. "Other" included the Executive Function and Group Operations, as well as Supervisory Policy, which works on the development of policy related to supervisory matters in both a domestic (U.S.) and international context. Interaction among these different areas is discussed in detail in the next section.[8]

[7] The SG has realigned its departmental structure since this analysis. The teams responsible for oversight of non-LISCC firms have been shifted from CFI (since renamed the LISCC Portfolio department) to LIFI (now named the Large and Foreign Banking Organization department). In addition, following a reorganization of the New York Fed's supervision staff at the beginning of 2015, the analysts in the CFPA function were either reassigned within the SG or became part of a unit outside of the SG.

[8] Group Operations included about forty staff members in the supervisory development programs of new hires for examiners and risk specialists.

3. How Is the New York Fed's Supervisory Staff Organized?

3.1 Overview

The structure and organization of the SG staff date from a significant reorganization that took place in 2011. Drawing on lessons learned during the financial crisis, the reorganization was designed to reshape both the internal structure of the group and the interactions among staff members in order to enhance communication and facilitate identification of emerging risks through greater emphasis on cross-firm perspectives. In addition, the reorganization was intended to foster engagement between senior supervisory staff and senior managers and members of the board of directors at supervised firms (Dahlgren 2011).

To these ends, staff members engaged in the prudential supervision of large bank and nonbank financial companies at the New York Fed are assigned to one of two types of groups: *firm-focused teams* concentrating on individual companies or portfolios of companies (the gray areas in Chart 2) or *risk departments* concentrating on a particular type of risk facing these firms (the largest blue area in the chart).[9] While the two sets appear distinct in an organization chart, in practice there is considerable interaction between the firm-focused teams and the risk departments, as when risk department members are assigned to firm-focused teams on a long-term basis. This section describes the structure of the firm teams and risk departments, the various roles that different team and department members play, and the way that staff members interact across teams and departments. The discussion also highlights how the structure varies based on the size and complexity of the bank holding company or nonbank firm being supervised.

3.2 Firm-Focused Supervisory Teams

Each of the largest and most complex bank and nonbank financial companies has its own dedicated New York Fed team whose primary responsibility is supervision of the firm (Federal Reserve Bank of New York 2016). As of February 2016, these companies included nine domestic and foreign banking companies that are part of the LISCC portfolio and three systemically important nonbank financial firms that had been designated by the FSOC for supervision by the Federal Reserve (Table 1).

Each firm-focused supervisory team is headed by a senior supervisory officer (SSO)—typically a senior vice president with experience in supervision, technical expertise relating to the firm's primary business activities, and/or experience in the banking industry—assisted by a deputy supervisory officer (DSO). The SSO oversees the supervisory program for the firm and is the point of contact for the firm's chief executive officer (CEO) and board of directors; for foreign banking companies, the SSO may interact with the global senior executive group ("C-suite") and directors, as well as those overseeing the firm's U.S. operations. The SSO also interacts regularly with other New York Fed SSOs and with those holding similar positions at other Reserve Banks (known as "central points of contact," or CPCs). The DSO is responsible for the day-to-day management of the team, including logistics and resources, and meets regularly with firm officers at the next level down from the CEO.

The SG firm-focused teams for companies in the LISCC portfolio had the equivalent of between eight and twenty-one staff members assigned directly to the team, with an average team size of twelve, based on actual hours worked in 2014 (Table 2, top panel).[10] The number of team members generally corresponds to the size and complexity of the firm. Aside from the SSO and DSO, firm-focused team members fill one of three roles: financial analyst, business line specialist, or corporate function specialist. Financial analysts specialize in assessing the firm's financial condition, including earnings, capital, and liquidity, and interact regularly with the company's chief financial officer (CFO). Business line specialists are responsible for understanding the firm's business strategy and performance in its major business lines and interact with the heads of those business lines. Corporate function specialists interact with the firm's chief operating officer (COO) and staff, and are responsible for understanding a range of governance and operational activities, including the firm's resolution and recovery planning, incentive compensation structure, and enforcement action responses. The precise composition of the team across these three specialties reflects the size and complexity of the firm and the span of its businesses and activities.

[9] As described in SR 15-7, the LISCC coordinates the supervision of firms in the LISCC portfolio; the activities of the New York Fed's SG staff are conducted as part of this Systemwide program. The LISCC Operating Committee is ultimately responsible for execution of the LISCC supervisory program (Board of Governors of the Federal Reserve System 2015c).

[10] Internal supervisory allocation data are self-reported by employees and require subjective work classification—conditions leading to some potential measurement error in the tables and charts that rely on this data source.

Table 2

Staffing for New York Fed Supervision of LISCC Portfolio Firms

Full-Time-Equivalent Headcount Based on Actual Hours in 2014

Firm-Focused Team Staff: LISCC Firms

Total	Average	Median	Minimum	Maximum
137	12	10	8	21

Risk (ERS) Department Staff: LISCC Firms

Total	Average	Median	Minimum	Maximum
104	9	10	2	18

Total Risk (ERS) Department Staff

All	Credit Risk	Funding and Liquidity Risk	Legal and Compliance Risk	Market and Counterparty Risk	Model Risk	Operational Risk
262	55	38	40	66	27	35

Source: Federal Reserve Bank of New York internal supervisory time allocation data.

Notes: This table shows a measure of full-time-equivalent headcount based on actual hours worked by New York Fed Supervisory Group staff on firm-focused teams and risk departments assigned to firms in the LISCC portfolio supervised by the New York Fed. Figures are rounded to the nearest whole number. Average, median, minimum, and maximum are measured across firms in the LISCC portfolio. LISCC is Large Institution Supervision Coordinating Committee. ERS is Enterprise Risk Supervision.

3.3 Risk Department Specialists

In the case of the largest and most complex firms, specialists from the SG's Enterprise Risk Supervision department are assigned to the firm-focused team on a long-term basis. These risk specialists have reporting responsibilities to both the SSO and the head of the risk department. The risk specialists are responsible for understanding the firm's risk exposures and risk management along several dimensions, including credit, liquidity, operational, and market risk. Risk specialists also participate in cross-firm assessments of market developments, emerging risks, and risk management approaches. The work of risk specialists assigned to firms in the LISCC portfolio is also coordinated through the Risk Secretariat, a subgroup of the LISCC Operating Committee charged with reviewing and evaluating risk management practices and helping to prioritize risk-related supervisory activities across the LISCC portfolio (Board of Governors of the Federal Reserve System 2015c).

The number of risk specialists assigned to each firm-focused team and the particular risks covered by those specialists vary according to the business focus and risk exposure of the firm, but a comparison of the upper and middle panels of Table 2 suggests that, as of 2014, risk specialist teams assigned at LISCC firms were typically about 45 percent of the total team assigned to the firm (firm-specific and risk). Risk specialists are most commonly assigned to teams supervising BHCs in the LISCC portfolio, though even on these teams, not every risk type is covered by a specialist from one of the risk departments. When risk types are not covered by a specialist, or when teams have no risk specialists, other team members are responsible for understanding the firm's exposure to and management of the risk in question.

The SG's risk departments cover a range of risks facing large, complex financial institutions. Some risk departments specialize in liquidity risk, others in credit risk, operational risk, legal and compliance risk, market and counterparty risk, or model risk. The bottom panel of Table 2 displays the allocation of staff by risk categories based on actual-hours-equivalent headcounts during 2014 and irrespective of whether the staff was assigned to LISCC firms or not. Within each risk type, department members may focus on particular aspects of the risk in question. For example, the credit risk team has subspecialists in wholesale credit (large loans to corporations or loans associated with commercial real estate) and in retail/consumer credit. The market and counterparty risk team has specialists in particular types of trading

products, such as foreign exchange, interest rate products, equities, or commodities.

The risk specialists assigned to the firm-focused teams represent a large share of the risk departments' staff. In addition to the risk specialists, the risk departments have in-house supervisory and analytical staff. These staff members are responsible for cross-firm analysis, targeted work at a particular firm at the request of an SSO, and coverage of portfolios of firms whose teams do not have dedicated risk specialists. Several risk departments have analytical units that manage and analyze large data sets collected from the banks. These units include staff in the liquidity risk department working with detailed firm-specific data about the maturity, funding, and cash flow characteristics of the assets, liabilities, and off-balance-sheet exposures of the consolidated firm and its major legal entities;[11] staff in the market and counterparty department who analyze counterparty-level exposures at major derivatives dealers; and the Shared National Credit (SNC) team in the credit risk department, which plays a critical role in the interagency program examining the treatment of these large loans across banking companies.[12]

Aside from work done by the risk teams, analysis in other areas of the SG and the New York Fed also serves as a critical input and support to the prudential supervision of the large, complex BHCs and nonbank financial institutions overseen by the New York Fed. For instance, a separate team of analysts assesses business line revenue performance, earnings and financial performance, and capital trends at these firms.[13] The work of these analysts supports the LISCC and its assessment of the large, complex firms in that portfolio, including those located outside the Second District. However, unlike the risk specialists, the "capital and performance" analysts are not integrated with the supervisory teams. Nonetheless, their work helps shape the supervisory agenda for LISCC firms, as explained further in Section 4.

[11] These data are collected on regulatory report forms FR 2052a and FR 2052b. See Board of Governors of the Federal Reserve System (2015d) for more detail.

[12] The Shared National Credit Program was established in 1977 by the Board of Governors of the Federal Reserve System, the Federal Deposit Insurance Corporation, and the Office of the Comptroller of the Currency to provide an efficient and consistent review and classification of any large syndicated loan. Today, the program covers any loan or loan commitment of at least $20 million that is shared by three or more supervised institutions. The agencies' review is conducted annually, usually in May and June (Board of Governors of the Federal Reserve System 2015e).

[13] As noted earlier, through 2014, these analysts were part of CFPA, which had a staff of twenty-eight at year-end 2014 (see Chart 2). Following a reorganization of the New York Fed at the beginning of 2015, some of these analysts became part of a unit outside of the SG.

3.4 Coordination and Information Sharing within the Supervision Group

Over time, supervisory staff members rotate across the firm-focused teams and, less frequently, among the risk departments. The Board of Governors requires that SSOs rotate at least every five years, with the possibility of extensions in special circumstances. New York Fed headcount data starting in 2000 indicates that the SSO spells at LISCC firms have generally been significantly shorter than five years, with an average of about 2.3 years.[14] The tenure limit is applied to all firm-focused team members in the SG, including the risk specialists. Thus, it is common for individuals to move from team to team over time, with the goal of balancing the in-depth knowledge gained about a particular firm with the fresh and independent perspective acquired by exposure to more than one institution. Rotation is intended to benefit the team as well as the individual, both by bringing in staff who do not necessarily share common assumptions with existing team members and by mitigating any tendencies to adopt the perspective of the firm being supervised. It is less common for staff to move from one risk department to another, given the specialized knowledge required to be an effective risk specialist. Risk specialists do, however, move to different firm-focused teams and into different assignments within the risk departments.

Members of both firm-focused teams and risk departments meet regularly to share information and observations and to coordinate analysis when appropriate. The most important mechanism for this interaction is provided by the so-called affinity groups, cross-firm groups of SG staff members who have common specialties and work focuses, such as financial analysts, business line analysts, and corporate function specialists. These groups generally meet weekly, with members attending in person at the New York Fed offices. Analysts and specialists from supervisory teams at other Reserve Banks and at the Board of Governors also participate in the affinity groups to facilitate broader information sharing and knowledge building.

[14] This figure excludes the most recent SSO assignments since these have not yet been completed. Including them in the calculation would otherwise lead to a right-truncation bias.

3.5 Impact of 2011 Reorganization

As noted above, a reorganization of the New York Fed's supervisory staff for the large, complex bank and nonbank firms took place in 2011. The goal of the reorganization was to build on lessons learned from the financial crisis about the importance of having a holistic understanding of risk and return at large, complex firms, including an understanding of the firms' business strategies and key revenue drivers. A primary objective was to broaden knowledge of each firm by moving away from a narrower focus on risk management and controls to a more integrated assessment of risk, revenue, and business strategy (Dahlgren 2011).

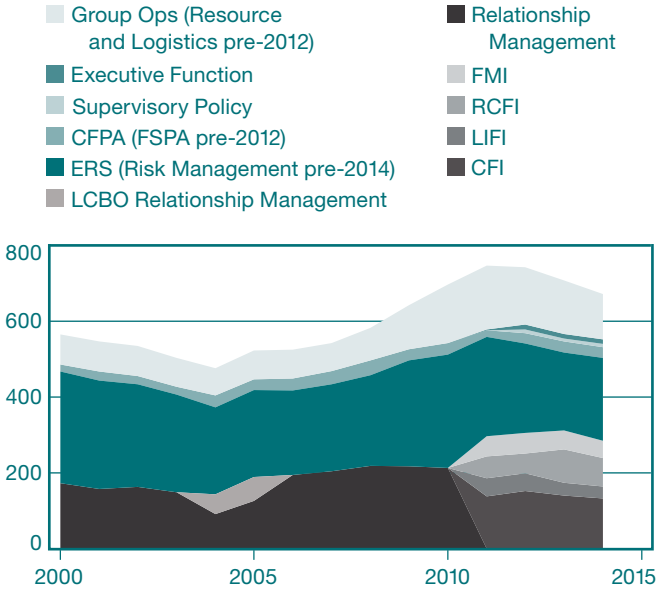
Prior to the reorganization, the firm-focused supervisory teams (shades of gray in Chart 2) were part of a single relationship department (Chart 3), although within that department, the teams were managed on a portfolio basis. More significantly, the teams focused on individual firms (known as "relationship" teams at that time) and the analysts specializing in different types of risk (known as "risk" teams) were less closely integrated. Risk specialists were not assigned to firm-focused teams on a long-term basis, but instead went from firm to firm on a project basis. SSOs (then referred to as central points of contact, or CPCs) would make requests for assistance from risk specialists to participate in firm-specific examinations; in some cases, risk specialists would work with the relationship team as part of a broader horizontal exam sponsored by the risk department and designed to cover several firms.

As a result of the reorganization, risk staff members now allocate an increasing portion of their time to a single firm. Chart 4 shows the portion of the risk department staff that is assigned to a single institution, as measured by the share of staff members who devote at least two-thirds of their time to one firm. This share rose from less than 5 percent to more than 30 percent after 2011.

Further, the new organizational structure formalized the three distinct roles within each firm-focused team (financial analyst, business line analyst, and corporate function specialist). Under the previous structure, relationship team members covered many of the same topics addressed by the financial analysts and corporate function specialists. However, the emphasis on business line strategy and performance is a new orientation (Dahlgren 2011). This new orientation—which is consistent with guidance that applies to the supervision of large, complex financial companies across the Federal Reserve[15]—is intended to provide insight into how the firms are generating profits and what risks are posed by the strategies the firms are pursuing, as a way of providing context to the evaluation of risk management and internal audit. Thus, the new approach involves a less direct focus on a firm's risk management and internal audit units as ends in themselves, and more focus on how the work of these areas supports (or does not support) the firm's business strategies and risk appetite.

Until recently, firm-focused teams were on-site in the sense that they were located in offices at the institution they were supervising. Typically, the supervised firm would provide a separate, dedicated area for the supervisory team. Team members also had access to work areas in New York Fed offices so that they could work off-site as needed. The idea in locating firm-focused supervisory teams on-site at the supervised institutions was to provide ready access to senior management and to internal systems and information networks at the supervised firm. Over time, however, technological enhancements have made access to firms' internal

Chart 3
The Evolving Department Allocation of Supervision Group Staff, Based on Headcount: 2000-14

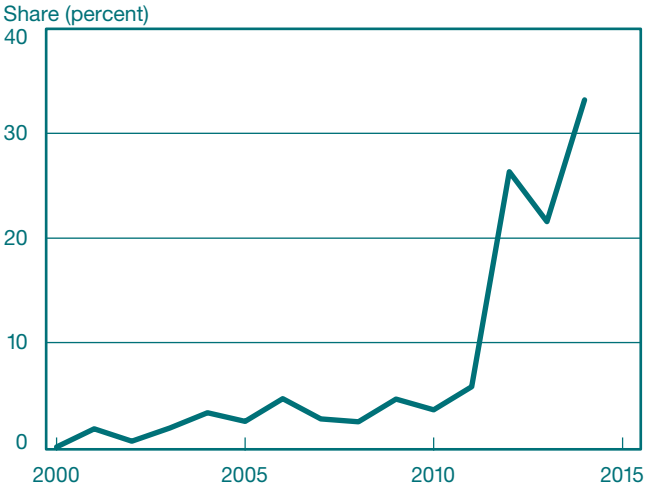


Source: Federal Reserve Bank of New York internal staff allocation data.

Note: CFPA is Cross-Firm Perspectives and Analytics; FSPA is Financial Sector Policy Analysis; ERS is Enterprise Risk Supervision; LCBO is Large Complex Banking Organizations; FMI is Financial Market Infrastructure; RCFI is Regional, Community, and Foreign Institutions; LIFI is Large International Financial Institutions; CFI is Complex Financial Institutions.

[15] SR 12-17 describes the conceptual framework for supervision of large financial institutions, which focuses on enhancing resiliency and reducing the impact of a firm's failure. See Board of Governors of the Federal Reserve System (2012).

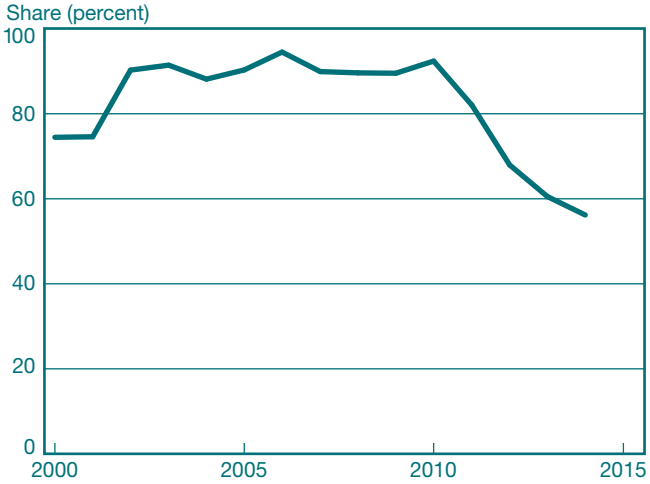
Chart 4
Risk Department Staff Allocated to a Single Institution



Source: Federal Reserve Bank of New York internal time allocation data.

Notes: The chart shows the share of risk department staff members who devote at least two-thirds of their supervisory hours to a single firm. Total supervisory hours exclude absences, training, and technical assistance.

Chart 5
Fraction of Hours Spent by LISCC Firm-Focused Staff On-Site



Source: Federal Reserve Bank of New York internal time allocation data.

Note: LISCC is Large Institution Supervision Coordinating Committee.

systems from remote locations much easier. As a result, the supervisory teams are being relocated to New York Fed offices on a permanent basis to facilitate interaction, cooperation, and information sharing among SG staff, as well as to foster analysts' independence. This pattern is evident in the fraction of on-site hours spent by LISCC firm-focused SG staff, which was about 55 percent in 2014 as compared with roughly 90 percent in the ten years prior (Chart 5).

3.6 Interaction with Other Supervisors

The Federal Reserve is the consolidated supervisor of BHCs and systemically important nonbank financial companies, meaning that it is responsible for having an integrated view of "the organization's structure, activities, resources and risk, as well as [addressing] financial, managerial, operational or other deficiencies" (Board of Governors of the Federal Reserve System 2015a). This consolidated oversight encompasses the parent holding company and its subsidiaries. Many of these subsidiaries are themselves regulated and supervised entities, such as commercial banks, thrifts, registered broker-dealers, and insurance companies. Thus, as part of the consolidated oversight of a bank holding company, members of the Federal Reserve supervisory staff interact with supervisory staff from other federal agencies, including the Office of the Comptroller of the Currency, the Federal Deposit Insurance Corporation, and the Securities and Exchange Commission, and with state financial sector supervisors (for instance, the New York State Department of Financial Services).[16]

Federal Reserve supervisors make use of the work carried out by other federal and state supervisors in their oversight of commercial bank and other regulated holding company subsidiaries. Under the terms of the Gramm-Leach-Bliley Act (GLBA), Federal Reserve supervisors rely as much as possible on the examination reports of these other agencies in assessing the condition of these subsidiaries (Board of Governors of the Federal Reserve System 2015a). Beyond relying on reports, Federal Reserve supervisors meet regularly with supervisory staff from the other agencies to share information about the firm and the relevant subsidiary, as well as information about supervisory plans, activities, and findings. In addition

[16] The Federal Reserve is the primary federal supervisor of state-chartered commercial banks that are members of the Federal Reserve System ("state member banks"). The Federal Reserve shares supervisory responsibility for state member banks with state banking or financial services supervisors. In supervising these entities, which are often subsidiaries of bank holding companies, members of the Federal Reserve supervisory staff coordinate extensively with staff from state supervisory agencies.

to gaining the insights of other federal and state supervisors, Federal Reserve supervisors convey "information relating to the financial condition, risk-management policies, and operations of a banking organization that may have a material impact on the regulated subsidiary, as well as information concerning transactions or relationships between regulated subsidiaries and their affiliates" (Board of Governors of the Federal Reserve System 2015a).

Federal Reserve supervisory staff members also interact with home country supervisors of foreign banking organizations (FBOs) operating in the United States. As noted in a Federal Reserve policy document describing the supervision of the combined U.S. operations of foreign banks (SR 08-9), "supervision of a large complex FBO requires cooperation and information exchange between home and host country supervisors" (Board of Governors of the Federal Reserve System 2008). In practice, this cooperation involves formal sharing of information derived from supervisory activities, generally "facilitated by an MOU [memorandum of understanding] that establishes a framework for bilateral relationships and includes provisions for cooperation during the licensing process, in the supervision of ongoing activities, and in the handling of problem institutions" (Board of Governors of the Federal Reserve System 2008). These formal arrangements are augmented by periodic visits between the Federal Reserve and home country supervisory staff that include discussion of general topics concerning banking industry developments as well as "strategy sessions focusing on individual FBOs and specific supervisory issues and initiatives" (Board of Governors of the Federal Reserve System 2008).

4. Work Content: What Do Supervisors Do?

4.1 Overview

This section describes how the supervision of large, complex bank and nonbank companies is conducted on a day-to-day basis at the New York Fed. The discussion primarily covers the work of the firm-focused supervisory teams, including the risk specialists embedded on those teams, but also describes how the analytical work done by the risk departments and other cross-firm analysts is integrated with the supervision of these firms.

Most of the work of the firm-focused supervisory teams can be classified as either information gathering and analysis or follow-up to that analysis, including assigning supervisory ratings, determining enforcement actions, and tracking subsequent remediation efforts. The section first describes the different ways in which the firm-focused teams conduct information gathering—including continuous monitoring and examinations—as well as the range of subsequent outcomes. The section then describes how the teams determine which projects and type of monitoring to pursue, including a description of the annual supervisory planning cycle and the process of synthesizing supervisory work to assign a rating to each firm. Finally, the discussion covers the process by which priorities are set between work that is particular to an individual firm and work that covers multiple firms—known as "horizontal" work.

4.2 Activities of the Supervisory Teams

The work of the supervisory teams is shaped by supervisory guidance in the form of manuals, supervisory letters, and other written policies and procedures that codify supervisory expectations and provide direction to the teams in structuring their activities at the firms. These materials include the Bank Holding Company Supervision Manual, a publicly available document that provides instructions "for conducting inspections of bank holding companies . . . to ascertain whether the financial strength of the bank holding company is being maintained on an ongoing basis and to determine the effects or consequences of transactions between a holding company or its nonbanking subsidiaries and its subsidiary banks" (Board of Governors of the Federal Reserve System 2015a, 2015f).[17] Supervision and Regulation Letters address "various policy and procedural matters related to the Federal Reserve's supervisory activities" (Board of Governors of the Federal Reserve System 2015g).[18] The SR Letters, which are also publicly available, are intended to provide information both to supervisors and to supervised institutions. As such, the letters address a diverse range of topics, including the overall supervisory program for large, complex financial institutions (SR 12-17), recovery planning (SR 14-8), model risk management (SR 11-7),

[17] A similar manual focused on the supervision of commercial banks is also available; see Board of Governors of the Federal Reserve System (2015f).

[18] According to the Board of Governors website, "Supervision and Regulation Letters, commonly known as SR Letters, address significant policy and procedural matters related to the Federal Reserve System's supervisory responsibilities. These letters are issued by the Board of Governors' Division of Banking Supervision and Regulation and are a means of disseminating information to banking supervision staff at the Board and the Reserve Banks, as well as to supervised banking organizations" (Board of Governors of the Federal Reserve 2015g).

counterparty credit risk management (SR 11-10), and stress testing (SR 12-7). Finally, these public documents are supplemented by internal policies and procedures intended to provide direction to supervisory staff in designing and implementing their supervisory work programs.

The traditional model of bank supervision involves a full-scope examination of a bank's financial condition and operations that is conducted annually and assesses the bank as of a moment in time. While this approach is still used for smaller banks and BHCs, the larger and more complex bank and nonbank firms have for some time been subject to ongoing supervision over the course of the year. Under an ongoing supervisory approach, the firm-focused supervisory teams engage with management at the firm and review and analyze information that is provided to them on a continuous basis; this type of oversight is referred to as "continuous monitoring." The teams also engage in more detailed analyses and assessments of particular issues at different points over the course of the year,[19] through "enhanced continuous monitoring" and formal examinations. These more detailed forms of information gathering and analysis can be firm-specific and conducted by a single team, or can involve multiple banks and thus be coordinated across several teams, including in-house analyst teams in the risk departments and other areas of the SG as well as other Reserve Banks and other supervisors.

The three approaches used to gather information about larger and more complex firms—continuous monitoring, enhanced continuous monitoring, and formal examinations—differ in their goals as well as in their structure and execution. The following sections discuss each of these supervisory approaches in greater detail. The conceptual and practical boundaries between the approaches are not always distinct. For instance, it can be difficult to distinguish the intense scrutiny of an issue identified through continuous monitoring from enhanced continuous monitoring, or to determine whether a particular issue should be pursued by means of enhanced continuous monitoring or a formal, targeted examination. The following discussion thus focuses on the broad differences rather than some of the finer nuances.

[19] These more detailed assessments can occur at any point during the year, in contrast to the traditional supervisory model, in which all assessment of the bank occurs at the same "as of" date.

4.3 Continuous Monitoring

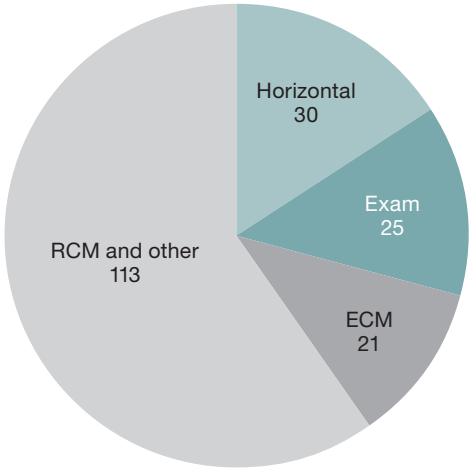
Continuous monitoring activities are intended to enable each firm-focused supervisory team to "develop and maintain an understanding of the organization, its risk profile, and associated policies and practices" (Board of Governors of the Federal Reserve System 2015a), as well as to identify gaps or issues that might lead the team to do more in-depth analysis. Continuous monitoring involves meetings with bank management, review of internal reports, and regularly produced analysis based on internal firm data. Continuous monitoring activities are almost always focused on, and structured around, an individual firm and its particular characteristics, business focus, and management structure. In contrast, enhanced continuous monitoring and formal examinations are intended to be "deeper dives" into particular issues or concerns about the firm, involving more analytical work and leading to conclusions about the effectiveness of internal controls, risk management, or business strategies, as well as offering an assessment of the firm against its internal guidelines, regulatory or industry standards, or peer practice. Enhanced continuous monitoring can be less formal and more exploratory than formal examinations, but with both approaches, the teams focus on a particular issue that has been identified as a potential concern. The allocation of hours to each type of activity in 2014, expressed in headcounts of SG staff working on firms in the LISCC portfolio, is shown in Chart 6.

As part of continuous monitoring, firm-focused team members meet with bank management on both a scheduled and an ad hoc basis. The regularly scheduled meetings can have specific agendas focused on issues of interest to the team or can be open ended to provide an opportunity for bank management to share its view of important developments. Team members may also use open-ended meetings to ask questions about recent decisions or steps taken by the firm, as a way of gaining further insight into the firm's governance processes.[20] Different team members typically meet with different levels of bank management and with managers whose responsibilities span different areas. For instance, as noted above, the SSO meets frequently with the firm's CEO and board members. Financial analysts meet with the firm's CFO and senior staff; the business line specialists meet with the corresponding business line managers; corporate function specialists meet most often with the COO; and the risk specialists meet with internal auditors and staff at the supervised

[20] In these settings, team members might ask questions such as "How did you get comfortable with that decision?" or "How did you gather the information to make that choice? What analysis did you do?"

Chart 6

Activity Allocation of LISCC Team in 2014, Based on Headcount



Source: Federal Reserve Bank of New York internal supervisory hours allocation data.

Notes: "Horizontal" includes cross-firm programs such as the Comprehensive Capital Analysis and Review (CCAR) and Comprehensive Liquidity Analysis and Review (CLAR). "Exam" refers to nonhorizontal examination activities. ECM is enhanced continuous monitoring; RCM and other is regular continuous monitoring and all other activities (including nonsupervisory ones). LISCC is Large Institution Supervision Coordinating Committee.

institution who report to the chief risk officer (CRO). Team members often meet with multiple individuals at the firm to discuss the same topic or ask the same questions, since inconsistent responses can be indicative of an issue at the firm. Aside from their use in gathering information, meetings can also be a means of conveying feedback, especially to senior management and board members.

A second key component of continuous monitoring is the review of internal data produced by the firm. These data include regulatory reports, which provide comprehensive and standardized reporting across firms and over time; internal reports, which offer customized, nuanced reporting by the firm using metrics developed for internal management purposes; and external reporting, such as financial statements, which complement information from regulatory reports. The teams have the authority to request any report or data produced by the firm and, as a matter of practice, regularly receive a very large number of internal reports and analyses as well as access to the firms' internal reporting systems. Reports generated for business line managers, senior managers, and the board of directors are of particular interest, since they yield insight into the information available to decision makers at the firm and thus into the decision-making process. Aside from these materials, the teams also receive daily, weekly, monthly, and quarterly reports containing business line, risk management, and other internal control metrics; such documents frequently contain very detailed information about the firm's performance, risk exposures, and internal oversight.

One challenge faced by the teams is the large volume of information provided, which increases the difficulty of conducting a comprehensive, detailed assessment. Reviews of regular management reports focus primarily on identifying changes and new developments; these assessments can provide topics for discussion in meetings with the firm and/or spur further exploration and analysis. Analysis provided by the firms' in-house risk departments and by analysts in other parts of the SG and the New York Fed complements the examination of internal management reports that is conducted by team members. For instance, analysis of detailed liquidity data by the New York Fed liquidity risk department can identify changes in a firm's liquidity position or liquidity risk profile that might lead to discussion with the firm and further analysis and exploration by the firm-focused team or the liquidity risk department.

4.4 Enhanced Continuous Monitoring and Examinations

In contrast to continuous monitoring, which consists of ongoing, repeated activities of the firm-focused supervisory teams, enhanced continuous monitoring and formal examinations involve discrete supervisory "projects" that are generally conducted on a onetime basis. As noted above, enhanced continuous monitoring is intended to provide insight into a particular topic or business strategy, risk levels, or risk management practices and controls. It can also be used to learn more about an area or fill a knowledge gap. As such, it is a "deeper dive" into an issue or question that has already been identified—an effort to understand the scope and depth of the issue and whether further information gathering and analysis or remedial actions on the part of the firm are warranted. Enhanced continuous monitoring could involve more extensive meetings with firm management to discuss particular issues or topics in detail (in other words, with specific, pre-planned agendas); special requests for data beyond what is provided in the internal management reports normally received by the team; limited testing of individual transactions to assess compliance with internal policies, supervisory guidance,

or regulation; and assessment and documentation of the information gathered. Enhanced continuous monitoring can be focused on issues specific to an individual firm, or can be used to develop a horizontal, cross-firm perspective on an area or topic.

The results of enhanced continuous monitoring vary according to the nature of the particular project and what is discovered during the exercise. For instance, enhanced continuous monitoring exercises that are aimed at filling knowledge gaps result primarily in enhanced information and understanding by the supervisory team. Review of the findings and communication back to the firm could be limited and informal in these cases. In contrast, enhanced continuous monitoring projects that are intended to explore control or risk management weaknesses at one or more firms could result in enforcement actions ranging from informal "supervisory observations" to public "cease and desist" orders. In these latter cases, there would be extensive vetting (review) of the findings by supervisory team members, by one or more of the risk departments, by more senior management within the SG, and, for companies in the LISCC portfolio, by the LISCC Operating Committee. Outcomes would be communicated to the firm in writing, with subsequent tracking and follow-up by the firm-focused team to ensure that the deficiencies that have been identified are being addressed.

Like enhanced continuous monitoring, formal examinations also involve a "deep dive" into a particular topic or issue affecting one or more firms. There are several types of examinations, including target examinations, which assess a firm's practices against its internal guidelines, regulatory or industry standards, or peer practice; discovery examinations, which focus on "understanding . . . a particular business activity or control process—for example, to address a knowledge gap identified during the risk assessment or other supervisory process" (Board of Governors of the Federal Reserve System 2015a); and horizontal examinations, which involve coordinated work across several institutions. Procedurally, target examinations involve several stages, including the delivery of introductory letters to the banks notifying them of the examination and requesting information; a "scope" memo that defines the rationale and objectives of the examination, including questions to be answered and procedures to be performed; memos documenting the findings and conclusions ("product memos"); meetings with the firms to present the results verbally ("close-out meetings"); and a formal examination report communicating findings to the firm. Depending on the focus, examinations can also involve more extensive transaction testing than is typically done during enhanced continuous monitoring. Each stage of the examination process is vetted by various participants and management within the SG and, for horizontal examinations, with System oversight groups.

Distinguishing formal examinations from some forms of enhanced continuous monitoring can be difficult. Both involve a thorough analysis and assessment of a particular issue or area accompanied by extensive information gathering, either at an individual firm or across several firms; the actual activities carried out—meetings, information requests, testing, and analysis—can be identical. In addition, both can result in enforcement actions requiring substantive change in processes, governance, and activities at the firm. However, the two approaches differ in the level of formality and structure involved in the exercise. Typically, examinations are far more structured than enhanced continuous monitoring and can take much longer to get started and to complete. Thus, the supervisory teams often favor enhanced continuous monitoring over formal examinations because it is more flexible and can be timelier. That said, the structured nature of a formal examination can mean that resources (principally, the time of team members) are officially allocated to the exam, whereas staffing of enhanced continuous monitoring is more fluid.

As noted earlier, both enhanced continuous monitoring and examinations tend to be discrete exercises carried out on a onetime basis. The Federal Reserve also conducts several large horizontal supervisory programs that involve similar activities but occur on an annual or ongoing basis. These programs include the Comprehensive Capital Analysis and Review (CCAR), which focuses on internal capital planning and capital adequacy; the Comprehensive Liquidity Analysis and Review (CLAR), which focuses on internal liquidity planning and liquidity resources (Tarullo 2014); and the Supervisory Assessment of Recovery and Resolution Preparedness (SRP), the Federal Reserve's annual horizontal review of the LISCC firms' options to support recovery and progress in removing impediments to orderly resolution (Board of Governors of the Federal Reserve System 2015c). While many of the activities conducted under these programs are similar to those involved in enhanced continuous monitoring and horizontal examinations, there are some important distinctions. The programs can involve more firms than would typically be involved in a horizontal exam—for instance, in 2016, the CCAR included thirty-three firms spanning the LISCC and large banking organization (LBO) portfolios. CCAR and CLAR are the primary lenses through which capital and liquidity adequacy at the participating firms are assessed (which is why they are "comprehensive" analyses and reviews), whereas a typical target examination is more narrowly focused. In some cases, the programs also have their own distinct set of possible remedial actions; for example, the Federal Reserve can object to a firm's capital plan in the CCAR (in which case the firm's ability to pay dividends and make share repurchases is restricted) or require substantial structural changes at a firm whose resolution plan is deemed not credible.

4.5 Remedial Steps and Follow-Up

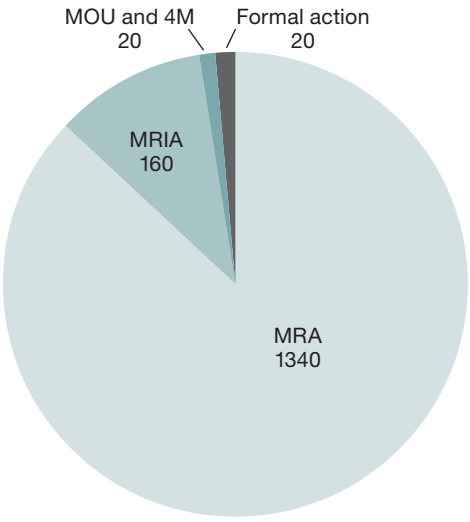
Aside from the follow-up actions discussed previously, which are specific to these large, horizontal programs, both the programs and day-to-day supervision conducted by the firm-focused supervisory teams can result in a range of supervisory actions intended to make firms address shortcomings identified through the supervisory process. When deficiencies in a firm's risk management, governance, or other controls are revealed through regular or enhanced continuous monitoring, formal examinations, or a supervisory program, or if a firm is found to be in a financial condition that threatens its safety and soundness, supervisors can take various actions to compel the firm to address the deficiencies. These supervisory actions generally take the form of written communication to the firm's board of directors or to an executive-level committee of the board (Board of Governors of the Federal Reserve System 2013).

The prevalence of various types of supervisory actions issued to LISCC institutions overseen by the New York Fed is shown in Chart 7. The mildest of these supervisory actions are matters requiring attention (MRAs) and matters requiring immediate attention (MRIAs). MRAs are about eight times as frequent as MRIAs. According to SR 13-13, MRAs "constitute matters that are important and that the Federal Reserve is expecting a banking organization to address over a reasonable period of time, but the timing need not be 'immediate.'" MRIAs, meanwhile, are "matters of significant importance and urgency that the Federal Reserve requires banking organizations to address immediately and include: (1) matters that have the potential to pose significant risks to the safety and soundness of the banking organization; (2) matters that represent significant noncompliance with applicable laws or regulations; [and] (3) repeat criticisms that have escalated in importance due to insufficient attention or inaction by the banking organization." The distinction between an MRA and an MRIA lies in the "nature and severity of the matters requiring corrective action" and the "immediacy with which the banking organization must begin and complete corrective actions."

The MRA or MRIA specifies the particular concern being raised as well as a time frame in which the firm must remediate the deficiency. Firms receiving MRAs or MRIAs will typically develop a remediation plan; the supervisory team then reviews the plan and is responsible for following up to ensure that it has been implemented. This follow-up can take the form of a subsequent examination or regular or enhanced continuous monitoring. If the firm fails to sufficiently address the concerns identified in the MRA or MRIA, the matter can be escalated into more severe enforcement actions (Board of Governors of the Federal Reserve System 2013). It is typical for a banking organization to have many outstanding MRAs and MRIAs at any given time, reflecting the outcomes of the range of supervisory activities undertaken by the firm-focused supervisory team and other Federal Reserve supervisory staff.

A third type of supervisory action is the memorandum of understanding (MOU). Chart 7 shows the joint incidence of MOUs and the formal supervisory actions known as 4(m) agreements ("4Ms").[21] MOUs and 4Ms are distinct but are grouped together in the chart because they are the most severe actions that are not publicly disclosed. An MOU is considered to be more severe than an MRA or MRIA, typically encompassing multiple deficiencies at a firm. MOUs also differ from MRAs and MRIAs in that MOUs are agreements between the

Chart 7
Supervisory Actions Issued to LISCC Institutions in the Second Federal Reserve District
January 2011–November 2014



Source: Federal Reserve Bank of New York internal data on enforcement activity.

Notes: The chart shows the number and type of supervisory actions issued to LISCC financial institutions supervised by the Federal Reserve Bank of New York between January 2011 and November 2014, irrespective of whether the action is ongoing (open) or resolved (closed). All counts are rounded to the nearest ten. Blue areas include MRAs (matters requiring attention), MRIAs (matters requiring immediate attention), MOUs (memoranda of understanding), and 4Ms (4(m) agreements). Formal enforcement actions include cease and desist orders, written agreements, and other formal actions. LISCC is Large Institution Supervision Coordinating Committee.

[21] The term 4(m) agreement comes from the corresponding section of the BHC Act.

Federal Reserve and the supervised firm while MRAs and MRIAs are determined by the Federal Reserve alone. MOUs often incorporate restrictions on a firm during the period in which it is remediating the concerns raised in the MOU.

MRAs, MRIAs, MOUs, and 4Ms are typically considered confidential supervisory information and thus are not publicly disclosed by the Federal Reserve. In contrast, most formal supervisory actions such as written agreements, cease and desist orders, and fines ("civil money penalties") are publicly disclosed by the Federal Reserve Board. Written agreements and certain cease and desist orders (referred to as "consent orders") are agreed to by the Federal Reserve and the supervised institution, stipulate findings about the firm, and specify a course of action to address the findings. Cease and desist orders can also be imposed without the agreement of the firm. A 4M agreement may be issued when a holding company is either engaged in impermissible activities or when the holding company or one of its depository institution subsidiaries is either inadequately capitalized or not well managed. These formal supervisory actions have legal force, meaning that should the firm fail to meet the terms of the action, it can face fines and other actions, such as a requirement to restrict its growth or to divest certain assets.

The severity of the supervisory action taken depends on the severity of the deficiency that has been identified. Supervisors need not start with less severe actions before imposing more severe ones or take informal enforcement actions before taking formal ones, though escalation of insufficiently addressed actions certainly does occur. MRAs, MRIAs, and both formal and informal enforcement actions can be initiated by the firm-focused supervisory team; they can also be initiated by other supervisory staff in the SG or at the Board of Governors in coordination with the firm-focused team—for instance, as part of broad programs such as the CCAR and CLAR. If sufficiently severe, MRAs and MRIAs given to firms in the LISCC portfolio can be reviewed by or be subject to the approval of the SSO's management or the LISCC Operating Committee. MOUs and formal enforcement actions are developed jointly by New York Fed and Board of Governors staff, and are signed by officials of the Reserve Bank and/or officials of the Board of Governors.

Supervisory actions typically are in force for a year or more as the firm's management implements changes to address issues raised in the actions. Table 3 shows the duration of supervisory actions at Second District LISCC institutions issued between 2011 and 2014 that were closed or still ongoing as of November 2014.

Tracking progress against supervisory actions, especially MRAs and MRIAs, is one of the key elements of continuous monitoring. Typically, the corporate function specialists on the team are administratively responsible for this tracking, with assessment of the steps taken by the firm to address the issues identified in the action conducted by subject matter experts, such as other team members or staff from the risk departments. A variety of inputs can help determine whether an action can be lifted, including independent review and testing done by the supervisory team and the work of the firm's internal audit team (which would typically be the group within the firm responsible for tracking and determining compliance with enforcement actions). A key question in determining whether the action can be closed is whether the changes implemented by the firm to address the concerns in the enforcement action are sustainable over time. Depending on the severity of the deficiency addressed in the action, the decision about whether the issues have been addressed could rest with the supervisory team and SSO or could require vetting and approval by the LISCC Operating Committee (for firms in the LISCC portfolio) or by more senior officials at the Reserve Bank or Board of Governors.

4.6 BHC Ratings

In addition to enforcement actions, supervisory ratings are a critical product of the information gathering and analysis done by the team over the course of the year. Bank holding companies are assigned a rating from 1 to 5 under the "RFI/C(D)" rating system. The letters indicate different components considered in the rating—"R" is for risk management, "F" is for financial condition, "I" is for the potential impact of the nondepository entities in the holding company on the depository institution(s) in the holding company, "C" is for the composite rating (that is, the overall rating considering and weighing the ratings on "R," "F," and "I"), and "D" is the rating assigned to the depositories (such as commercial banks or thrifts) owned by the holding company. The "R" and "F" ratings have subcomponents capturing different aspects of risk management (for example, board and senior management oversight) and financial condition (capital, liquidity, asset quality, and earnings), each of which is assigned its own rating. The "R" and "F" ratings are a summary of these subcomponents (though generally not a simple average) and the composite "C" rating reflects the ratings of the individual "R," "F," and "I" components (though, again, generally not a simple average). The highest rating is a "1," indicating the strongest performance and practices and least amount of supervisory concern, while a rating of "5" indicates the lowest performance and a very high degree of supervisory concern (Board of Governors of the Federal Reserve System 2004). Ratings are assigned on an absolute basis rather than a relative one, so the

Table 3

Duration in Years of Supervisory Actions Issued to LISCC Institutions in the Second Federal Reserve District January 2011–November 2014

Issues Closed (Resolved) as of November 2014

Issue Type	Average	Minimum	Maximum	Count
Matter requiring attention (MRA)	1.4	0.0	3.5	680
Matter requiring immediate attention (MRIA)	1.0	0.0	2.7	110
Formal action	0.5	0.0	1.5	10

Issues Open (Ongoing) as of November 2014

Issue Type	Average	Minimum	Maximum	Count
Matter requiring attention (MRA)	1.7	0.1	3.9	660
Matter requiring immediate attention (MRIA)	1.8	0.2	3.8	50
Formal action	2.7	0.9	4.0	10
Memorandum of understanding (MOU) and 4M	2.3	0.1	3.2	20

Source: Federal Reserve Bank of New York internal data on enforcement activity.

Notes: The table shows summary statistics for the duration of supervisory actions. All counts are rounded to the nearest ten. Because the table covers the interval between January 2011 and November 2014, the maximum duration is about four years. LISCC is Large Institution Supervision Coordinating Committee.

median rating across firms can vary over time and with economic and financial market conditions. In addition, some studies have found differences in supervisory stringency in assigning ratings over the business cycle (Krainer and Lopez 2009).

Ratings are important supervisory outputs because they help communicate supervisors' views of the firm to its management and board of directors (typically, information about a BHC's RFI/C(D) rating is closely held within the firm); because they foster communication and common understanding within the Federal Reserve about relative and absolute assessments of different BHCs; and because BHCs with low ratings can face constraints on their activities and growth—for example, through merger and branching restrictions.

Ratings can be changed at any point during the year based on new information or analysis, but in general, ratings for the large, complex firms in the LISCC portfolio are assigned annually. The process of assigning ratings is referred to as "roll-up," reflecting the idea that the rating incorporates all the information and analysis generated by the firm-focused supervisory team and other supervisory staff over the course of the year. For the large, complex banking firms, the roll-up begins with the SSO and supervisory team proposing ratings for the components and composite. The team documents the rationale for the ratings based on assessments made over the course of the year using continuous monitoring, enhanced continuous monitoring, and examinations; on input from supervisory programs such as the CCAR and CLAR (which are critical in determining the capital and liquidity subcomponents, respectively, of the "F" rating and the risk management elements of the "R" rating); on peer comparisons; and on other data and analysis. Ratings changes receive particular attention. The proposals developed by the supervisory team are reviewed by others in the SG, and then by the LISCC Operating Committee, which has final approval of the rating. Typically, vetting of these ratings is performed for all firms in the LISCC portfolio at the same time as a way of promoting consistency across firms and across Federal Reserve Districts.

4.7 Planning and Priorities

While the work of the firm-focused supervisory teams takes place throughout the year, it is based on an annual cycle of planning and evaluation. The cycle begins with the teams' assessment of the key risks facing each firm based on the firm's business line focus, strategies, and financial condition. Identifying these risks helps direct the work of the supervisory teams by ensuring that the most important risks are addressed in the work plan for the year.

The key output of this process is the "supervision plan," which outlines what the firm-focused team plans to do over the coming year, including continuous monitoring, enhanced continuous monitoring, examinations, and work on horizontal programs such as CCAR, CLAR, and the SRP. The supervision plan is developed by the SSO based on guidance provided by the relevant System oversight group for firms in the LBO and FBO portfolios and by the LISCC Operating Committee for firms in the LISCC portfolio; the LISCC Operating Committee sets final priorities for supervisory plans for firms in the LISCC portfolio. The guidance helps the SSO establish priorities among various cross-firm projects and programs, such as the CCAR, and firm-specific work. For firms in the LISCC portfolio, these plans are discussed with the LISCC Operating Committee twice a year to reconfirm priorities and to establish new areas of focus based on industrywide or firm-specific developments. The supervisory plan is not shared with the supervised firm.

The goals of the planning process are to identify the key supervisory objectives for the coming year—for example, the areas or topics that the team will analyze in depth or issues that will be the key focus of continuous monitoring and enhanced continuous monitoring—and to ensure that the team has sufficient resources to achieve those objectives. Ideally, the supervision plan also allows time to address unforeseen developments so that these events do not crowd out other important work.

Often, there is more work that could be done than time or staff to do it. Given these resource constraints, the SSO sets priorities for the team based on input from several sources, including the firm-focused supervisory team, the risk departments, other areas of the SG, and the relevant management oversight group. The LISCC Operating Committee, for instance, has subcommittees that review and suggest priorities in coordination with the risk departments and with analysts assessing capital and performance. These subcommittees bring together risk specialists, SSOs, other team members, and analysts from the New York Fed and other District Banks to share information and identify cross-firm issues (Board of Governors of the Federal Reserve System 2015c). This process results in suggestions for more in-depth work using enhanced continuous monitoring or horizontal examinations. Members of the SG risk departments and business line specialists are actively involved in these subcommittees and so have a role in proposing these cross-firm projects.

Firm-specific work is generally proposed by the SSO and the firm-focused supervisory team. The risk specialists, in coordination with the risk departments, may also suggest potential areas for further analysis at individual firms. Overall, about half the work done by the firm-focused teams (including the risk specialists) is firm-specific and half involves cross-firm work, including Systemwide programs such as CCAR and CLAR.

5. Summary

The supervision of large, complex financial institutions is one of the most important, but least understood, elements of the Federal Reserve's efforts to foster financial stability. Supervision involves oversight and monitoring to assess whether these firms are engaged in unsafe or unsound practices, and to ensure that the firms take appropriate actions to correct these practices. Importantly, supervision is distinct from regulation, which involves defining the rules under which these firms operate. Much of supervision is confidential—supervisors work with confidential information about the firms and many supervisory actions are not publicly disclosed. While the Federal Reserve has publicly described the goals and objectives of supervision, the confidentiality surrounding supervisors' day-to-day work makes it difficult for outsiders to understand what supervisors do and how they do it.

The goal of this article has been to bring greater transparency to System supervisory activities by describing how the supervision of large, complex financial organizations is carried out at the Federal Reserve Bank of New York as part of the Federal Reserve System's broader supervisory structure for these firms. We provide an overview of the departmental and team structure of the New York Fed's Supervision Group and data about staffing levels and time allocation across various supervisory activities. In particular, we document the shift in focus since the financial crisis toward greater specialization of supervisory staff at individual banking companies and the integration of risk specialists with firm-focused teams.

We also describe the day-to-day work of supervisors on various types of monitoring and analysis, including both firm-specific activities and "horizontal" analysis, in which similar issues are examined across a set of BHCs. We detail the most common approaches used by supervisors to ensure that firms take steps to correct practices or conditions that might threaten the safety and soundness of the firm or the financial system, including the assignment of supervisory ratings and the issuance of enforcement actions such as MRAs and MRIAs.

Understanding how supervision works is a critical precursor to determining how to measure its impact and effectiveness. This article takes a first step toward that understanding by clarifying the objectives of supervision and by showing what supervisors do on a day-to-day basis to meet these objectives.

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