OFR

OFFICE OF FINANCIAL RESEARCH

2013 ANNUAL REPORT

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Letter from the Director

December 2013

Since the Office of Financial Research published its first annual report in July 2012, the United States financial system and its institutions, markets, and infrastructure have continued to stabilize and strengthen. Likewise, the Office has continued to grow over that period, and is beginning to deliver on our core mission: to fill critical gaps in financial data and analysis for the benefit of the Financial Stability Oversight Council and, ultimately, the public. I am pleased to present this *2013 Annual Report* to Congress — our second — to document our progress and to lay out the agenda for the work ahead.

Although the U.S. financial system is stronger and functioning more smoothly than it was 17 months ago, threats to financial stability remain. This report analyzes those threats. Among them are vulnerabilities in short-term, wholesale funding markets. The current financial environment, marked by low interest rates and low volatility, has spurred risk-taking, making markets and institutions more vulnerable to a sharp increase in interest rates, volatility, or both. Operational risks could also destabilize the "plumbing" of the financial system — the infrastructure for payments, clearing, and settlement. In addition, uncertainty about the U.S. fiscal outlook could threaten financial markets.

For our part, the past year and a half has marked a transition in organizational priorities. Our primary focus has shifted from standing up the OFR to building on the progress we are making to deliver on our mandate. Nonetheless, continuing to build the OFR remains critical to our success. For example, we are filling key management positions to provide leadership, and our staff has nearly doubled as we move toward our steady-state workforce. We have completed construction of the first phase of the information technology needed to manage and analyze large financial datasets. We continue to refine our strategic planning and goals to meet our mandates, and we have put in place performance goals and measures to track our progress and to promote transparency and accountability in fulfilling our mission.

As we have done over the past two years, the OFR is developing new analytical tools and refining existing ones to assess and monitor threats to financial stability. This report includes two examples. The first is a Financial Stability Monitor that provides a snapshot or "heatmap" of several financial stability indicators. The second is a tool recommended by the OFR's Financial Research Advisory Committee: a detailed funding-and-liquidity map to help pinpoint vulnerabilities in markets for securities financing transactions.

The Office is also establishing a framework and criteria for assessing policy tools needed to mitigate threats to financial stability. This effort includes fulfilling our statutory mandate to evaluate stress tests, as well as studying the impact of policies related to financial stability and providing related advice.

To be clear — the Office does not make policy; the Council does. However, the OFR is in an objective position to appraise today's financial stability tools and the new tools that are being developed for what has become known as the "macroprudential toolkit." This toolkit has not yet been tested and is far from complete. For example, supervision of the financial system is evolving from a bank-centric view to a holistic design that balances appropriate prudential oversight with a broader approach spanning the entire financial system. Our job is to inform the debates about these tools by evaluating alternatives amid evolving needs, and to assess how they may complement or conflict.

We can't analyze what we can't measure, and gaps in the scope and quality of financial data still significantly limit the ability of policymakers to assess threats and evaluate ways to mitigate them. The OFR's mandate includes identifying and filling such gaps, and we are starting to deliver. For example, we are collaborating with Federal Reserve staff to fill gaps in data about U.S. repo markets. Our report

in September 2013 on *Asset Management and Financial Stability* also threw important data gaps into sharp relief. As we work to fill them, no priority is higher than preserving and strengthening the security of sensitive data, and we will take all necessary and appropriate precautions to ensure that any data we collect will be stored and used safely and securely.

Progress in developing and implementing critical standards for financial data has accelerated over the past year and a half. The need for such standards is compelling. They are essential to be able to aggregate, analyze, compare, and link financial datasets, so that these data will accurately reflect financial activity and positions, as well as the crucial linkages between institutions and markets. Because the Legal Entity Identifier initiative is a basic building block in the standards architecture, we have invested substantial effort and resources to assure its successful adoption, and the progress cited in this report is encouraging.

In our *2012 Annual Report,* we stated that the Office may promulgate regulations to standardize the types and formats of data reported and collected on behalf of regulatory agencies. This year, we are engaging with relevant regulators to help standardize the formats used to collect derivatives data from swap data repositories, which will facilitate aggregating them on a global basis.

We also noted last year that the Office will produce and maintain catalogues of reference entities and instruments for financial data. With help from our advisory committee, we now have a plan to develop those catalogues. However, much more work is needed to identify financial instruments and products, and to map the relationships among them.

This report, like the one in 2012, reflects the views of the OFR and our staff, but with needed collaboration and engagement from Council member organizations and their staffs. Our report is now published about six months after the Council's Annual Report and attempts to build on that document. In that sense, the two reports are complementary. The Council report is comprehensive and proposes ways to mitigate vulnerabilities in the financial system, while the OFR report dives more deeply into specific issues and evaluates policy tools.

Strong collaboration is a hallmark of the way that the Council and the Office function. Vigorous discussions among the Council member organizations and their staffs have elevated the rigor and quality of our work and the Council's understanding of that work for its benefit and the benefit of the public. Although fundamental uncertainty will always exist about threats and risks across the financial system, we believe that by working together, we can achieve better analytical and empirical outcomes to promote financial stability. I hope that this report reflects the wisdom and the power of that process.

Richard Berner
Director, Office of Financial Research

1 Executive Summary

This second *Annual Report to Congress* documents the meaningful progress the Office of Financial Research (OFR) has made in meeting our statutory mandates and mission since we published our first annual report in July 2012.

The Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 (Dodd-Frank Act) requires the OFR to report annually to Congress on:

1. the state of the U.S. financial system, including an analysis of any potential threats to financial stability;
2. the status of efforts by the Office in meeting our mission; and
3. key findings from OFR research and analysis of the financial system.

Chapter 2 in this report outlines ways we expanded our data and tools for assessing and monitoring threats to financial stability on behalf of the Financial Stability Oversight Council (Council).

Chapter 3 presents a framework for analyzing the effectiveness of tools and policies that make up a macroprudential toolkit for promoting financial stability.

Chapter 4 discusses OFR research on the sources and uses of short-term funding, liquidity monitoring, and financial network analysis. We have made our basic research results extensively available in several published working papers and articles.

Chapter 5 summarizes our framework for prioritizing gaps in the data needed for financial stability analysis, discusses the progress of the Office and other regulators in addressing those gaps, and lists our priorities for the future.

Chapter 6 describes our strategy and projects for promoting financial data standards. It documents our leadership on data standards initiatives, especially to the implementation of the global Legal Entity Identifier system.

Our agenda for the coming year builds on this foundation. The final chapter sets out our plans to continue expanding our monitoring, research, and analytical capabilities and publications; improving the scope and quality of data related to markets, particularly short-term funding markets; and promoting essential data standards. Over a longer time period, we will extend that work and respond to the Council's needs through our financial stability data and research programs.

Analyzing Threats to Financial Stability

The Office has a mandate to assess risks to the financial stability of the United States and to monitor, investigate, and report to Congress and the Council on changes in those risks.

To fulfill that mandate, we report regularly to the Council on developments in the financial system and on tools and metrics for detecting and measuring potential threats to financial stability. Financial stability occurs when the financial system, even under stress, operates sufficiently to provide its six basic functions for the economy — credit allocation and leverage, maturity transformation, risk transfer, price discovery, liquidity provision, and facilitation of payments.

Building on the framework outlined in our *2012 Annual Report,* we analyze threats to financial stability as vulnerabilities that result in market failure and disruptions to financial activity with adverse consequences for the economy. Threats to financial stability can emerge from within or outside the financial system and can be cyclical or structural.

In this report, we present a prototype Financial Stability Monitor, a comprehensive new tool to track threats and the interplay among them. The monitor addresses five components of financial stability risk: macroeconomic, market, credit, funding and liquidity,

and contagion. This is Version 1.0; the monitor will continue to evolve as we develop and test its performance, evaluate new indicators, and respond to the ways financial innovation may change intermediation, asset allocation, and risk management.

Our analysis suggests that threats to financial stability have generally abated since the publication of the OFR's *2012 Annual Report* and the Council's more recent *2013 Annual Report*. However, threats remain; chief among them are: vulnerabilities in markets for securities financing transactions and credit, vulnerabilities to an increase in interest rates and volatility, operational risks, and uncertainty about the U.S. fiscal policy outlook.

The indicators in our Financial Stability Monitor suggest that market participants are taking credit and duration risk as they reach for yield amid persistently low interest rates and are likely vulnerable to interest-rate and volatility shocks. Our pricing models suggest there may be mispriced credit risk amid weakening standards for loan underwriting, as reflected in looser covenants and bank lending conditions.

The Office and the Council continue to highlight financial stability risks related to securities financing transactions in repos (repurchase agreements) and other short-term funding markets. These markets are still exposed to the risk of runs and fire sales. Vulnerabilities remain in money market funds and similar sources of cash in these markets. In our report, *Asset Management and Financial Stability,* we drew attention to a related risk — a rapid unwinding in response to market shocks of the reinvestment of cash collateral in securities lending transactions. Financial entities that engage in leveraged carry trades (borrowing short-term to invest in long-term assets) are particularly vulnerable. Examples include the rapid growth in mortgage real estate investment trusts, which hold mortgage-backed securities and finance them in the repo market.

Notwithstanding near-term fiscal improvement, concerns about the longer-term U.S. fiscal policy outlook persist. These concerns reflect lack of a clear resolution of the nation's long-term budgetary challenges and the uncertainty about the process for implementing sustainable fiscal adjustments. Future episodes of fiscal brinksmanship could in the short run result in abrupt, destabilizing changes in government bond prices, potential deleveraging of financial obligations (because of the extensive use of Treasury securities as collateral in financial markets), and contagion to other markets. Longer-term risks include the potential erosion of Treasury debt as a global benchmark and the U.S. dollar's reserve currency status.

In this report, we also highlight the work we did at the request of the Council to inform the Council's consideration of potential threats to financial stability in asset management activities and firms. In keeping with our mandates for transparency and accountability, we published a report requested by the Council on the asset management industry in September (see Chapter 2 and OFR, 2013).

Evaluating Macroprudential Policy

Macroprudential policies are meant to reduce the likelihood and severity of financial crises, strengthen the financial system by addressing specific vulnerabilities, and foster market discipline. The Dodd-Frank Act requires the Office to analyze such policies as part of its research function, which includes conducting, coordinating, and sponsoring research to support and improve regulation of financial entities and markets; evaluating and reporting on stress tests or other stability-related evaluations of financial entities supervised by Council member agencies; conducting studies and providing advice on the impact of policies related to systemic risk; and promoting best practices for financial risk management.

Chapter 3 describes a framework for evaluating the impact and effectiveness of macroprudential policy tools. Implementing such tools requires an ongoing assessment of potential threats to financial stability, which in turn depends on high-quality and detailed data and a comprehensive inventory of the policy toolkit available to mitigate those threats. Evaluation involves choosing a framework for assessing the effectiveness of such tools and specifying criteria for picking the right tool for the job, while achieving balance between macroprudential tools and other policies.

U.S. regulators have expanded the macroprudential toolkit since the recent financial crisis. Supervision of the largest bank holding companies has expanded to include annual assessments of capital adequacy,

including supervisory stress tests, and mandatory resolution plans through living wills. Banking regulators have issued rules that strengthen the level and quality of capital, including supplementary leverage ratios for large firms, specific capital conservation buffers, and mechanisms to invoke countercyclical capital buffers. The banking regulators have also issued proposed rules for the largest banking organizations that would further increase their required supplemental capital ratios and establish liquidity coverage ratio requirements. Under the Dodd-Frank Act, the Council has designated three nonbank financial companies and eight financial market utilities for heightened prudential supervision by the Federal Reserve Board.

Gaps still remain in the U.S. and global macroprudential toolkits. For example, although regulators have begun to address vulnerabilities leading to the risk of runs on repo and money market funds, we believe that better tools are needed. Also, as noted in a recent OFR working paper, stress testing of large bank holding companies in the United States — a valuable exercise used to determine regulatory capital and liquidity planning at these institutions — could be improved by incorporating funding risks, potential spillovers, and feedback effects (see Bookstaber and others, 2013).

Progress on that front is coming. For the first time in 2014, eight bank holding companies with substantial trading or custodial operations will be required to test a counterparty default scenario, and, as in prior years, six bank holding companies with large trading operations will test a global market shock. More information about the supervisory stress testing approaches for U.S. financial companies would enhance transparency, investor confidence, and dissemination of best practices within the supervisory community.

Conducting Research on Financial Stability

The Office is required by statute to perform research on risks to financial stability and to evaluate attempts to mitigate those risks.

Chapter 4 summarizes three OFR research projects. In the first, we analyze the sources and uses of short-term funding. In the second, we outline tools for measuring and monitoring market liquidity, examining the measurement of liquidity shocks across asset classes. In the third, we show how network analysis can improve our understanding of contagion among financial firms who are exposed to each other.

We distribute the results of such research in the OFR Working Paper Series. To date, we have published 12 working papers. The research is diverse, with the strong common theme of improving our collective understanding of the causes and consequences of financial instability. Examples include examining the interconnected nature of financial institutions and markets, the roles that market participants play in creating and amplifying financial distortions, and the effects of regulations and risk management policies. Recent policy-related topics include analyses of proposed contingent capital rules, the historical use of macroprudential policy in the United States to moderate the credit cycle, and scenario design in regulatory stress testing.

We also conduct and publish research to support our mandate to improve the quality of financial data. For example, an OFR working paper explained how modern cryptography techniques may allow financial regulators and supervisors to mask identifying information and share data without compromising confidentiality.

Addressing Data Gaps

We have a statutory responsibility to improve the scope of data available for financial stability monitoring. Chapter 5 describes how we identify and fill data gaps on behalf of the Council.

The OFR identifies data needs through our research and monitoring and close collaboration with the Council and its member agencies. To take stock of available data to meet those needs, the Office compiled and maintains an inventory describing the data that Council member agencies purchase or collect. Comparing data needs with this inventory can help identify gaps, avoid duplication, reduce costs, minimize regulatory burden, and take advantage of existing data sources to the extent possible. To fill the gaps, we collaborate across the Council to develop priorities and then look to alternative ways to expand the scope of data, such as by better organizing existing data, promoting data standards, and collecting new data.

Chapter 5 cites specific data gaps the Office has begun to address. Our focus in 2014 will be to improve data measuring the sources and uses of short-term funding; collect data gauging the activities and terms of securities financing transactions, such as in the three segments of U.S. repo markets; and, if requested by the Council, address data gaps in asset management activities.

Protecting the security of sensitive data is our highest priority. At the same time, we are promoting ways to share such data consistent with that goal. To that end, we collaborate with Council member agencies and through the Council's Data Committee. Council member agencies have signed data-sharing agreements to protect, secure, and treat shared data consistently. With others in the Council, and responding to the suggestion of inspectors general, we are working to craft an interagency agreement that cross references different data security classification schemes to ensure that similar data will have the same security controls wherever they may be used.

The chapter also profiles two other data issues. First, it outlines our strategy for managing data, a process that ensures data quality is maintained through the data life cycle. In addition, it presents early results and lessons learned from our analysis of data measuring activity in money market funds, credit derivatives, and hedge funds.

Promoting Data Standards

Chapter 6 makes the case for data standards and explains the Office's data standards strategy. Standards set common, clear definitions for financial entities, instruments, positions, and transactions. Common definitions promote comparability so that terms and definitions mean the same thing regardless of the data source and information can be reliably combined from different sources and systems. Better financial data standards can improve reporting and risk management for firms, support microprudential supervision and market oversight, and promote macroprudential monitoring by the Council and the Office to assess risks to the financial system as a whole.

The Office supports the Council and its member agencies by standardizing the types and formats of data reported and collected. The Office's process for promoting data standards includes: (1) evaluating whether standards are needed for a particular set of data, and whether developing them fits the Office's mission; (2) determining whether the data in question are good candidates for standardization, and (3) determining the Office's strategy.

The Office continues to be a leader in the initiative to establish a Legal Entity Identifier (LEI), a unique, global standard for identifying parties to financial transactions. The LEI will help market participants and government regulators aggregate, compare, and analyze data for greater insights. The Office also recently published a working paper, with collaboration from certain Council member agencies, describing the need for and strategy to develop a unique mortgage loan-level identifier.

In addition, the Office assists Council member agencies with data standards initiatives. For example, we are working with the Commodity Futures Trading Commission and global regulators to align and standardize derivatives reporting.

The Agenda Ahead

In 2014, we will extend and expand our work in several dimensions. We will continue to pursue the initiatives described in this *Annual Report* and to build our institutional, human capital, and technological resources. We will focus on filling the most critical gaps in financial stability data and analysis for the benefit of the Council and the public.

Our top analytical priorities for 2014 include:

- developing the prototype Financial Stability Monitor described in Chapter 2 as a tool regularly used by policymakers;
- further developing our capacity and tools to identify, assess, and monitor threats to financial stability;
- improving and implementing the framework described in Chapter 3 to evaluate stress tests and the macroprudential toolkit;
- extending the work in Chapter 4 on markets for securities financing transactions;
- following up on our work on asset management to analyze new data collected from private fund advisers by the SEC; and
- continuing to expand our research on financial

stability, risk management, and related topics, and to make results available through our Working Paper Series and other publications.

Our top data priorities for 2014 include:

- creating reference databases for financial entities and financial instruments;
- improving the scope and quality of data related to repo and other markets for securities financing transactions;
- filling the data gaps identified in our asset management report, including for separate accounts and securities lending;
- identifying and obtaining the data we need to understand better the liquidity and funding flows discussed in Chapter 4;
- promoting the incorporation of the LEI in market practice and regulations;
- assisting and advising market regulators and our global counterparts in improving the standards needed to collect and share data measuring derivatives transactions and positions collected in trade and swap data repositories; and
- further developing the in-house capacity for efficient and effective data collection and management.

Our 2014 priorities for institution-building are aimed at strengthening our technological infrastructure and human capital resources and building the virtual research and data communities that we can use to meet our mission. We are now implementing the technology infrastructure to securely collect and analyze very large datasets. We have a strong and capable staff and continue to recruit dedicated professionals who can help us achieve our mission.

We awarded our first research grant in September 2013 through our collaboration with the National Science Foundation and expect to expand that program next year. We will continue to sponsor conferences and research on financial stability and related topics. We have received and begun to respond to valuable advice from our external Financial Research Advisory Committee about data and research. In addition, we continue to work closely with the Council and its member agencies, whose support has been essential from the start.

2 Analyzing Threats to Financial Stability

The first section of this chapter describes the Office's framework for evaluating threats to financial stability. The second section assesses and reports on specific threats and potential transmission channels. Chief among them are risks in short-term funding markets and credit markets, vulnerabilities to an increase in interest rates and volatility, and uncertainty about U.S. fiscal policy.

2.1 Financial Stability Monitoring Framework

The Office's framework for assessing threats to financial stability will serve as a monitoring device to identify vulnerabilities by focusing on selected economic indicators, financial market indexes, and other data. This prototype Financial Stability Monitor builds on a framework outlined in the OFR's 2012 Annual Report *and draws from other academic contributions to risk monitoring. It will continue to evolve as new, forward-looking indicators emerge.*

Threats to financial stability are vulnerabilities, typically exposed by shocks, that disrupt the functioning of the financial system and spread through it with adverse consequences for the economy. The purpose of a financial stability monitor is to give policymakers a periodic assessment of potential fragilities to help ensure a smoothly operating financial system.

A monitoring framework should assess whether the financial system would be able to provide its basic services in the face of shocks. The Office's *2012 Annual Report* outlined six services of a well-functioning financial system: credit allocation and leverage, maturity transformation, risk transfer, price discovery, liquidity provision, and facilitation of payments. Smooth functioning of these services leads to financial stability, but each may be vulnerable to shocks when market participants take them to extremes through excessive risk-taking, leverage, maturity transformation, and liquidity transformation. By focusing on those functions, we can monitor risks building within and across markets and institutions. Other monitoring approaches are typically organized along institutional or market lines, or by sector.[1]

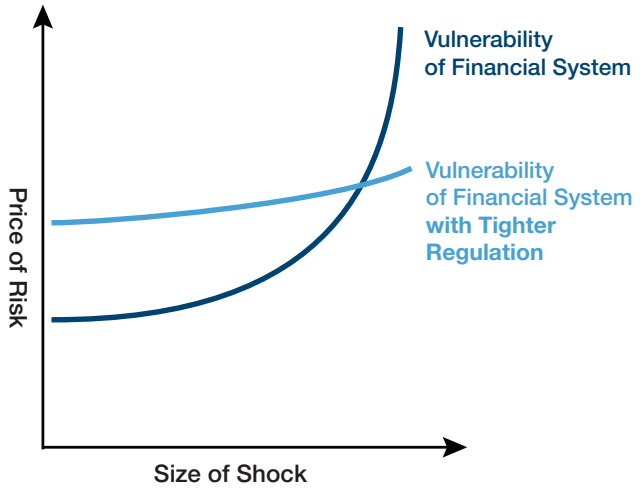
In this chapter, we present a prototype Financial Stability Monitor for tracking vulnerabilities and assessing how shocks may propagate, drawing on work by other researchers and existing tools for assessing financial stability (see insert on Monitoring Tools).[2] This framework assesses vulnerabilities that may stem from or amplify risks, focusing on credit, liquidity, funding, market, and macroeconomic risks, and interconnections that may transmit shocks across institutions and markets.

Vulnerabilities, Shocks, and Threats

Financial stability monitoring has evolved partly in response to lessons learned from the financial crisis. As the crisis showed, analysis of regulated entities may overlook weaknesses or a buildup of risk elsewhere in the financial system and may miss the ripple effect from failures in markets or institutions to risk repricing and asset fire sales. The crisis demonstrated how short-term funding runs can lead to broader problems with liquidity and solvency. It also showed how seemingly benign market conditions can lead to a buildup of risk.

The Office's framework for monitoring focuses on vulnerabilities in the financial system rather than shocks to it. Vulnerabilities are determinants of instability; shocks expose them. Examples of vulnerabilities include the potential for runs in money market funds that promise a fixed net asset value; lax loan underwriting standards; a rapid buildup of credit; insufficient bank capital or liquidity buffers to absorb losses or withdrawals; and excessive maturity transformation promoted by a period of low interest rates. Vulnerabilities may arise through market failures, incentives that lead to excessive risk-taking and the

Figure 1. Vulnerability to Shocks and Price of Risk



Source: Adrian, Covitz, and Liang (2013)

loss of market discipline, or new financial products or trading strategies that lead to a transformation of risk in a way that is not well understood. The wide range of possible conditions requires a dynamic approach. Financial system vulnerabilities can be structural or cyclical.[3] Determining the nature of the vulnerability is critical to designing the appropriate policy response, as described further in Chapter 3.

Shocks that expose these vulnerabilities can originate from inside or outside the financial system. Financial shocks may take several forms — the default of a major market participant, a sudden loss of market confidence in a particular asset or firm, or a disruption or failure in market infrastructure. Attempting to minimize the incidence of shocks is unlikely to be a successful strategy to promote financial stability because they are inherently difficult to predict (see Liang, 2013) and, furthermore, can also mask structural problems.

A more practical approach is to strengthen the financial system at its points of vulnerability to be more resilient when shocks inevitably hit. Distortions to incentives that lower the price of risk (typically accompanied by low volatility) tend to spur risk-taking, which can increase vulnerability of the financial system to shocks in the future (as illustrated by the dark blue line in Figure 1). Policies can make the financial system more resilient to shocks, for instance, by increasing the cost of securities financing transactions or raising capital standards.

Threats can be transmitted and magnified through various channels. Shocks originating in the financial sector are transmitted to the real economy, for instance, when banks and other financial institutions respond to liquidity or capital shortfalls by reducing their credit extension to nonfinancial companies (see BCBS, 2011). The recent global financial crisis underscored important linkages between the broad economy and the financial system. For example, shocks in trade finance credit led to declines in global trade, and asset fire sales and impaired funding channels caused a sharp decline in credit availability and associated contractions in economic activity in many countries.

Components of the OFR Financial Stability Monitor

Our prototype Financial Stability Monitor is displayed in Figure 2. It tracks five categories of financial system distress, using a mix of economic indicators, market indexes, and measurements calculated by the Office:

- Macroeconomic risk, including risks to economic growth, external balances, confidence channels, or price channels. Examples of indicators include financial conditions, sovereign financing needs, current account balances, or inflation expectations.
- Market risk, including the risk of losses across key asset classes and investment strategies due to adverse movements in interest rates, exchange rates, and other asset prices. Indicators include duration of investor positions, positioning, valuations of risk premiums, uncovered foreign exchange positions, asset-liability mismatches, or volatility.
- Credit risk, defined as the potential for a counterparty to fail to meet its financial obligations. Indicators include both market-implied and balance sheet measures, including credit spreads, balance sheet leverage, bank lending conditions, or asset quality.
- Funding and liquidity risk, defined as the risk that market participants cannot borrow funds or sell securities over a relatively short time without negatively impacting prices. Indicators include measures of market depth and breadth, dependence on short-term wholesale funding, or changes in the tenor and types of assets under management of short-term investors.

MONITORING TOOLS

A number of tools have been developed to assess risks to financial stability since the financial crisis, as described in the OFR's first working paper (see Bisias and others, 2012). Many build on the experience and lessons learned from past crises and some involve more than one approach (see Blancher and others, 2013). These tools fall into several categories:

Financial soundness of individual institutions. Analyzing individual banks' balance sheets enables comparisons across industry sectors and countries. Detailed data about assets and liabilities are necessary to anticipate how shocks may originate within financial companies. These measures have weaknesses: many are backward looking and not timely, and, since they typically focus on individual institutions, they do not take into account spillovers. There are also large gaps in data about some nonbank financial companies' activities.

Linkages between economic stress and financial stress. This macroeconomic approach uses stress tests, scenario analysis, and statistical models to identify the vulnerability of the financial system to shocks. Such models can be valuable, although because they are based on historical experience, they do not always handle rare, out-of-sample extreme events well.

Financial market-based indicators. These measures provide a high-frequency readout of vulnerabilities and can be combined with other models. For example, a tool identifying market conditions in which investors are under-compensated for risk can be paired with balance sheet data indicating excessive leverage, which together could signal a potential vulnerability. A weakness of market-based financial stability indicators is that they tend to be coincident rather than predictive, and they may be unreliable during periods of stress.

Interdependencies. This group of tools uses network analysis to map linkages among institutions and markets to identify potential contagion risks. A financial network model can simulate how a shock may be transmitted through the flow of funds, or show contributions to risk (see Section 4.4, for example).

Assessing threats using each of these tools in isolation may be misleading, because threats to financial stability may arise from many sources. A diverse and complementary set of tools is required. Bottom-up analysis can complement top-down approaches.

The monitoring framework should be flexible to allow for assessing risks at different levels, whether at the institution and market level or at a more aggregated macroeconomic and systemwide level. This recognizes that fragilities may appear at the micro level, but not at the macro level, or vice versa (see Hellwig, 1994). Such monitoring can inform the development of theoretical and empirical macro-financial models that seek to capture the complexity that stems from the interconnectedness of markets and institutions, feedback loops, and other accelerants that may amplify an initial shock.

- Contagion risk, defined as the vulnerability of the financial system to sudden shocks that may spread through seemingly unrelated parts of the financial system. We analyze indirect measures of interconnectedness, such as the systemic expected shortfall model, the conditional value at risk model, and the distressed insurance premium model (see Acharya and others, 2010; Adrian and Brunnermeier, 2011; and Huang, Zhou, and Zhu, 2011). Data on claims that banks have on each other, and their exposures to other sectors, are also included in this category.

We acknowledge three limitations to our framework. First, the metrics we employ in the monitor are largely contemporaneous. We will incorporate new, forward-looking indicators into our framework as they are developed. For example, the connection between volatility and leverage, discussed below, may offer insights to construct forward-looking indicators. Second, the

monitor should be treated as a starting point. It should be complemented by rigorous and robust quantitative assessments, such as stress tests, and qualitative market surveillance of supervisory and regulatory frameworks that are informed by knowledge about specific institutions. Finally, some risks are currently not readily quantifiable; in those cases, we apply a measure of judgment, and we will work to develop ways to quantify these risks.

In Figure 2, each of the five risk categories is evaluated using a series of underlying indicators based on maximum and minimum (mostly) daily levels prevailing from January 1, 1990 (if available) to the present. Some of the metrics — for example, volatility, lending conditions, positioning — treat both the maximum and minimum levels as states of high risk. For instance, we treat episodes of very low volatility and very high volatility as both representing stability risks, consistent with the "volatility paradox" hypothesis (see discussion in Section 2.2). The current positioning is determined by the cumulative z-scores (the sample mean subtracted from the latest reading and divided by the standard deviation) of the underlying indicators. This allows the indicators to be normalized. Each risk category is constructed as an equal-weighted average across the prevailing risk levels for each of the underlying indicators. The results are presented on a heat map spectrum in the Financial Stability Monitor; green means risks to stability are low and red indicates elevated risks.[4]

Figure 2 summarizes our current assessment of risks to financial stability (as of October 2013) relative to the Office's last annual report (July 2012). Across most of the elements we monitor, risks have generally abated over that period. But prior vulnerabilities remain, and new ones have surfaced.

U.S. macroeconomic conditions have generally improved amid easy monetary and financial conditions, gains in the housing market, and improving business and consumer sentiment. However, uncertainty about the U.S. fiscal policy outlook remains an ongoing risk. Market-implied sovereign and fiscal risk signals remain relatively elevated, reflecting in part concern about sovereign credit quality after the federal government shutdown and debt ceiling extension in October 2013.

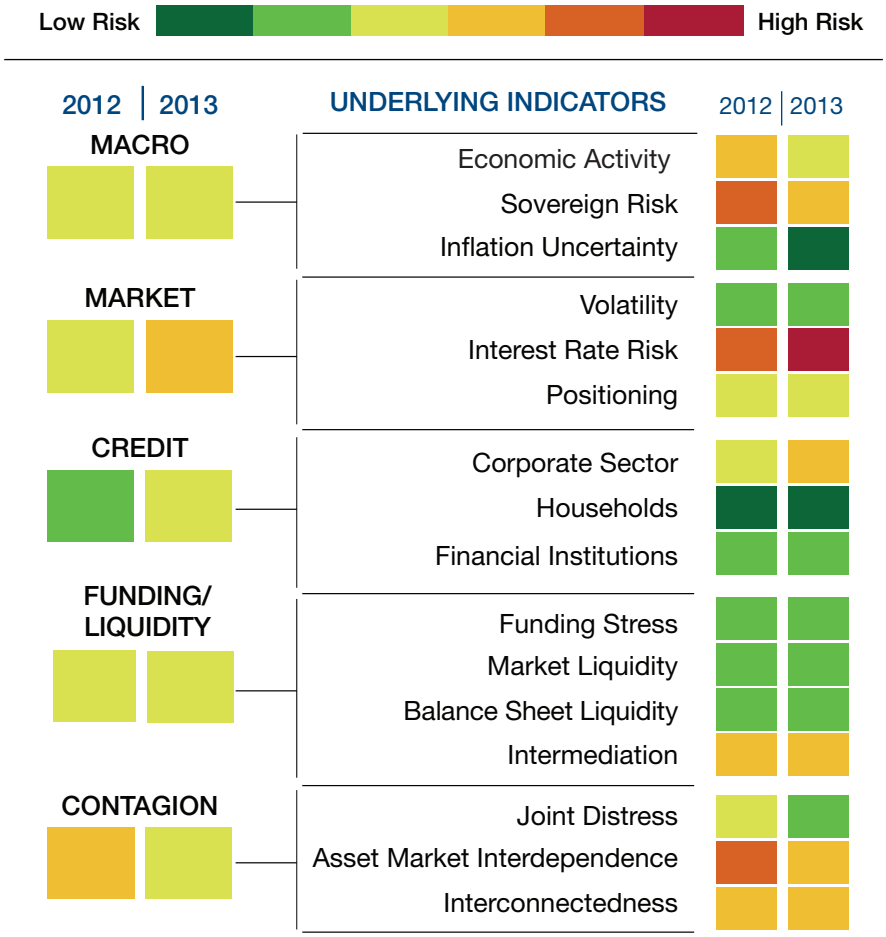
Market risk measures remain near long-term average levels, but a few pockets of vulnerability are notable. Duration risk, or the sensitivity of bond investments to a change in interest rates, is elevated. That signals an increasing risk of sizeable portfolio losses in the event of an unanticipated rise in interest rates. The low cost of volatility can lead to an expansion of trading strategies that depend on volatility remaining low, which could lead to destabilizing losses in the event of a sharp rise in volatility.

Credit risk measures are mixed. Since we published our last annual report, the ability of households to service debt, measured by payments of interest and principal relative to income, has improved. Delinquencies and default rates continue to decline or remain low. Although measures of credit risk based on the credit default swaps market suggest limited demand for insurance against default risk, pockets of risk continue to grow. Credit risk for nonfinancial corporations has increased slightly. The quality of bonds and loans issued has declined, with evidence of increased risk-taking in the leveraged loan sector and reduced compensation for risk. U.S. bank loan officers also report less stringent loan underwriting standards. Although leverage for households and banks has been declining since the financial crisis, corporate and other balance sheets show a rise in leverage over the same period, leaving systemwide balance sheet leverage still close to record levels.

Liquidity and funding risk measures show no obvious signs of imminent stress. However, the current environment of low rates and low volatility may suggest too sanguine a view of overall funding and liquidity dynamics. Broker-dealer inventories have diminished, owing to efforts to reduce market leverage and to a shift in funding and trading models. Eventually, this shift could lead to more sustained, structural reductions in market liquidity that amplify other vulnerabilities, for instance in a rising interest rate environment.

Contagion risk and interconnectedness have moderated since the Office's last annual report, according to several measurements based on an average of data from the six biggest U.S. bank holding companies. The systemic expected shortfall indicator, which predicts the expected percentage loss in equity value for large banks in a distressed market, is now at a post-crisis low. The CoVaR measure, which calculates the value at risk

Figure 2. OFR Financial Stability Monitor



Note: Green signifies low financial stability risks, while red signifies elevated risks. The figure represents a series of underlying indicators based on maximum and minimum (mostly) daily levels prevailing from January 1, 1990 (if available) to the present. Each risk category is constructed as an equal-weighted average across the prevailing risk levels for each of the indicators in the underlying categories. Positioning is determined by the average z-scores of the underlying indicators. 2013 represents data as of the end of October 2013 and 2012 as of the end of July 2012.

Sources: Bloomberg L.P., Haver Analytics, Congressional Budget Office, Federal Reserve, European Central Bank, Bank of England, Bank of Japan, OFR analysis

for the financial system based on distress at a single large bank, shows an improvement as large banks have increased capital and liquidity buffers. The distressed insurance premium, which represents a hypothetical insurance premium against financial distress and can be interpreted as each institution's marginal contribution to systemic vulnerability, has moderated and remains in a low-risk state. Improvements in balance sheet management in the U.S. banking sector have reinforced the declines experienced in these measures over the past year. In addition, the absorption ratio indicator, an aggregate measure of co-movement in market prices for a range of assets, has declined during the past year, and reflects moderate risk.

2.2 Current Threats to Financial Stability

This section identifies emerging risks and vulnerabilities in the financial system, and revisits threats cited in the Council's 2013 Annual Report *and the OFR's* 2012 Annual Report. *The OFR financial stability framework prioritizes these risks.*

Since the last OFR annual report in July 2012, uncertainty about U.S. interest rates led to a broad sell-off across global markets, unveiling important fragilities. Figure 3 shows the performance of global asset markets relative to a three-year average and the relative shift in risk appetite. Green represents a lower appetite for risk, for example, as represented by lower equity prices, wider credit spreads, or lower Treasury yields, while red represents a higher appetite for risk. The dotted line — an average of five asset classes — suggests that despite the decline in prices of certain risky assets, overall risk appetite remains above levels prevailing at the time of the last annual report. In particular, risks in the euro area have abated as its banking and sovereign debt crisis has morphed into a more manageable economic recession risk. Liquidity has improved, equity values have recovered, and credit spreads have tightened on sovereign debt issued by Greece, Ireland, Italy, Portugal, and Spain.

There was a sizeable correction in asset markets in May 2013 and June 2013 on expectations that improvements in the U.S. economy could prompt the Federal Reserve to taper the asset purchase program sooner than expected. Underperformance was most pronounced in emerging markets, with sovereign external and local currency debt spreads widening, implied default risk rising, and currencies coming under pressure. Poor performance was also pronounced in high-risk sectors and sectors that had previously benefited most from excess liquidity. Those concerns have since partly abated and equity and credit markets have recovered, but the episode was an important mini-stress test for markets that could presage the potential reaction to monetary policy tightening when it does occur.

In early October 2013, increased sovereign risk concerns related to the U.S. debt ceiling impasse and government shutdown led to a sharp rise in interest rate volatility, a widening in near-term sovereign credit default swap spreads, and a rise in measures of risk in short-term secured and unsecured funding markets. The episode was short-lived, and most sovereign risk measures returned to earlier prevailing benign levels after the debt ceiling was temporarily extended.

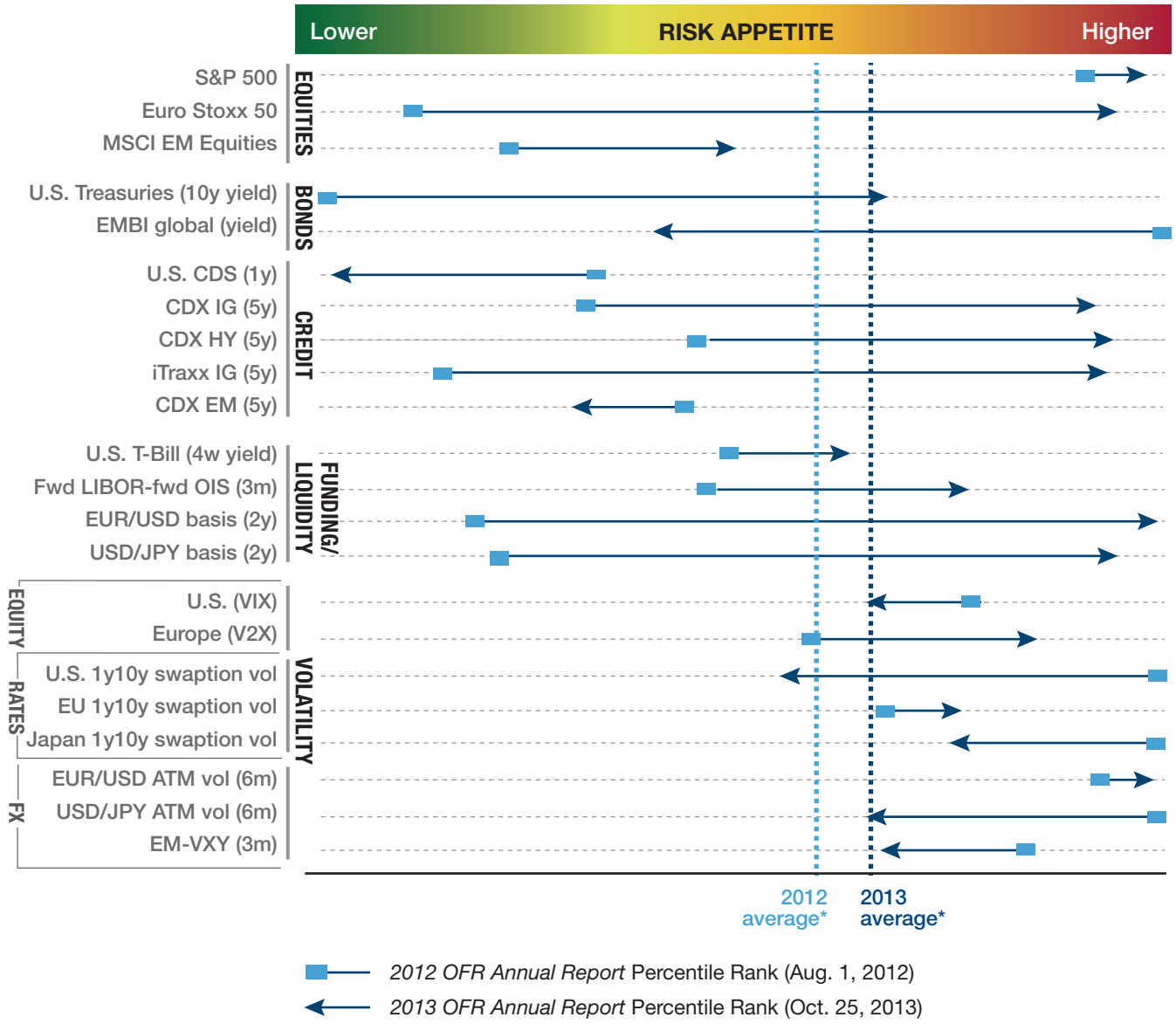
Although market conditions have since calmed, challenges remain. Threats to stability can be generally categorized in two ways: (1) cyclical or structural, and (2) inside or outside the financial system (Figure 4). Grouping threats in this way helps focus on the causes behind each threat, rather than just symptoms, although some threats contain both cyclical and structural causes. Many of the threats previously flagged by the Office and the Council in their respective annual reports remain relevant.

This section highlights the following potential threats:

- the risk of runs and asset fire sales in repurchase (repo) markets;
- excessive credit risk-taking and weaker underwriting standards;
- exposure to duration risk in the event of a sudden, unanticipated rise in interest rates;
- exposure to shocks from greater risk-taking when volatility is low;
- the risk of impaired trading liquidity;
- spillovers to and from emerging markets;
- operational risk from automated trading systems, including high-frequency trading; and
- unresolved risks associated with uncertainty about the U.S. fiscal outlook.

These risks in isolation do not necessarily lead to systemic weakness. But, in combination, they may

Figure 3. Financial Market Heat Map



Lower Risk Appetite = Lower equity prices, lower U.S. Treasury yields, wider credit spreads, higher volatility
Higher Risk Appetite = Higher equity prices, higher U.S. Treasury yields, tighter credit spreads, lower volatility

* Average across all five asset classes on Aug. 1, 2012, and on Oct. 25, 2013. Not all underlying series in the averages are shown above.
Note: The figure illustrates asset performance over the last three years to represent the post-crisis period. Each indicator is scaled to a percentile range rank between 0 and 100 and compared to the levels prevailing over the past three years. The middle of the risk appetite range corresponds to the median during the period, zero corresponds to the level consistent with the highest risk aversion during the period, and 100 corresponds to the level consistent with the lowest risk aversion during the period. The light blue marker represents the percentile rank as of the *2012 OFR Annual Report* in relation to its three-year history. The direction of the arrow displays the change in the risk appetite between the two OFR annual reports.

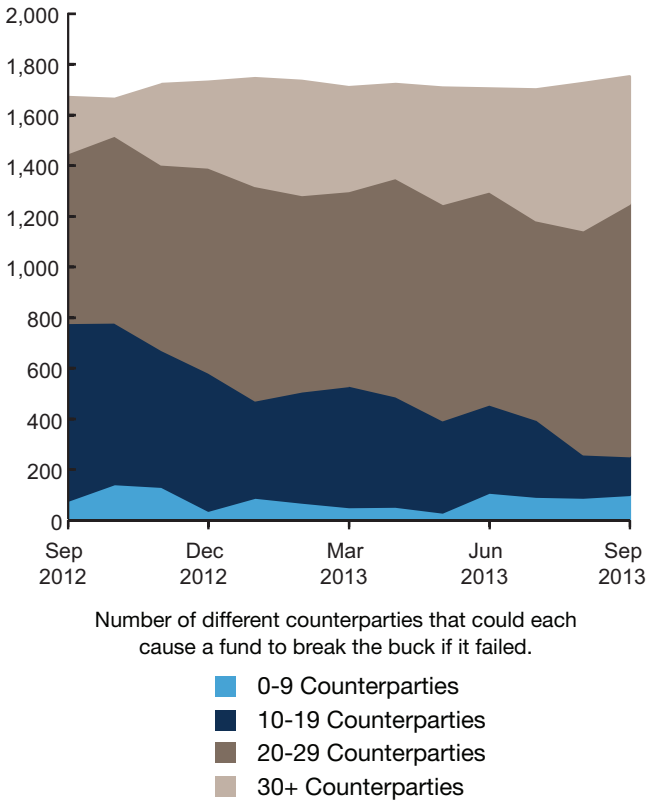
Sources: Bloomberg L.P., Markit Group, Ltd, MorganMarkets, OFR analysis

Figure 4. Threats to Stability

	Internal	External
Cyclical	• Excessive risk-taking in credit • Leveraged finance intermediation • Vulnerability to interest rate shocks • Vulnerability to volatility shocks • Asymmetric market liquidity risks. Diminished liquidity intermediation	• Eurozone sovereign risk, bank resolution delays, and corporate debt overhangs • Capital flow reversals and severe asset price volatility in emerging markets
Structural	• Vulnerability to runs in funding markets and destabilizing fire sales • Gaps in risk management and operational risk • Diminished liquidity intermediation • Data and analytical gaps and lack of data standards, contributing to low transparency or insight into financial exposures (see chapters 5 and 6)	• Domestic fiscal policy • Cyber attacks

Source: OFR analysis

Figure 5. Prime Money Market Funds' Exposure to Counterparty Failure (net assets in $ billions)



Note: Excludes exposure through repurchase agreements, asset-backed commercial paper, and guarantees of variable rate demand notes. Prime funds only, assuming a 40 percent recovery rate, based on the actual net asset value of each fund's stated portfolio.

Sources: SEC Form N-MFP, OFR analysis

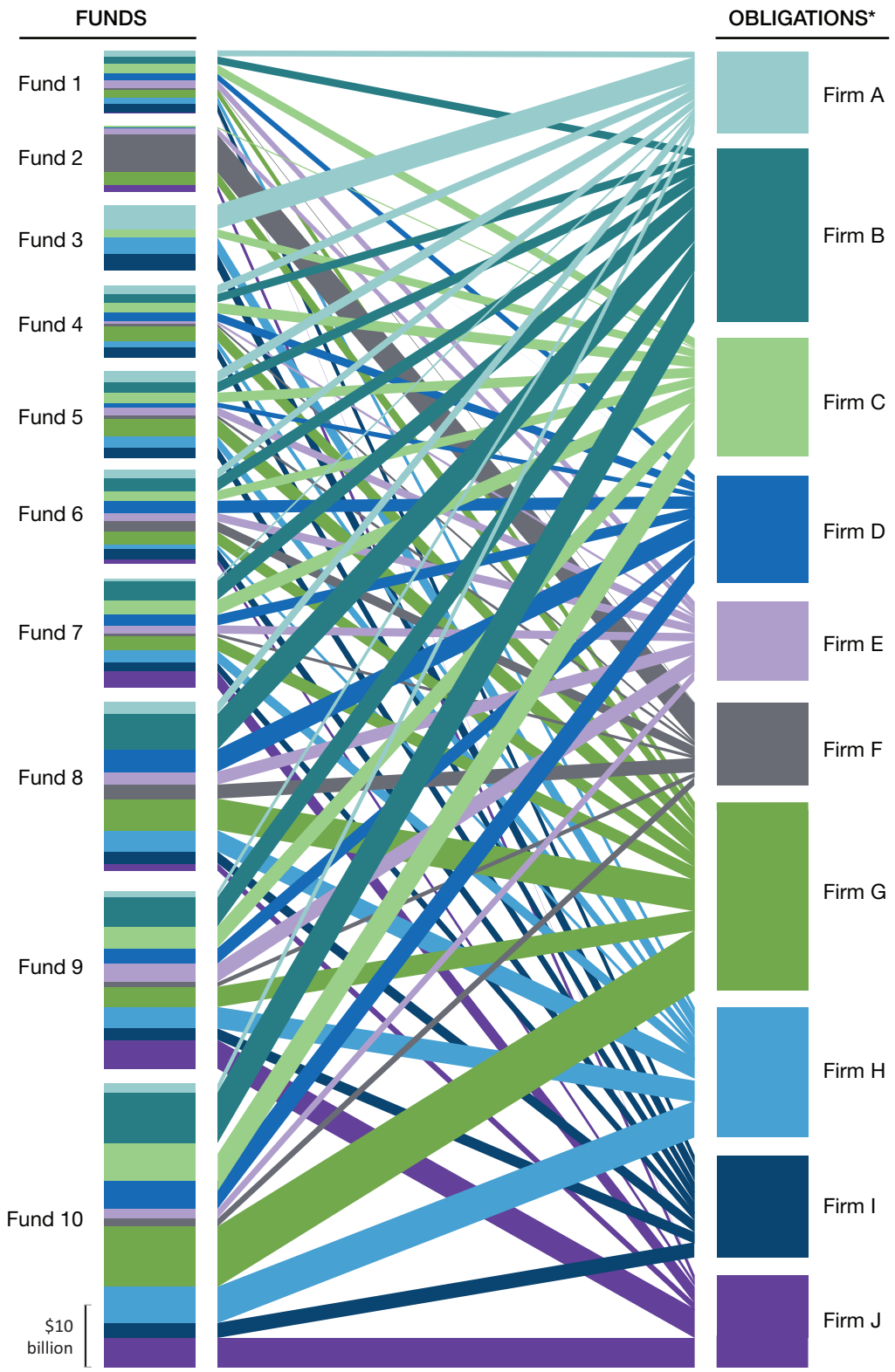
leave the financial system more susceptible to adverse shocks.

Wholesale Funding Market Run Risk and Fire Sales

In past reports, the Office and the Council have each highlighted financial stability risks related to repo markets. Regulators and market participants have made progress in reducing vulnerabilities in the repo markets to runs and asset fire sales.[5] Concentration has declined, collateral quality has improved, the volume of intraday credit has decreased, and some repo maturities have extended.[6] Potential ways to mitigate remaining risks in repo markets include the creation of an orderly liquidation facility, limitations on collateral types, an extension of repo maturities, and minimum collateral haircuts. These changes would enhance the macroprudential toolkit, although their extension to transactions between unregulated entities and harmonization with non-U.S. markets would need to be addressed (see Chapter 3).

Secured funding markets are still exposed to potential repo runs, which could amplify and transmit risk systemwide. Run risk stems from three current weaknesses. First, broker-dealers and others who obtain financing in the repo market are vulnerable to runs by counterparties. The Securities and Exchange Commission has proposed requiring prime money market funds to adopt floating share prices or impose

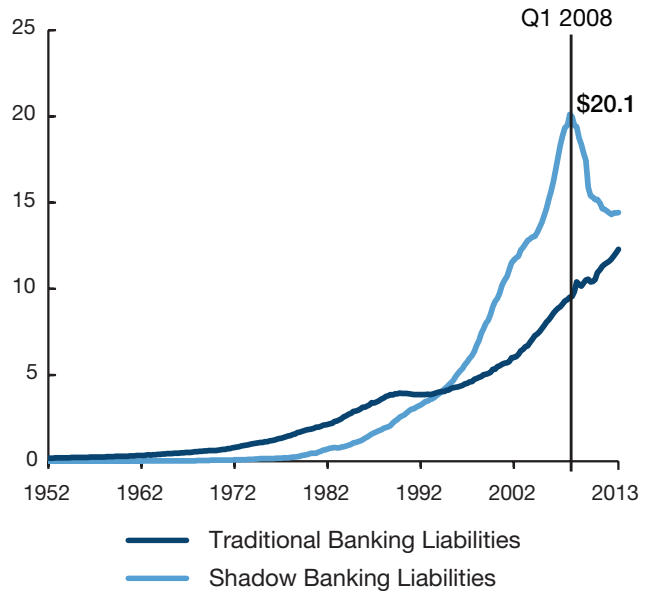
Figure 6. The Money Fund Network: Top Prime Fund Holdings ($ billions)



*Short-term obligations of financial institutions.
Note: The analysis involved private issuers only, excluding government, municipal, agency, and sovereign issuers. Assets were measured by aggregate principal value of holdings as reported on Sept. 30, 2013.

Sources: SEC Form N-MFP, OFR analysis

Figure 7. Shadow Banking versus Traditional Banking Liabilities ($ trillions)



Note: Traditional banking liabilities refer to total liabilities of U.S.-chartered depository institutions, foreign banking offices in the United States, banks in U.S.-affiliated areas, credit unions, and holding companies, less corporate bonds they have issued and other long-term liabilities. Shadow banking liabilities (netted from overlaps with the Federal Reserve Flow of Funds Table L.110) refer to the sum of total outstanding open market paper, total repo liabilities, net securities loaned, total GSE liabilities and pooled securities (prior to Q4 2008), total liabilities of asset-backed securities issuers, and total shares outstanding of money market funds.

Sources: Pozsar and others (2012), Federal Reserve, Haver Analytics, OFR analysis

liquidity fees or restrictions on withdrawals that could help reduce the likelihood of runs, but this system has yet to be tested (see FSOC, 2012b, and SEC, 2013a). Figure 5 illustrates the vulnerability of prime money market funds to counterparty failure. The most vulnerable funds would break the buck — fall below the $1 per share net asset value by more than half a cent — if any one of 30 or more counterparties defaulted; the less vulnerable funds would break the buck if any one of 10 to 19 counterparties defaulted. Figure 6 illustrates the connections of the largest money market funds to the institutional issuers whose securities they hold. In addition, forced asset (fire) sales are a risk if cash providers (such as money market funds) withdraw cash and collateral providers (typically broker-dealers) are unable to finance their positions. Finally, contagion risk could aggravate and extend such asset sales if the inability to unwind illiquid assets adds pressure on other securities and market participants.

Progress in addressing these risks for financial institutions has been mixed. The total and repo liabilities of shadow banking entities have declined significantly since the financial crisis (see Figure 7). However, mortgage real estate investment trusts (REITs) — leveraged investment vehicles that borrow shorter-term funds in the repo market and invest in longer-term agency mortgage-backed securities (MBS) — have not followed this trend.[7]

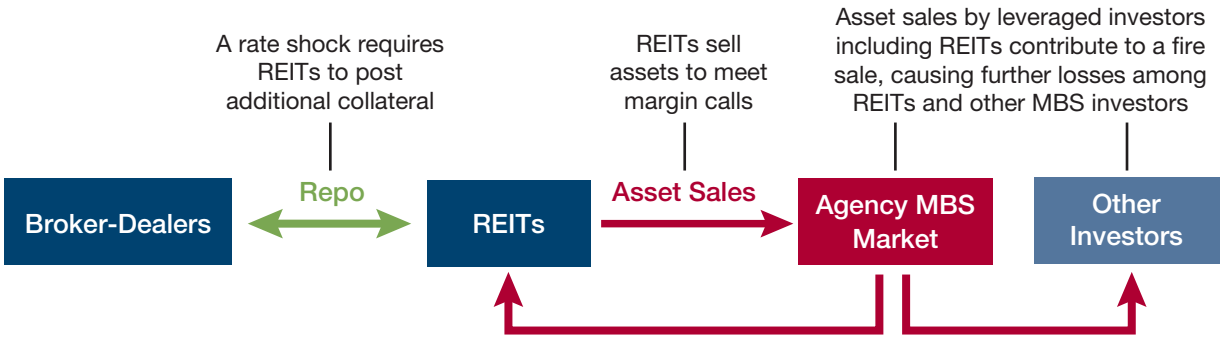
Mortgage REITs have grown nearly fourfold since 2008 and now own about $350 billion of MBS, or 5 percent, of the agency MBS market.[8] Two firms dominate the sector, collectively holding two-thirds of assets. By leveraging investor funds about eight times, mortgage REITs returned annual dividend yields of about 15 percent to their investors over the past four years, when most fixed-income investments earned far less. Mortgage REITs obtain nearly all of their leverage in the repo market, secured by MBS collateral.

Lenders typically require that borrowers pledge 5 percent more collateral than the value of the loan, which implies that a mortgage REIT that is leveraged eight times must pledge more than 90 percent of its MBS portfolio to secure repo financing, leaving few unencumbered assets on its balance sheet. If repo lenders demand significantly more collateral or refuse to extend credit in adverse circumstances, mortgage REITs may be forced to sell MBS holdings. Timely asset liquidation and settlement may not be feasible in some cases, since a large portion of agency MBS trades occurs in a market that settles only once a month (see Figure 8).

Although their MBS holdings account for a relatively small share of the market, distress among mortgage REITs could have impacts on the broader repo market because agency MBS accounts for roughly one-third of the collateral in the triparty repo market. Mortgage REITs also embody interest rate and convexity risks, concentration risk, and leverage. For these reasons, forced-asset sales by mortgage REITs could amplify price declines and volatility in the MBS market and broader funding markets, particularly in an already stressed market.[9]

Figure 9 illustrates how the combination of these risks could lead to spiraling losses at mortgage REITs. These are not merely hypothetical concerns. During May 2013 and June 2013, when interest rates rose sharply and MBS spreads widened, mortgage REITs sold about

Figure 8. Example of a Mortgage REIT Fire Sale



Sources: Bloomberg L.P., REIT financial statements, OFR analysis

Figure 9. Example of Stress on a Mortgage REIT Balance Sheet

(1) Starting sample REIT balance sheet.

Assets		Liabilities	
MBS	115.0	Repo	100.0
of which:			
encumbered	105.0		
unencumbered	10.0		
		Equity	15.0
		Leverage	7.7
		Haircut	5%

(2) MBS price declines reduce book value, equity, and repoable assets, and increase leverage.

Assets		Liabilities	
MBS	110.0	Repo	100.0
of which:			
encumbered	105.0		
unencumbered	5.0		
		Equity	10.0
		Leverage	11.0
		Haircut	5%

(3) REITs are unable to raise capital and sell some assets to reduce duration and leverage.

Assets		Liabilities	
MBS	80.0	Repo	70.0
of which:			
encumbered	73.5		
unencumbered	6.5		
		Equity	10.0
		Leverage	8.0
		Haircut	5%
Asset Sales			30.0

(4) Selling by REITs and other leveraged investors leads to further MBS price declines.

Assets		Liabilities	
MBS	75.0	Repo	70.0
of which:			
encumbered	73.5		
unencumbered	1.5		
		Equity	5.0
		Leverage	15.0
		Haircut	5%

(5) Lenders raise haircuts to account for increased volatility, requiring further sales.

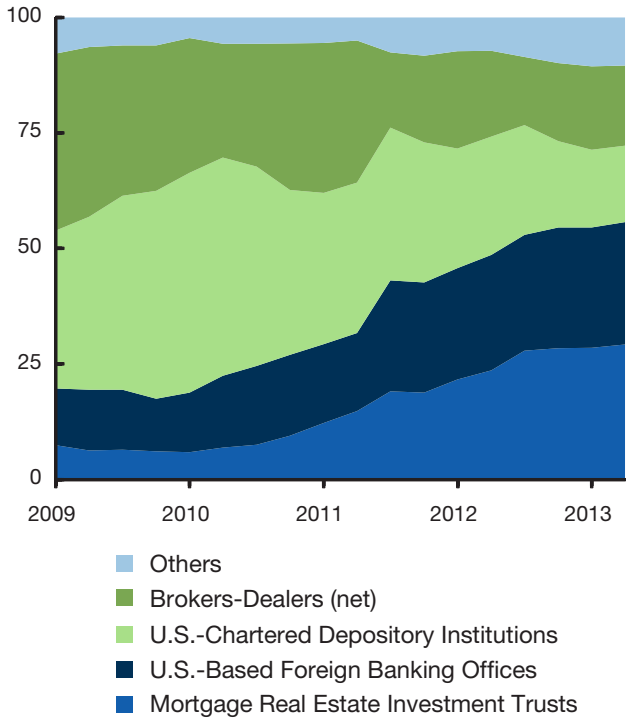
Assets		Liabilities	
MBS	58.0	Repo	53.0
of which:			
encumbered	58.0		
unencumbered	0.0		
		Equity	5.0
		Leverage	11.6
		Haircut	9%
Asset Sales			17.0

(6) Investors demand a return to eight-times leverage, leading to more sales.

Assets		Liabilities	
MBS	40.0	Repo	35.0
of which:			
encumbered	38.2		
unencumbered	1.8		
		Equity	5.0
		Leverage	8.0
		Haircut	9%
Asset Sales			18.0
Cumulative Asset Sales			65.0

Sources: Bloomberg L.P., REIT financial statements, OFR analysis

Figure 10. Fed Funds and Repo Liabilities by Entity Type (percent)



Sources: Federal Reserve, Haver Analytics, OFR analysis

$45 billion of MBS, or roughly 12 percent of their holdings. Most all those sales were to prevent leverage ratios from rising sharply. Although many mortgage REITs sold assets and decreased the duration of their portfolios, some allowed their leverage to rise, which exposed them to greater potential losses from subsequent increases in interest rates. More data would be needed to assess the likelihood and potential market impacts of distressed selling by mortgage REITs (see Chapter 5).

U.S.-based foreign banking offices also rely heavily on wholesale funding (see Figure 10).[10] Since the start of 2009, the combined share of repo funding channeled to foreign banking offices and mortgage REITs has increased about 20 percent to about 55 percent, while the share of repo borrowing by U.S. banks and broker-dealers has fallen to 34 percent. The dependence on wholesale funding by U.S. branches of foreign banks, which includes both repo and large time deposits, stems from their limited access to retail deposits. U.S. foreign banking offices have increasingly loaned borrowed funds to broker-dealers, which could imply vulnerabilities for the broker-dealer community if U.S.-based foreign banks' access to wholesale funding was to be unexpectedly curtailed. Foreign banks obtain large amounts of secured financing from money market funds and other short-term, risk-averse investors. The large share of repo funding channeled to foreign banks means that shocks abroad can impact U.S. funding markets. For example, the European crisis of 2011 contributed to funding strains for U.S. branches of European banks as money market funds reduced exposures to jumbo certificates of deposit.

Credit Risk

Among nonfinancial corporations, leverage has been increasing since 2012, and there are reasons to be concerned about a potential deterioration in corporate balance sheets once interest rates begin rising.

After the crisis, nonfinancial corporations managed their balance sheets conservatively to reduce debt and build liquidity, while profits grew at an accelerating rate. Since 2010, however, leverage on investment-grade and high-yield corporate balance sheets has been rising (see Figure 11). Early in the cycle, most of that

increase was at corporations with strong credit ratings and low debt. More recently, weaker companies have followed suit. Corporate cash buffers have been steadily diminishing, reversing the hoarding that took place earlier.

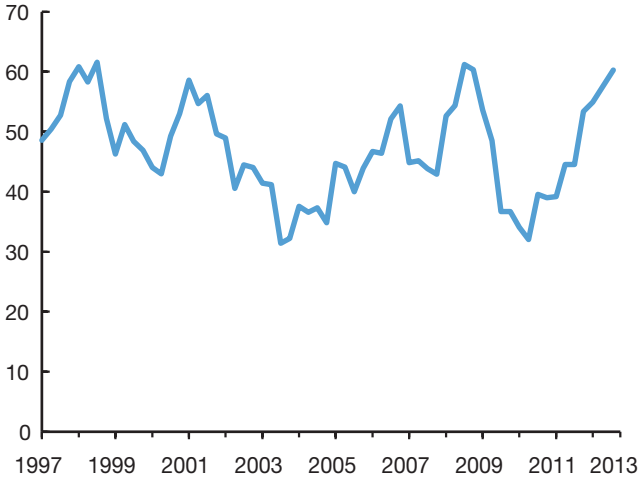
Underwriting standards continue to weaken by some measures. Companies with low credit ratings have been among the biggest issuers of new debt, with recent transactions turning more aggressive. There has been a spate of payment-in-kind bonds, which pay interest or dividends to investors with additional debt. Also, less-strict terms are being used in legal covenants attached to leveraged loans. Another sign of weaker underwriting standards are dividend-refinancing loans, which increase leverage through the financing of shareholder dividends by reducing the capital stock that buffers a firm from insolvency.

Relatively easy financial conditions often are accompanied by, or lead to, a compression in risk premiums and higher asset prices. Loans with weaker covenants (cov-lite loans) carry less stringent borrower obligations and represent one example of mispriced credit risk. With fewer investor protections for cov-lite loans, expectations of recovery on default are lower. Consequently, a cov-lite risk premium should exist to account for lesser creditor protection (fewer covenants) and lower expected recoveries. Based on historical recovery and default rates, these loans should command a risk premium of 30 to 35 basis points, but are currently priced below or only on par with other comparable loans requiring stronger protections for lenders.[11] By the same token, despite the deterioration in fundamentals, corporate borrowing costs and the spread investors are willing to pay per unit of balance sheet risk are at historically low levels, implying a lower price of credit risk and greater risk of a sharper adjustment in reaction to an adverse shock.

Duration and Interest Rate Risk

Investment portfolios now face growing duration risk — the risk that investors will incur outsized losses in the event of an unexpected rise in interest rates as a result of exposure to long-dated, fixed-rate bonds. Courtesy of a long period of low yields, low volatility, and investors' search for yield, duration risk is at recent historical highs.[12] Portfolio allocations to fixed income instruments also remain above the recent historical

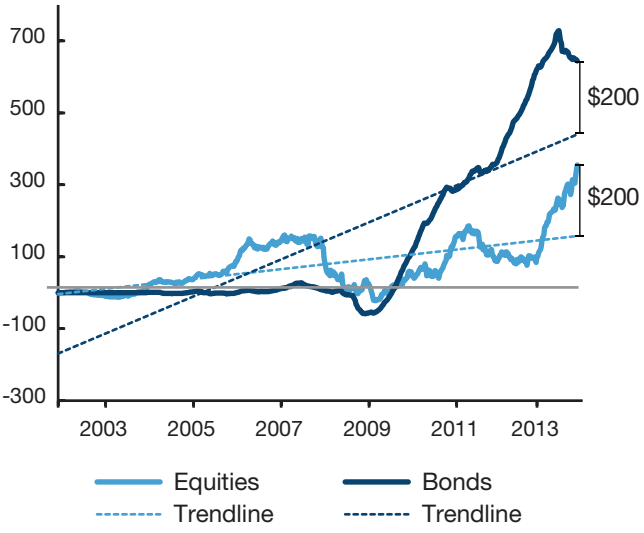
Figure 11. Share of Corporates Exhibiting a Year-on-Year Increase in Leverage (percent)



Note: Leverage is defined as the ratio of net debt to EBITDA (earnings before interest, taxes, depreciation, and amortization).

Sources: Morgan Stanley, Bloomberg L.P.

Figure 12. Cumulative Mutual Fund Flows ($ billions)



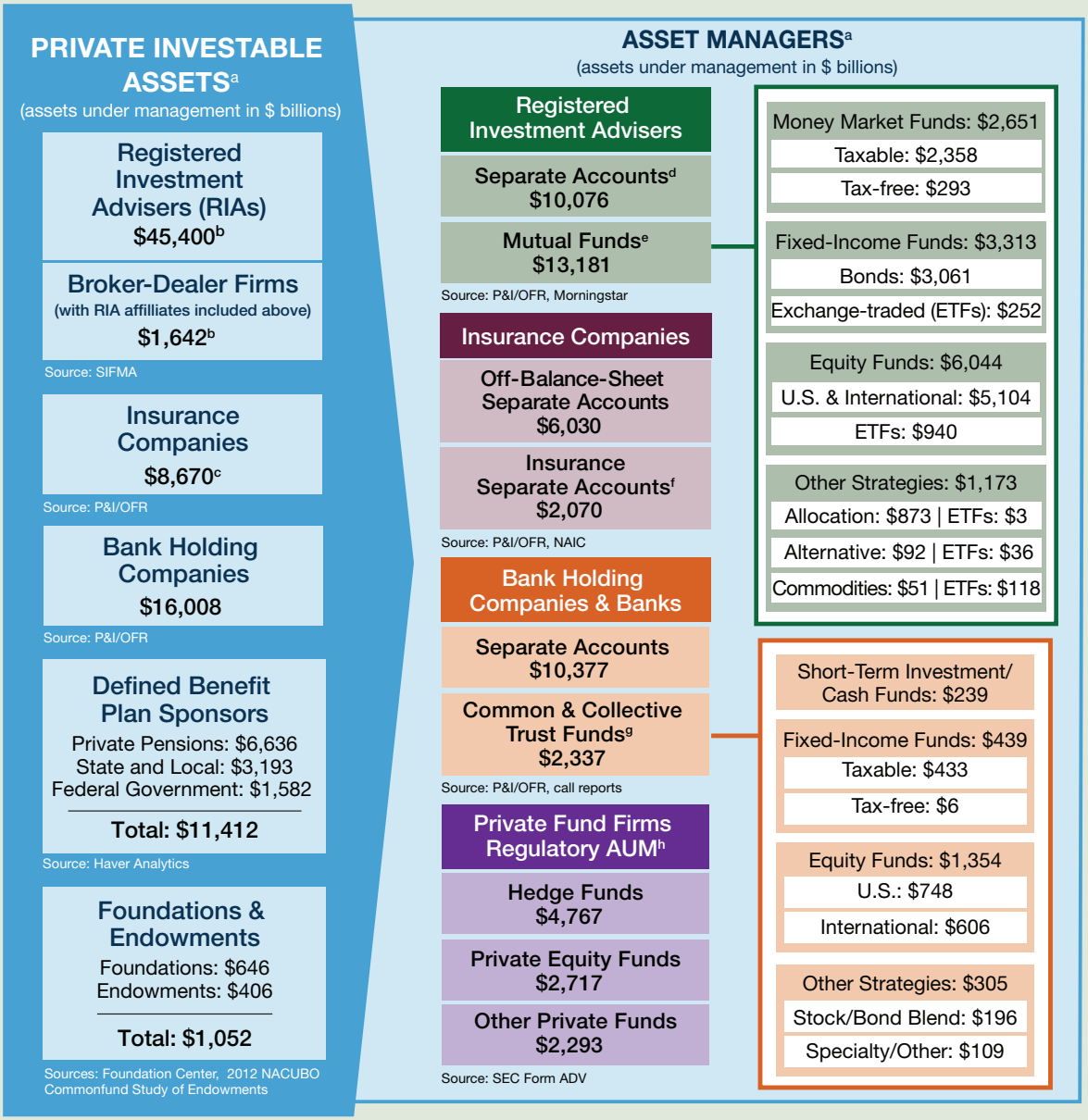
Sources: EPFR Global, Haver Analytics, OFR analysis

ASSET MANAGEMENT AND FINANCIAL STABILITY

The OFR issued a report in September 2013 analyzing the asset management industry and its activities to understand the threats they might pose to financial stability and to assess potential channels through which they may transmit or amplify such threats.

The Financial Stability Oversight Council requested the report to better inform its analysis of whether — and how — to consider such firms for enhanced prudential standards and supervision under Section 113 of the Dodd-Frank Act.

Figure 13. Asset Management Industry Overview



[a] Figures include double-counting due to cross-investing among managers and multisourcing of data in construction of table.
[b] Includes all nonexempt registered investment advisers as reported on SEC Form ADV.
[c] Some insurance companies reporting data to Pensions & Investments (P&I) classify insurance separate accounts and other on-balance-sheet assets as assets under management.
[d] Separate accounts estimated by deducting registered funds from total worldwide assets under management using P&I data
[e] Mutual funds registered in the United States.
[f] Separate accounts managed by an insurance company, the assets are on the insurance company's balance sheet.
[g] Does not include limited purpose trust companies with state charters.
[h] Regulatory AUM refers to gross assets under management, without adjusting for leverage.

Source: OFR (2013)

In the report, ***Asset Management and Financial Stability***, we estimate that, at the end of 2012, the U.S. asset management industry oversaw the allocation of approximately $53 trillion in financial assets (see Figure 13). The exact figure is unobtainable because of double-counting due to cross-investing and other issues. However, industry sources have similarly estimated total assets under management at $54.8 trillion (see IAA and SIFMA, 2013).

The report notes that the asset management industry is central to the allocation of financial assets on behalf of investors. By facilitating investment for a broad cross-section of individuals and institutions, discretionary asset management plays a key role in capital formation and credit intermediation, while spreading any gains or losses across a diverse population of market participants.

A cornerstone of the report is that the asset management industry and its activities differ in important ways from commercial banking and insurance. Asset managers act primarily as agents, managing assets on behalf of clients. Losses are borne by — and gains accrue to — clients rather than asset management firms. In contrast, commercial banks and insurance companies typically act as principals, directly bearing losses and accruing gains.

However, the risks in some types of asset management activities are similar to those in activities at banks and other nonbank financial companies. These activities increasingly cut across the financial system in a variety of ways. For example, asset managers may create funds that can be close substitutes for the money-like liabilities created by banks. They engage in various forms of liquidity transformation, primarily, but not exclusively, through collective investment vehicles, and they provide liquidity to clients and to financial markets.

We chose asset management activities, rather than firms, to be the basic building blocks for analyzing the industry, because firms have a diverse mix of business models, offer a broad variety of funds, and engage in many activities. This approach permitted the flexibility to analyze risks posed by firms (firm divisions, or firms as consolidated entities) or by industry market sectors by aggregating activities and assessing the interplay among them. Analyzing activities individually or in combination permitted analysis of transmission channels for risks, as well as assessments of how the practices of the industry or its firms could amplify risks to financial markets, institutions, or funds.

The scope of the report excludes hedge funds and other private funds because the SEC Form PF and the OFR are evaluating data being collected on these funds. It also excludes money market funds because the Council earlier released a detailed analysis of these funds and their risks, and the SEC recently proposed additional reforms.

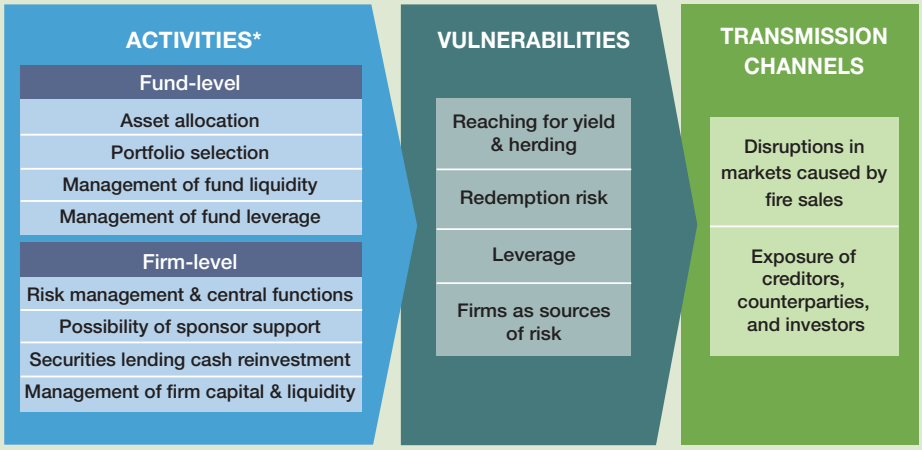
The asset management report focuses on four key factors that make the industry vulnerable to financial shocks (see Figure 14):

- "reaching for yield" and herding behaviors;
- redemption risk in collective investment vehicles;
- leverage, which can amplify asset price movements and increase the potential for fire sales; and
- firms as sources of risk.

The report also discusses two potential transmission channels: disruptions in markets caused by fire sales, and exposures of creditors, counterparties, and investors.

Registered funds, publicly listed companies, and banks and other regulated entities provide information about their activities. However, the report highlights data gaps related to asset management, particularly to separate accounts managed by U.S. asset managers and activities such as repo transactions and the reinvestment of cash collateral from securities lending. We discuss these further in Section 5.4.

Figure 14. Asset Management Activities, Vulnerabilities, and Transmission Channels

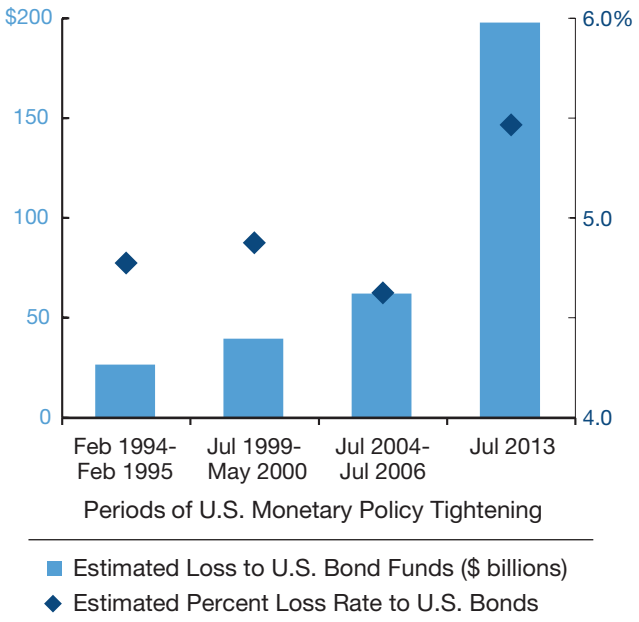


Example 1: Losses in highly leveraged funds, combined with reaching for yield behavior, could amplify fire sales and adversely affect fund counterparties.

Example 2: During a crisis, the rapid unwinding of investments of cash collateral from securities lending could pose risks that amplify fire sales and trigger runs.

Source: OFR (2013)
* The activities and examples are illustrative and not exhaustive.

Figure 15. Estimated Impact of an Immediate 100-Basis-Point Shock to Interest Rates ($ billions and percent)



Note: Hypothetical rate tightening beginning November 2013. For 1994-95 cycle, bond convexity set to zero as convexity data for that period are unavailable.

Sources: Investment Company Institute, Haver Analytics, Barclays Capital, OFR analysis

trend, despite the rise in yields in May 2013 and June 2013 (see Figure 12). Thus, losses from a given change in interest rates would be larger than in the past.

These positions increase the vulnerability for some market participants to outsized losses that could be difficult to absorb in the event of an unanticipated increase in long-term rates. To assess the degree of vulnerability, we simulated an adverse interest rate shock to estimate losses by bond funds from an instantaneous parallel shift in the yield curve of 100 basis points from current levels. We then compared the impact of such losses in today's context to loss rates from a similar hypothetical scenario during the three previous periods of U.S. monetary policy tightening. Losses during each tightening cycle are calculated by averaging monthly estimated losses, where the Barclays Capital U.S. Aggregate Bond Index is used as a proxy for duration and mutual fund bond holdings are based on data from the Investment Company Institute. Figure 15 shows that losses could rise to nearly $200 billion (or 5.5 percent of GDP), underscoring that current bond portfolios are vulnerable to a sudden, unanticipated rise in long-term rates.

Interest rate risk extends beyond nonfinancial bond portfolios. On the asset side, banks have increased their holdings of longer-term assets, leaving them more exposed to interest rate risk. On the liability side, U.S. banks have seen dramatic growth in their non-interest-bearing deposits relative to total banking system liabilities. The ratio now stands at a 30-year high. It is unclear how much of the growth is attributable to structural factors or cyclical factors. Challenges exist for banks and regulators in modeling the behavior of these deposits as interest rates rise. There is a non-negligible risk that deposits would shift to alternative, higher-yielding investments as rates rise.

In the event of an adverse interest rate shock, policymakers would likely adopt actions aimed at tempering the rise, for instance through communication and fine-tuning policies. However, determining the underlying drivers of the rise could be challenging. For instance, the roughly 100 basis point rise in long-term rates that took place during the May–June period mostly reflected an increase in term premiums (the extra yield needed for investors to hold a long-term bond instead of a series of short-term bonds) rather than short-rate expectations (see Adrian and Fleming, 2013).

To understand this rise in the term premium, we evaluate the statistical relationship between the term premium and its drivers. Decomposing the term premium is a challenging task, in part because the term premium itself is unobservable. Following Gagnon and others (2010), we constructed a model in which the term premium (the difference between long-term and short-term bond yields) on 10-year U.S. Treasury securities is a function of macroeconomic fundamentals and uncertainty, volatility in financial markets, and supply factors.[13] We estimated the model over the past 22 years, and assessed drivers of increases and decreases in the term premium during the pre- and post-crisis periods.

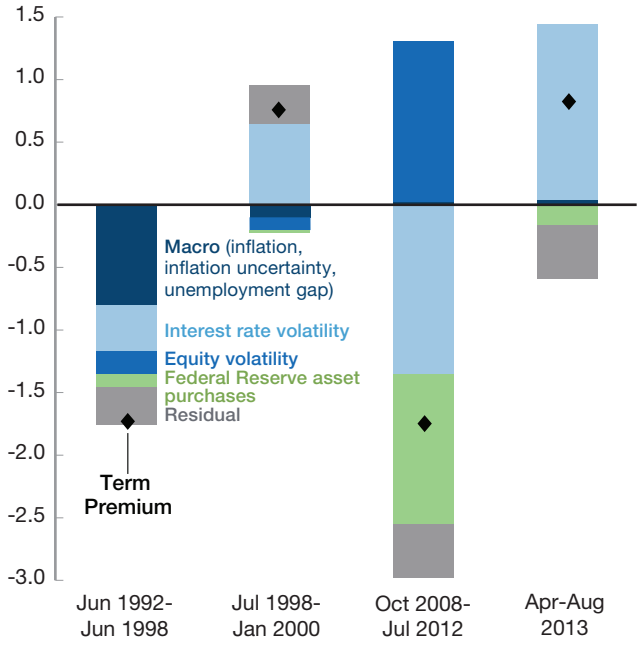
Figure 16 summarizes our main findings. During most of the 1990s, the term premium steadily declined, driven predominantly by an improvement in macroeconomic factors, as unemployment and inflation decreased steadily. By contrast, interest rate volatility, reflecting interest rate uncertainty, was a key driver of the rise in the term premium from late 1998 to 2000. Beginning in 2008, the Federal Reserve's asset purchase program became an important driver of the decline in the term premium, while macroeconomic factors became less important.[14] During the most recent period, our model suggests that increased interest rate volatility has more than accounted for the rapid rise in long-term rates, reflecting increased difficulty evaluating the future direction of interest rates. Although our model is imperfect, the preliminary findings suggest that changes in the term premium will be strongly tied to investor perceptions of the future path of nontraditional monetary policy as the Federal Reserve pares back its asset purchases.

Volatility: Low for Long Risks

Excessive credit risk-taking, ample liquidity, and low volatility increase the threat of a volatility-induced shock, when a sudden spike in volatility creates a plunge in asset prices and surge in risk aversion. Low volatility does not necessarily imply low risks to financial stability. Future risks to financial stability may actually rise precisely during periods of low volatility, a pattern that has been referred to as the "volatility paradox" (see Bookstaber, 2011).

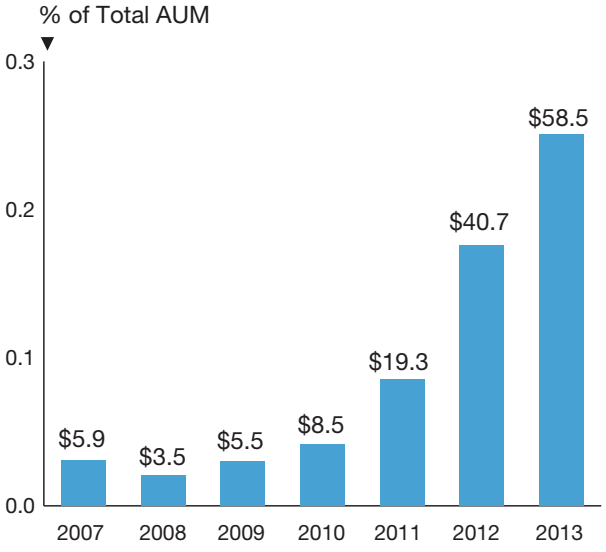
The risk-taking behavior of financial firms typically moves inversely to financial market volatility. A

Figure 16. Drivers of Change in 10-Year U.S. Treasury Term Premium (percentage points)



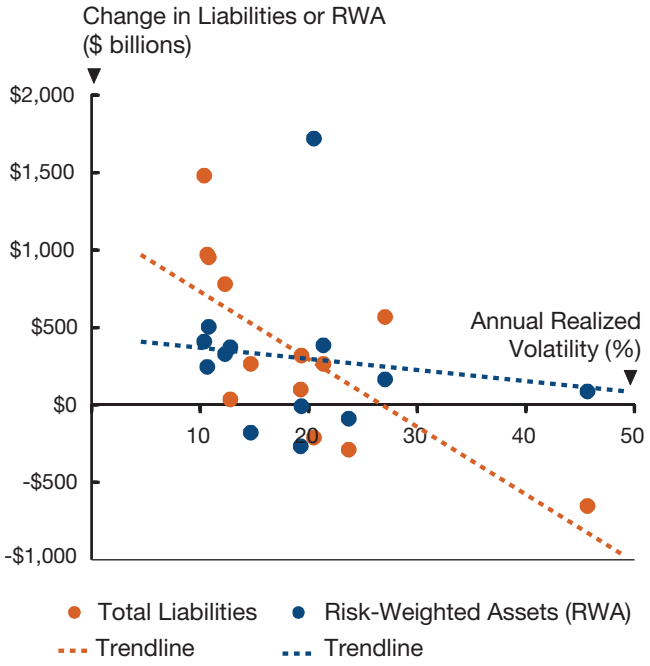
Sources: Haver Analytics, Federal Reserve, University of Michigan, OFR analysis

Figure 17. Assets Under Management in Low Volatility Trading Strategies ($ billions)



Sources: eVestment, Morningstar Inc., Bloomberg L.P., OFR analysis

Figure 18. Change in Debt and Risk-Weighted Assets to Average Market Volatility (Q2 2001-Q2 2013)



Note: Data include Bank of America, Bank of New York Mellon, Bear Stearns, Citigroup, Goldman Sachs, JPMorgan Chase, Lehman Brothers, Merrill Lynch, Morgan Stanley, U.S. Bancorp, and Wells Fargo. Liabilities and RWA values were adjusted for inflation using the GDP deflator.

Sources: Bloomberg L.P., SNL Financial, Haver Analytics, OFR analysis

Figure 19. Corporate Bond Inventories, Repos, and Market Size

Note: 2013 values include latest available data.

Sources: Haver Analytics, Securities Industry and Financial Markets Association

financial institution that has set internal limits on daily trading losses has more opportunities to take risk when market volatility declines. If such a firm does nothing to change its assets, liabilities, or trading strategies, its value at risk will also decline. The firm's management may react by taking on additional risk to reap higher profits. Low volatility reduces the price of risk-taking, which creates incentives to take on more risk. Declining market volatility will reduce risk premiums, increase the attractiveness of future cash flows from debt or earnings, and boost asset prices.

For these reasons, the current environment of low interest rates and suppressed volatility has increased the attractiveness of trading strategies that depend on interest rates remaining low as the price of risk has declined (see Figure 17). Such trading positions are highly exposed to a reversal in volatility. The figure likely understates the true magnitude of low volatility trading strategies, because it does not include option-embedded low volatility structured products.

There are other ways for financial firms to adjust their risk profiles. For instance, firms borrow funds to acquire risky assets, pushing up prices of these assets and driving down risk-adjusted performance until supply and demand come closer to balance. By the same token, trading strategies can themselves be leveraged. Increasing leverage during times of low volatility can set the stage for future vulnerability because leverage is an essential ingredient for funding runs and fire sales, two contributors to financial instability.[15]

Figure 18 shows that, on average, firms increase their debt when market volatility is low.[16] Even though debt increases, risk-weighted assets do not increase, presumably because low volatility of returns lowers the risk weights. This means as firms increasingly use debt to finance the purchase of assets, they may not have to proportionately adjust their capital ratios because risk-weighted assets do not change.

A key reason why low volatility encourages leverage is that, at least indirectly, it reduces the cost of wholesale funding. When those costs are low, incentives to add leverage increase. Firms may use the cheap funds they raise during low-volatility periods to purchase illiquid assets, the prices of which are rising.

By comparison, in periods of rising volatility, the cost of funding is rising and the prices of risky assets are

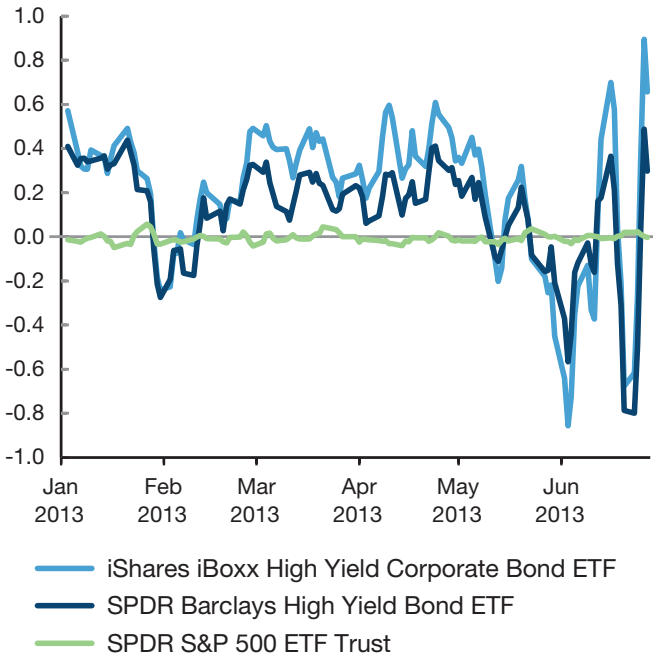
falling. Unwinding those positions quickly in such circumstances may be difficult or impossible. Nor is it easy to quickly raise additional equity to lower debt levels when volatility is rising. Overleveraged investors whose portfolios are losing in value may be subject to margin calls and have to sell assets in a declining market to raise cash. That means fluctuations in market volatility can sow the seeds of instability by producing waves of aggregate increases in leverage, followed by troughs of aggregate deleveraging, with the inherent danger of fire sales.

Impaired Trading Liquidity

Impaired trading liquidity — the inability to execute large trades without having a significant impact on market prices — could aggravate some of the threats already discussed. Market liquidity measures show a mixed picture. The current high levels of central bank liquidity may be masking some weakness in trading liquidity. Within the corporate bond market, some evidence indicates that liquidity is more bifurcated than before the crisis.[17] Liquidity has become increasingly concentrated, with large, investment-grade bonds showing the strongest liquidity, while some smaller, high-yield issues have become less liquid. The gap has widened as broker-dealers' securities holdings have shifted toward larger, more frequently traded corporate bonds. The growth in exchange-traded funds within the corporate bond market increases the potential to weaken market liquidity during periods of market stress (see Figure 20 and OFR, 2013).[18]

The sources of diminished trading liquidity are not fully understood. A commonly cited source is reduced broker-dealer capacity and a higher premium for the risk of holding inventory. Broker-dealer inventories of fixed-income instruments have declined since 2007, particularly for corporate bonds. The shift in inventories has occurred against the backdrop of an expanding corporate bond market, reducing the ability of broker-dealers to act as shock absorbers during market stress (see Figure 19). Other changes since the crisis may have also affected structural market liquidity, including shifts in the investor base, risk appetite, and trading behavior.

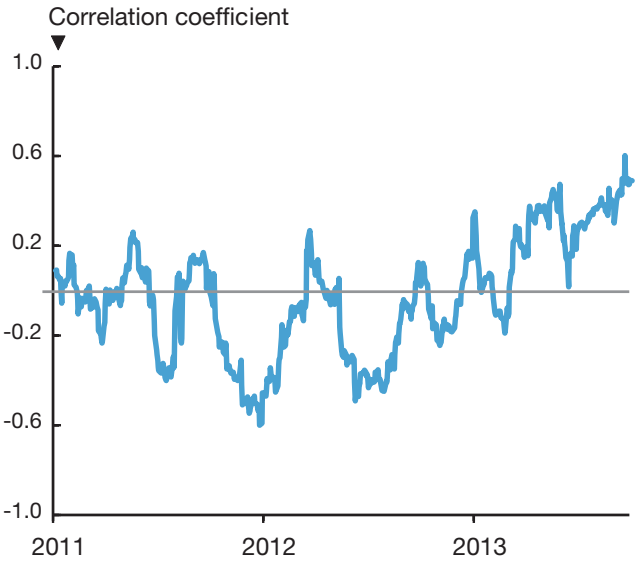
Figure 20. ETF Price Premium or Discount to Net Asset Value (percent)



Note: 3-day moving average.

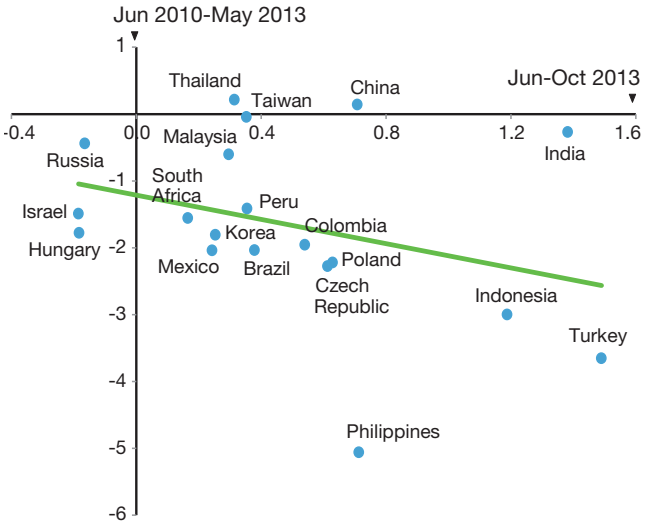
Source: Bloomberg L.P.

Figure 21. Rolling 2-Month Correlation Between Changes in 10-Year U.S. Treasury Yields and Emerging Market Bond Yields



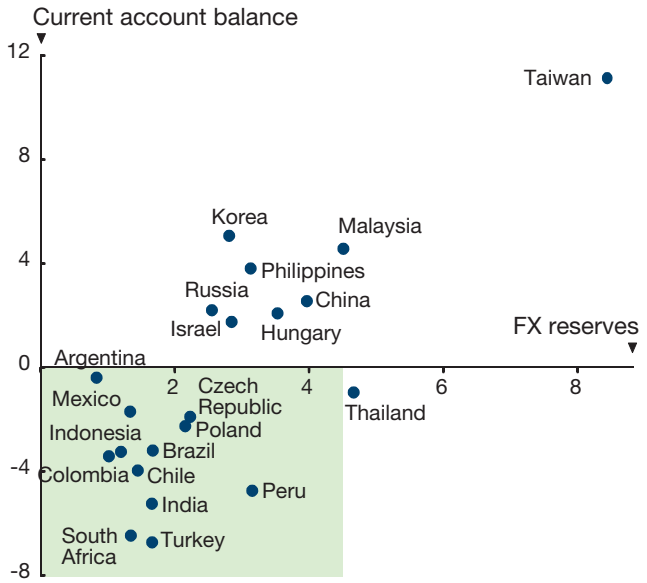
Sources: Bloomberg L.P., MorganMarkets, OFR analysis

Figure 22. Change in 10-Year Local Currency Emerging Market Sovereign Bond Yields (percentage points)



Sources: Bloomberg L.P., OFR analysis

Figure 23. Domestic Fundamentals in Emerging Markets (percent as a share of GDP)



Note: Data are comprised of trailing four quarter averages ending June 2013.

Sources: Haver Analytics, OFR analysis

Foreign Risks: Spillovers to and from Emerging Markets

Accommodative monetary policies in advanced economies, strong domestic fundamentals in select emerging markets, and a structural increase in investor allocations have led to strong cross-border portfolio flows to emerging markets over the last few years. Foreign flows have predominantly targeted emerging market bonds, with cross-over and nondedicated emerging market investors increasing their footprint. In some emerging markets, domestic policies have encouraged local companies to expand debt to high levels and boost leverage (see IMF, 2013e).

Increased sensitivity between the U.S. risk-free rate and emerging market capital inflows has increased the vulnerability of capital flows to a sudden increase in U.S. rates. A reversal in capital flows could highlight vulnerabilities that have built up, particularly where sovereigns and corporates have become dependent on capital inflows to meet near-term borrowing and refinancing needs. An abrupt reversal in inflows would be damaging for countries with external imbalances or near-term refinancing needs.

Yield-seeking capital flows across borders, driven by both external and domestic factors, have driven a decline in local bond yields.[19] Markets for emerging-market bonds have grown increasingly more sensitive to changes in U.S. interest rates (Figure 21). Rises in yields for 10-year Treasury bonds have been accompanied by a depreciation in emerging-market currencies, higher bond yields, and weakness in equity valuations.

The sell-off in emerging markets that began in late May illustrates what could happen once U.S. monetary conditions tighten. Higher U.S. interest rates coincided with a pullback in capital flows to emerging markets and increased instability in emerging market assets. The first phase of the sell-off was concentrated in highly liquid proxy trades (trades that use one asset class to take positions in another asset class — for example, positions in commodity producers' assets to proxy for China). The second phase saw a more pronounced sell-off in assets that had been the primary beneficiaries from excess liquidity since the start of the Federal Reserve's quantitative easing program (see Figure 22). The third phase reflected further

FINANCIAL INTERMEDIATION IN CHINA

New channels for credit intermediation have reshaped China's financial system and driven growth in the ratio of private nonfinancial sector credit to GDP from 117 to 170 percent between 2008 and 2012. Most notable has been the growth of wealth management products (WMPs), off-balance-sheet investment products offered by banks, trusts, and securities companies.

Wealth management products provide investors a higher return than deposits and can be invested in any combination of government securities, corporate bonds, trust loans, interbank loans, securitized loans from banks, and other assets.

The growth of the WMP market has been rapid and extensive. Restricted by a 75 percent loan-to-deposit cap and other constraints, banks sought to transition into WMP issuance and broader portfolio lending. Outstanding bank-issued WMPs, including those issued in cooperation with trust and securities companies, were 7.6 trillion renminbi (Rmb) at the end of 2012 ($1.3 trillion), up from Rmb 800 billion at the end of 2008. Including WMPs issued by trust and securities companies without bank participation, total WMP issuance is estimated to be between Rmb 8.5 billion and Rmb 9.8 billion (see Rothman, 2013).

Risks in WMPs vary. Bank-issued WMPs generally have terms of six months or less, invest in liquid assets with shorter maturities such as government securities, and offer returns 50 to 200 basis points higher than deposit rates. Bank-issued WMPs may be on or off a bank's balance sheet, depending on product guarantees. WMPs issued by trust and securities companies may offer returns of 10 percent to 15 percent, and invest in riskier assets, such as weaker quality corporate loans, loans to local government financing vehicles, and similar products.

Chinese regulators have tried to control excesses in the WMP sector. In March, China's banking regulator announced new rules to limit WMPs invested in riskier nonstandard debt instruments. In June, China's central bank refrained from alleviating tight interbank liquidity conditions for several trading sessions, driving interbank lending rates to 30 percent, compared to a typical rate of 5 percent. The initial reluctance of the central bank to address the liquidity squeeze was interpreted by the market as a policy decision to restrain the rapid growth of off-balance-sheet lending.

China's economic growth has slowed despite rapid increases in credit. Banks are facing significant headwinds. A number of bank loans issued during the 2008-09 stimulus have been restructured or rolled over in recent years to avoid nonpayment. In past years, banks had ample liquidity because of limited competition to deposits from alternative investments. However, with the growth of WMPs and nonlending credit channels, competition for deposits has intensified, leading to increasing strains on bank liquidity.

Despite these risks, there are reasons to believe that the threats to financial stability in China may be manageable. High reserve requirements of 20 percent permit room for easing if nonperforming loans rise, and the central government has low debt, permitting room for policy support. Though lending to small and medium-sized enterprises has increased, the majority of borrowers continues to be larger state-owned enterprises, and most capital is provided through state-owned financial institutions.

Also, despite the growth in off-balance-sheet funding through WMPs and other products, China's financial sector is still funded primarily by domestic deposits and options for international investment are limited, reducing the likelihood of capital flight. On top of this, China's foreign exchange reserves, at more than $3.5 trillion, are the largest in the world, providing additional financial support.

A closed capital account and financial strength to manage a crisis make a material threat to U.S. financial stability unlikely from current conditions in China. However, U.S. financial markets are not impervious to economic and financial activity in China. Inflows of Chinese capital contributed to low U.S. interest rates and the housing bubble in the mid-2000s. A collapse in global commodity prices, reduced prices for manufactured goods, or lower returns for foreign companies invested in Chinese markets could create headwinds for global economies. The current shifts in China's financial markets are significant and in time could have a large impact on global financial markets.

Figure 24. Policy Buffers in Emerging Markets

Note: Data as of July 2012 and November 2013.

[a] Green if gross financing needs are less than 5% of GDP and overall balance is less negative than -2% of GDP; red if gross financing needs are greater than 10% of GDP or overall balance is more negative than -3% of GDP; yellow otherwise.

[b] For inflation targeters, green if the policy rate is at least 4% and projected CPI inflation is at least 1 percentage point lower than the (upper bound of the) inflation target (range); red if the policy rate is lower than 2% or projected inflation is above the (upper end of the) inflation target (range); and yellow otherwise. For non-inflation targeters, green if the policy rate is at least 4% and projected inflation is 3% or lower; red if the policy rate is lower than 2% or projected inflation is above 6%; and yellow otherwise. Countries operating under currency board regimes are coded as red.

[c] Green if current account balance is greater than 6% of GDP and FX Reserves are greater than 6% of GDP; or if current account balance is less negative than -5% of GDP and FX reserves are greater than 40% of GDP; red if current account balance is more negative than -5% of GDP or FX reserves are smaller than 6% of GDP; yellow otherwise.

Sources: Haver Analytics, International Monetary Fund, various central banks, OFR analysis

differentiation, with heightened volatility in emerging market assets with the weakest domestic fundamentals (for example, weaker relative growth prospects, low or eroding foreign exchange reserves, large external financing needs, high levels of leverage, or limited policy buffers). On these measures, markets in several countries look vulnerable, including Turkey, South Africa, India, Indonesia, and Brazil (see Figure 23).

Sustained volatility can feed on itself, spilling over to other risk assets as losses trigger fund redemptions and asset sales. Emerging markets are generally more resilient as an asset class than in the past, thanks to liberalized exchange rates, more prudent macroeconomic policies, and issuance of debt in local currencies rather than in dollars. But vulnerabilities remain, including the buildup of corporate debt and leverage (see IMF, 2013e), rapid nonbank credit growth (see insert on Financial Intermediation in China), and diminished policy buffers. Emerging markets are now larger and more connected to developed markets, which means stress can be more readily transmitted directly or indirectly to the U.S. through various conduits, including funding, foreign exchange, credit, and growth channels.[20]

An increase in U.S. policy rates could create challenges for overseas central banks seeking to maintain a looser monetary policy stance. An already challenging policy environment for certain emerging markets with less capacity to absorb external shocks increases the risk of a policy error. Figure 24 shows significant differentiation in monetary, external, and fiscal buffers. Since our last annual report, buffers have eroded in Indonesia, Malaysia, Peru, India, and South Africa. The thinner cushion means less room for stimulus, more difficulty in managing external shocks, and a greater risk of a policy error.

Operational Risk

Developing more secure internal risk controls and risk management systems remains an ongoing structural risk theme. The Council's latest annual report cited technological and operational failures, natural disasters, and cyber-attacks as potential sources of significant financial system stress (see Figure 25). One key source of operational risk across all markets is the growing role of automated trading systems, including high-frequency trading systems, which use

Figure 25. Examples of Operational Risks

	Technology Failures	Natural Disasters	Cyber Attacks
Risk	Highly automated trading systems are vulnerable to technology failures. Automated and high-frequency trading execution may compound impact of trading or operational errors.	May cause severe damage to energy, telecommunications, and transportation infrastructures, critical post-trade financial utilities, including core settlement and clearing functions.	Cyber-attacks and hacking cause disruptions, which affect the financial system's resilience and soundness
Recent episodes	**Flash Crash (2010)** – 9 percent daily plunge in Dow Jones. **Facebook IPO (2012)** – dysfunction in Nasdaq systems delayed trading. **Knight Capital (2012)** – $440 million trading loss triggered from unintended orders due to software malfunction. **Goldman Sachs (2013)** – erroneous orders in equity options. **Nasdaq (2013)** – trading halt due to processor outage.	**Superstorm Sandy (October 2012**) – caused a two-day closure of the NYSE and NASDAQ. Fixed-income markets were also closed for a day. Money markets had minor disruptions.	A number of financial institutions have experienced distributed denial of service (DDoS) attacks, which overload a targeted computer server with e-mail traffic, and hacking attacks. **JPMorgan Chase and Regions Financial Corp. (July 2013)** – experienced intermittent outages that were DDoS-related. **OpUSA (May and September 2013**) – hackers coordinated online attacks against banking and government websites in operation they called "OpUSA."
Mitigants	Strengthen internal, external, and systemic controls	Strengthen contingency planning and testing, incident management, personnel, and dependencies	Ensure that safeguards keep up with rapid technological advancements

sophisticated algorithms to place rapid-fire orders after analyzing large volumes of market data.

Automated trading represents a significant portion of daily equity and foreign exchange volumes and a sizable portion of Treasury market volumes. Given these volumes, high-frequency trading poses several potential financial stability risks, suggesting that closer monitoring may be warranted.

Liquidity is the most commonly cited concern. Some studies suggest high-frequency trading improves market liquidity in equity and foreign exchange markets by narrowing bid-ask spreads, suppressing volatility, and improving price discovery (see Hendershott, Jones, and Menkveld, 2011, and Chaboud and others, 2009). But research suggests that such activity may disappear during periods of high volatility. Liquidity could decline if large losses accumulated quickly and unexpectedly, and trading controls were inadequate. Also, liquidity provided by high-frequency trades is not the same as the liquidity provided by traditional market-makers, as it lacks depth due to the small size of quotes and the fact that high-frequency-trading firms have no market-making obligation. If there are fewer traditional market-makers because of narrower bid-offer spreads, the exit of high-frequency traders during times of market stress could reduce liquidity (see Barker and Pomeranets, 2011).

Price discovery is another concern. The proliferation of trading in private market venues such as single-dealer trading platforms and dark pools — off-exchange venues that let large institutions trade anonymously — may be tied to the rise of high-frequency trades. This type of activity potentially leads to market

fragmentation, affects transparency, and impairs price discovery. Studies have shown that high-frequency traders tend to follow a price reversal strategy (rapidly buying after price declines and selling after increases), and are quick to detect price anomalies and act to stabilize prices. However, high-frequency traders also employ a narrower range of investment strategies, which may distort asset prices if similar trades are executed by several firms simultaneously.

The potential for increased market volatility is also a risk, although the evidence is mixed on precisely how high-frequency trading may affect volatility. Zhang (2010) shows that high-frequency trading increases stock market volatility, particularly among stocks with a high proportion held by buy-and-hold institutional investors. The supply of such stocks for trading each day may be small, and high-frequency trading could significantly impact price volatility. Other studies suggest that high-frequency trading distorts market conditions through prices, but not necessarily through the volume of shares traded (see Brogaard, 2010).

Risk management measures used by high-frequency trading firms are not well understood and require further investigation, particularly regarding controls, capital, and the framework for assessing intraday positions that change rapidly. Weak risk management of high-frequency trading increases the potential for counterparty risk because prime brokerages are the primary channel to public trading venues for high-frequency trading clients.

From a financial stability perspective, the OFR is focused on the potential interaction of various risks, such as a volatility shock amid extended portfolio duration and an inability or unwillingness of marketmakers to provide liquidity. In that scenario, high-frequency trading systems may obscure price discovery, exaggerate illiquidity, increase volatility, and contribute to extreme price changes. The initial trigger may be a loss by a large institution that leads to a market disruption, with a cascading effect on markets and market participants.

U.S. Fiscal Policy Outlook

Despite the recent sharp narrowing in the U.S. federal budget deficit, the U.S. fiscal policy outlook carries financial stability risks, driven by three factors. First, a rapid pace of deficit reduction carries economic costs. Second, a clear resolution of the nation's long-term fiscal challenges is still lacking. Finally, the political process for implementing sustainable fiscal adjustments has become more uncertain.

Caps on discretionary spending and other measures have led to near-term fiscal improvement. The federal deficit has declined sharply over the past two years from an estimated 8.7 percent of GDP in fiscal year 2011 to 4.1 percent in 2013. Under current law, and due in part to additional cuts to take effect in January 2014 as part of the budget sequester, the Congressional Budget Office projects the deficit will decline to 2.1 percent of GDP by fiscal year 2015 (see CBO, 2013a).

But this substantial fiscal adjustment carries two risks. First, it has created a fiscal drag on an economy that remains weak. Second, it creates an extra burden on other policy levers to support the economy. A policy mix that keeps short-term interest rates and unconventional monetary policy tools in place for an extended period potentially increases future risks to financial stability, whether through excessive risk-taking in credit markets or through volatility and interest rate shocks.

In the longer term, two other adverse trends cause greater concern. The absence of bipartisan agreement has raised questions about whether long-term fiscal problems may be resolved smoothly, as noted in the Council's *2013 Annual Report* and in the Office's *2012 Annual Report*. The budget sequester did not address the longer-term sources of U.S. budget challenges. Without further action, federal deficits and debt are likely to rise again as a share of GDP after 2018, as growth in entitlement outlays and debt service outstrips economic growth (see CBO, 2013b).

Equally concerning, the political process to address fiscal challenges has become increasingly uncertain, as shown by the debt-ceiling crisis in the summer of 2011, the "fiscal cliff" crisis in December 2012, and the government shutdown and debate over extending the debt ceiling in October 2013.

Delays in addressing long-term challenges could have longer-term, and potentially permanent, adverse financial stability consequences, including:

Increased credit and liquidity risk premiums. What sets Treasury securities apart from other highly rated

sovereign credits is their creditworthiness and high liquidity. The strong creditworthiness of Treasury debt is reflected in the safe-haven role it plays during periods of broad market volatility. The liquidity of Treasuries is evidenced by their tight bid-ask spreads, high turnover rates, and prevalence as benchmarks in financial transactions. Doubts about the ability of the U.S. government to meet fiscal challenges could contribute to increased credit-risk premiums and an erosion of the liquidity advantage, translating into structurally higher yields, a steeper Treasury curve, and increased volatility. Spillovers into risk assets would likely follow, including wider credit spreads, lower asset prices, and reduced liquidity.

Erosion of safe haven and reserve currency status. Concerns about U.S. sovereign risk could lead central banks to reduce their dollar reserves and diversify into other currencies. That would boost United States borrowing costs and weaken the dollar, with spillover effects on other U.S. and global assets, in the absence of offsetting policy actions.

In addition, near-term, future episodes of fiscal uncertainty could result in shorter-term, destabilizing effects on financial markets, with adverse consequences for the U.S. and global economies, such as:

Forced deleveraging pressure. Concerns about potential payment delays likely would have pronounced market impacts. Yields on short-term Treasury bills could rise and the markets for derivatives and term repos could also be affected, as Treasuries are the most frequently used collateral in these markets, other than cash.

During the latest episode, government-only U.S. money market funds — which hold about $950 billion of assets — registered a $55 billion decline in assets under management during the first two weeks of October. Once the political impasse ended, flows swiftly reversed. But if such actions persisted, they could lead more counterparties to sell, potentially resulting in asset fire sales in a worst case scenario. Even without delayed payments, Treasury repo market lenders could permanently increase discounts on borrowers' collateral, triggering more margin calls and a wave of deleveraging because of the mere risk of such action.

Cascade of downgrades. Major credit rating agencies have warned that episodes of uncertainty over the fiscal outlook could contribute to pressure to downgrade U.S. government debt. Further U.S. sovereign downgrades would put at risk the ratings of other entities, particularly financial institutions, clearinghouses, the government-sponsored enterprises, municipalities, and any institution (including foreign entities) with large exposure to Treasuries. A single-notch downgrade would not be expected to have much impact on markets. Some types of Treasury investors are insensitive to price and ratings, and would likely retain large holdings as long as liquidity remained sufficient. Other investors with specific mandates might simply adjust their mandates.[21] But a multinotch downgrade could be more damaging.

Effects on other dollar-denominated assets. The combination of reduced U.S. sovereign creditworthiness, systemwide downgrades, higher haircuts, and reduced access to financing would likely lead to a broader correction in fixed-income securities that are priced off of the Treasury curve.

Operational risk. Segmentation in the Treasury market between securities that are at greater risk of nonpayment and other Treasury securities could affect collateral used for repo transactions, margins for futures exchanges, or over-the-counter derivative transactions.[22] Impaired collateral that is ineligible for the Federal Reserve's funds transfer system would have to be settled through other means, raising the risk of payment-and-settlement failures. This kind of cash payment delay or default could result in a "credit event," triggering certain conditions attached to credit default swaps.[23] Although net and gross amounts outstanding are small relative to the size of the market and the credit default swap payout on protection is low, potential operational challenges could arise if the full amount of outstanding credit default swap contracts were settled simultaneously.

Economic and institutional implications. Aside from the direct market impact, other broader macroeconomic effects would be likely if there were a protracted impasse over the federal debt limit or an outright government default on its debt. Job creation, consumer spending, consumer confidence, and economic growth would be hurt, potentially leading to pressure on overall financial conditions and asset markets (see U.S. Treasury, 2013).

3 Evaluating Macroprudential Policy

The OFR has a statutory mandate to study and advise on the impact of policies related to financial stability, and to evaluate and report on stress tests. This chapter describes a framework for evaluating macroprudential policies and other tools designed to promote financial stability, and examines several tools proposed for use in the United States.

3.1 A Framework for Evaluating Policy Tools

Macroprudential policies seek to strengthen the financial system by addressing specific vulnerabilities and fostering market discipline. This section (1) provides a brief recap of the threat assessment framework discussed in Chapter 2, which is needed to inform macroprudential policy; (2) discusses the objectives of macroprudential policy and the policy toolkit; (3) explains the criteria for evaluating the effectiveness of macroprudential policy, including potential unintended consequences; and (4) discusses the criteria for picking the right policy tools to respond to specific threats.

Financial stability is a statutory policy objective for the Council and its member agencies. Policy analysis is focused on assessing threats to financial stability and policymakers are creating more tools to combat those threats. Federal Reserve Chairman Ben Bernanke recently noted that "a central bank must take into account risks to financial stability if it is to help achieve good macroeconomic performance" (see Bernanke, 2013). As described in Chapter 2, the OFR and the Council are developing tools for assessing and monitoring threats to financial stability, but significant gaps remain in the availability of data and in the indicators to measure and monitor threats.

Implementing macroprudential policies to address those threats is inherently complicated. That is because macroprudential policies and tools are specifically designed to address vulnerabilities across the financial system, not just on one part of the system. Moreover, threats often arise from several vulnerabilities. As discussed below, several tools may be needed in combination — a toolkit — to mitigate them.

Macroprudential policy tools should work alongside microprudential regulation, which focuses on safety and soundness of individual financial institutions and the functioning of financial markets. These tools should also work alongside monetary policy, which promotes price stability and maximum employment and output. Indeed, the three may be complementary and give policymakers more options to achieve multiple policy goals. However, they may also conflict with each other. For example, the recent financial crisis illustrated that monetary policy may achieve stable growth and low inflation even as imbalances build within the financial system.

The U.S. toolkit has grown significantly to include new rules for capital and liquidity for banks and bank holding companies, including the countercyclical capital buffer and the proposed liquidity coverage ratio. Stress testing, capital planning, orderly resolution authority, and incentives for centrally clearing derivatives also are part of the toolkit. Understandably, many additions to the U.S. toolkit tend to concentrate on banks and bank holding companies. However, it is also important to look at tools that have been proposed to address threats that may arise outside the banking system, such as tools to reduce market vulnerabilities. In addition, it is worth examining tools adopted or proposed in other countries, for example, targeted countercyclical tools to address excesses in specific credit markets.

Macroprudential tools are as inherently complicated to evaluate as they are to implement. First, metrics for gauging financial stability are elusive and multifaceted, reflecting the numerous services the financial system provides. Second, we often rely on forensic analysis to judge policy effectiveness, lacking evidence that a particular policy resulted in a specific financial stability

outcome. That's obviously true when analyzing any economic or financial policy tool, but unlike microprudential and monetary policy tools that have been tested and evaluated, macroprudential tools are newer and in many cases have yet to be used, let alone tested and evaluated. Consequently, the framework for evaluating such tools must be developed from the ground up. Finally, reflecting the nature of the toolkit, financial stability tools must be examined both individually and in combination with others.

Four elements are critical to implementing a macroprudential policy framework:

1. an ongoing assessment of potential threats to financial stability, which depends on high-quality, comprehensive, and detailed data;
2. a comprehensive policy toolkit to mitigate those threats, because with multiple threats and a complex and diverse financial system, the policy tools need to be diverse and targeted;
3. a framework to assess the effectiveness of such tools, drawing on the experience in the United States and other countries; and
4. criteria to pick the right macroprudential policy tool for the job, including getting the balance right with monetary policy and microprudential regulation.

Ongoing Assessment of Threats

A macroprudential threat assessment must first evaluate the vulnerabilities in the system and then identify potential shocks that would expose those vulnerabilities.

As discussed in Chapter 2, the threat assessment should target the causes of vulnerabilities to identify possible mitigants. For example, these vulnerabilities could emerge through market failures, a loss of market discipline, or misaligned incentives.

Macroprudential policy design also depends on understanding financial innovation. Financial activities and risks are constantly evolving. Innovation can make the financial system run more smoothly, and well-managed financial innovation is critical to an efficiently functioning financial system that can adapt to changing circumstances.

But innovation can also shift risks in unexpected ways. In recent decades, many innovations in financial products had been widely seen as enhancing the ability of market participants to divert risks to those best equipped to manage them. But during the financial crisis, innovations in many cases allowed increased risk-taking by buyers and sellers and made the financial system vulnerable to shocks. In addition, some innovations result from efforts to evade prudential regulations and market oversight. Other innovations could represent attempts to gain advantage by institutions that have dominant positions or even monopolies in particular markets.

Macroprudential policy analysts must track the risks in financial intermediation activities that are evolving through the development of new products, new activities, and new types of financial firms. For that reason, a key complement to our quantitative monitoring framework is a qualitative assessment of structural vulnerabilities, including an assessment of the potential unintended impacts of regulatory and accounting policies on different types of financial institutions.

Policymakers recognize that fundamental uncertainty exists in anticipating shocks that trigger crises. The potential for future crises necessitates developing policy tools that help identify vulnerabilities before the shocks hit, tools to use during a crisis to reduce its severity, and tools to repair and promote recovery in the aftermath.

Defining the Macroprudential Policy Toolkit

The best-developed U.S. macroprudential policies address vulnerabilities that arise in the provision of credit or from interconnectedness, and that bolster resolution planning before and during a crisis. However, macroprudential policies in the United States have largely remained bank-centric since the crisis. Judging by the growing share of credit intermediation in nonbank institutions and in capital markets in Figure 26, financial activity appears to have continued to migrate toward securities markets, as these new bank-oriented tools have reduced the relative profitability of such activities in banks.

Macroprudential policy addresses vulnerabilities in the financial system and promotes incentives that restore market discipline to reduce the likelihood of financial crises and lessen the severity of any crises that

occur. Macroprudential policy tools can act either as shock absorbers to prevent shocks from disrupting the performance of the financial system, or guardrails to set incentives or controls for the activities of financial institutions and help to restore market discipline.

In defining the toolkit, the key questions are:

- Who does the tool affect?
- What risks does the tool address?
- Under what circumstances is the tool used?
- How is the tool used?

Who Does the Tool Affect?

Does the tool apply narrowly to one type of financial firm or broadly to a type of activity, regardless of the type of firm? Although banks have been subject to more microprudential regulation given their leading role in financial activities and the presence of federal deposit insurance, regulatory differences can prompt risky activity to migrate from banks to nonbank financial firms.

What Risks Does the Tool Address?

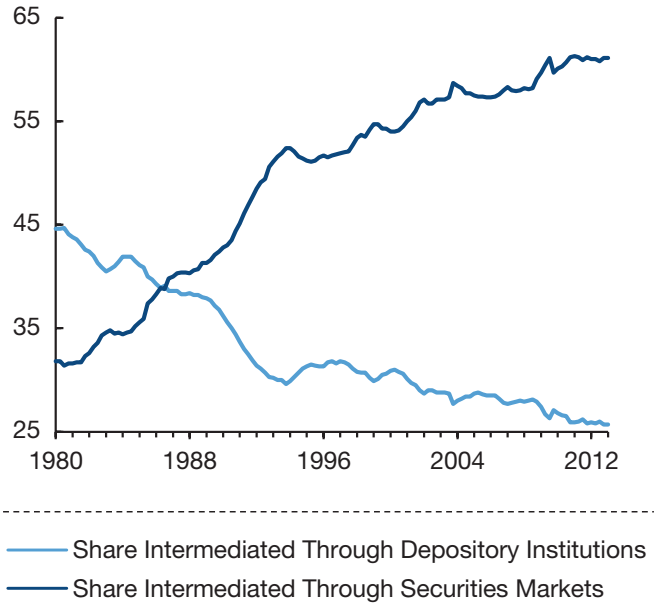
Policymakers need multiple types of tools to address the five types of financial system distress described in Chapter 2 — macroeconomic risk, market risk, credit risk, funding and liquidity risk, and contagion risk.

Under What Circumstances Is the Tool Used?

Pre-crisis macroprudential policies are designed to reduce the likelihood of future crises or limit the severity of a disruption, and would be deployed to respond to issues identified by financial stability monitoring. Crisis-response macroprudential policies reflect the recognition that crises can occur and that policymakers need to have tools to limit their impact — to respond and prevent distress in credit and funding from creating feedback loops between the financial sector and the real economy.

Pre-crisis policies can be countercyclical or structural (through-the-cycle). Structural policies address aspects of the financial sector that could create vulnerabilities throughout the cycle; these include policies that promote simpler, easier-to-resolve financial institutions. Countercyclical policies come in two types: discretionary (policymakers have to activate the policy) and automatic (criteria for activating the policy are determined in advance). Automatic stabilizers, like the anti-lock brakes in a car, deploy automatically when vulnerabilities arise. An advantage of automatic stabilizers is that they do not depend on consensus or the judgment of policymakers.

Figure 26. Origin of Private Nonfinancial Debt Outstanding (percent)



Source: Morgan Stanley calculations based on Federal Reserve Flow of Funds data

How Is the Tool Used?

Is the tool broad-based or sector-specific? Does the tool address flows or amounts outstanding? Does the tool address prices or quantities? Capital standards, which address the level of capital, tend to be broad-based. Tools used outside the United States, such as limits on loan-to-value (LTV) or debt-to-income (DTI) ratios, tend to focus on risks in specific sectors and on flows. They address loan originations rather than existing loans. Capital standards affect the supply of credit by affecting the cost of lending from the perspective of the bank or other financial institution. LTV and DTI limits affect the demand for credit by increasing the cost to the borrower and reducing the pool of eligible borrowers for certain types of loans.

Figure 27 summarizes macroprudential policies being used or discussed internationally, not all of which would be easily implemented in the United States. Bold-faced examples reflect the current U.S. macroprudential policy toolkit. Tools are organized by when (for example, pre-crisis or post-crisis) and how they are used (for example, cyclical or structural).

Pre-Crisis Cyclical Policies. Most of the policy discussion and focus internationally is on pre-crisis macroprudential tools that are countercyclical, particularly to moderate excessive credit growth or mitigate the effects in the event of a downturn. Such tools include countercyclical capital buffers for large internationally active banks, which would alter capital requirements when federal regulators determine that excessive credit growth is contributing to an increase in systemic risk; time-varying capital risk weights for banks; and LTV and DTI limits, which could apply just to bank lending or to all lending of a given type.

These tools require identification of metrics for triggering activation, as well as decisions on how much to ramp up or taper down to affect credit provision. Other potential pre-crisis tools relate to funding risks, such as targeted reserve requirements or capital surcharges on short-term wholesale funding.

Pre-Crisis Structural Policies. There are two basic types of macroprudential tools for use through-the-cycle: policies to affect how the system performs its basic tasks and policies to promote resilience. Examples of structural policy initiatives affecting the functioning of the U.S. financial system include strengthened capital and liquidity requirements, and heightened supervision of large firms; reforms to money market fund regulation, which would strengthen the industry's liquidity and increase its resilience to funding runs; and margin requirements for over-the-counter derivatives and securities financing transactions (SFTs).

Since the financial crisis, substantial international dialogue has focused on new structural policies to promote greater resilience, particularly in banking. The Basel Committee on Banking Supervision has produced a new framework for heightened microprudential regulation to strengthen large banks' resilience, while including a macroprudential overlay. For example, the new framework includes an extra capital conservation buffer of 2.5 percent of risk-weighted assets above the regulatory minimum capital requirement. Banks that fall below the buffer would face limits on dividends and executive compensation. The goal of this standard is to build a buffer against unexpected losses, thus reducing the likelihood of banks falling below regulatory minimums.

The Basel Committee also proposed a liquidity coverage ratio, which is an example of a pre-crisis, structural policy directed at the funding channel (see BCBS, 2010b). This regulation would require banks and bank holding companies to have sufficient liquidity to cover a 30-day liquidity stress event. In October, the federal bank regulators released a proposed rule that would implement the liquidity coverage ratio in the United States. Internationally, some bank supervisors have established caps on net open foreign exchange positions to reduce vulnerabilities to external funding shocks.

In the United States, supervisory stress testing, especially focused on large, complex financial institutions, is an important new structural tool for promoting resilience. Supervisory stress testing has become a central component of the supervision of large bank holding companies and promotes market discipline by providing the public with information about individual banks' resilience under stress.

Under Dodd-Frank Act stress testing mandates, large bank holding companies and the Federal Reserve are required to produce annual stress tests based on three scenarios provided by the Federal Reserve — a baseline scenario, an adverse scenario, and a severely adverse scenario. The Dodd-Frank Act also requires the largest bank holding companies to produce stress tests based on their own scenarios six months after the annual stress tests.

For the Federal Reserve's Comprehensive Capital Analysis and Review (CCAR), bank holding companies must generate two additional sets of stress tests based on their own, company-developed baseline and stress scenarios. CCAR also requires institutions to alter their capital distribution plans if they are found to have deficient capital under the severely adverse scenario or weaknesses in their capital planning processes.

To address potential threats arising in nonbank financial companies, the Basel Committee and the International Association of Insurance Supervisors (IAIS) have been working to strengthen oversight of global systemically important nonbank financial institutions. The Financial Stability Board is coordinating global efforts to apply higher capital requirements to these companies. In July 2013, the IAIS released its assessment methodology and policy measures for

Figure 27. Types of Macroprudential Tools

Who	What (risks)	When and How		Examples*
Banks and Nonbanks	Credit (general or sectoral specific)	Pre-crisis	Cyclical	Banks: **Countercyclical capital buffer** (general), time-varying risk weights (sectoral), loan-to-value (LTV) or debt-to-income (DTI) requirements (sectoral), ceilings on credit growth (sectoral), variations in stress test scenarios Nonbanks: Could also have LTV, DTI, or credit growth limits
			Structural, through the cycle	Banks: **Capital conservation buffer**, require higher quality capital
		Crisis Management		Banks: **Government sales of troubled institutions**
		Post-crisis		Banks: **Countercyclical capital buffer** (general)
		Automatic stabilizer		Banks: Dynamic provisioning
	Funding	Pre-crisis	Cyclical	Banks: Reserve requirements
			Structural, through the cycle	Banks: **Liquidity coverage ratio (LCR)** (general), minimum haircuts on repo with nonbanks (sectoral), limits on net open FX positions (sectoral), short-term wholesale funding capital surcharges Nonbanks: for money market funds, **liquidity requirements** or floating net asset values
		Crisis Management		Banks: Restoring liquidity requirements Nonbanks: Central bank lending under emergency circumstances (limited under Dodd-Frank)
		Post-crisis		Banks: Relaxing liquidity requirements
		Automatic stabilizer		
	Interconnectedness/ resolvability	Pre-crisis	Structural, through the cycle	Banks & nonbanks: **Nonbank designation and heightened prudential standards for large bank and nonbank institutions, higher capital requirements for large, complex financial institutions, over-the-counter derivative clearing and margin requirements, bank stress testing**
		Crisis Management and Post-crisis		Banks and nonbanks: **Living wills, new orderly liquidation authority of Federal Deposit Insurance Corporation**
		Automatic stabilizer		

Source: OFR analysis

*Examples in boldface have been adopted by U.S. policymakers

global systemically important insurers, and the FSB endorsed the measures (see IAIS, 2013).

In the United States, the Financial Stability Oversight Council has designated three nonbank financial companies for enhanced prudential standards and Federal Reserve supervision under the Dodd-Frank Act. Separately, the Council has designated eight financial market utilities for enhanced risk-management standards appropriate for their functions of clearing and settlement transactions of cash, securities, and derivatives and netting exposures among financial companies.

Crisis Stabilization and Post-Crisis Policies. Crisis stabilization policies depend on the nature of the risk amplification channel. To prevent amplification of risks through funding shocks, the Federal Reserve has the authority as lender of last resort to lend to solvent banks and designated financial market utilities against eligible collateral. To address amplification of risks through other firms that have extensive interconnections in financial markets, the longstanding powers of the Federal Deposit Insurance Corporation (FDIC) to resolve banks have now been expanded to include authority in certain circumstances to resolve nonbank financial companies including bank holding companies. Internationally, policymakers continue to discuss issues and plan for the resolution of a cross-border firm.

Automatic Stabilizers. Automatic stabilizers are designed to mitigate financial shocks as a matter of course, rather than depend on policymakers to make judgments about cyclical risks. For example, Spain and Portugal use dynamic provisioning, which requires banks to build reserves for loan losses that would be sufficient throughout the business cycle (see Alberola, Trucharte, and Vega, 2011).[1] This policy would address the tendency of banks to neglect to set aside sufficient reserves in good times and then provision aggressively when borrowers begin having trouble repaying their loans, behavior that could have implications for financial stability if it reinforces the cost of downturns (see Bikker and Metzemakers, 2005). Dynamic provisioning would represent a change in longstanding accounting practices that allow banks to set aside reserves for a loan only when the loan is shown to be impaired. Because of its automatic, through-the-cycle component, dynamic provisioning is different from discretionary cyclical tools like the countercyclical capital buffer (see Clerc, Drumetz, and Jaudoin, 2001).

Contingent capital notes, or CoCos, also could act as automatic stabilizers. CoCos are bond-like instruments that convert into equity capital and automatically replenish the bank's capital under certain situations — for example, if the bank's regulatory equity capital ratio falls below the required limit. Some regulators are willing to treat these notes as equity capital before their conversion, because investors will bear losses in certain adverse situations. Regulators in the eurozone have embraced these instruments and, to date, eurozone banks have been the main issuers. One important concern about CoCos is that triggering conversion of debt into equity capital when a firm is already under stress might further weaken the firm.

Evaluating the Effectiveness of Macroprudential Policy Tools

Evaluators of macroprudential tools must answer three questions: Does the tool have the intended effect? What are the drawbacks? Are there any unintended consequences?

Does the Tool Have the Intended Effect?

The goals of a macroprudential policy tool need to be clear. Policymakers could have various goals in strengthening lending standards, for example, trying to prevent households from taking on more debt than they can afford or trying indirectly to limit the growth in housing credit to prevent an asset price bubble.

A macroprudential policy should target the ultimate cause of the problem rather than its symptoms. For example, if the expectation of redemption at par in money market funds makes them vulnerable to redemption runs, then the use of gates to limit redemptions when shocks occur may perversely make money funds more subject to run risk as investors attempt to be the first to exit.

An increase in experimentation with macroprudential tools across the world provides some evidence about their effectiveness. Most international policymakers who have used macroprudential tools believe they are effective and usage has been extensive in recent years, according to a recent study of 49 countries with a macroprudential policy framework (see Lim and others, 2011).

But every country's financial system is unique. A policy that works well in a country where financial activity occurs predominantly in banks may work very differently in a country where financial activity takes place in diverse markets and financial institutions. Several studies have found that higher amounts of equity capital can be costly to banks and lead to a decline in lending, although estimates vary among studies involving multiple countries (see Figure 28).

Analysts have conducted three types of empirical analysis to determine whether tools work.

First, case studies examine historical episodes in depth to understand why a tool was used, whether it worked as intended, and what the costs or unintended consequences were. For example, a recent OFR working paper described U.S. efforts to combat excesses in the credit cycle over the past 100 years, including tools that operated on the demand for credit through lending terms (margin requirements, LTV ratio caps, DTI ratio caps, maturity limits) and on the supply of credit through banks and other intermediaries (supervisory pressure, reserve requirements, interest rate ceilings). For many years, U.S. policymakers believed these tools were effective (see Elliott, Feldberg, and Lehnert, 2013). Comparisons to past episodes, of course, must be made carefully, because structural changes in institutions and markets over time could alter the effectiveness of a given policy tool and its ability to achieve a desired policy outcome. Nevertheless, this type of research is necessary to evaluate these policies.

Second, "event studies" examine the performance of a particular risk variable after a policy tool was introduced or revised. A staff report by the International Monetary Fund (IMF) contained event studies across several countries (see IMF, 2013b). For example, South Korea imposed a tax in 2011 on banks' noncore foreign currency liabilities. According to the IMF paper, this tax took effect at the same time as a substantial reduction in short-term foreign exchange liabilities. Similarly, New Zealand required in 2010 that 65 percent of banks' activities be funded by core funding, defined as local deposits and long-term wholesale funding. The authors concluded that this policy was successful because banks maintained core funding well above the required ratio after the law's implementation.

Third, analysis can estimate the direct effects of macroprudential policy more precisely by accounting for the accompanying monetary and fiscal policies, and broadening the scope of the analysis. Lim and others (2011) demonstrated that several tools, including LTV caps, DTI ratio restrictions, liquidity mismatch restrictions, and countercyclical capital requirements, could be effective across a range of institutional environments and across countries at different levels of financial

Figure 28. Estimated Impact on Credit Conditions of a 100-Basis-Point Permanent Increase in U.S. Banks' Capital Requirements

Study	Description	Change in Loan Rates (bps)	Change in Loan Volumes (%)
Macroeconomic Assessment Group (2010)[2]	Range of models using multicountry dataset.	15.5	-1.38
Elliott (2009)[3]	Loan pricing equation calibrated for U.S. banks.	4.8	n/a
Cosimano and Hakura (2011)[4]	Structural model of capital channel of monetary policy using multicountry dataset.	12.3	-0.98
Slovik and Cournede (2011)[5]	Accounting-based model applied to aggregate banking sector balance sheets. Data from United States, eurozone, and Japan.	14.4	n/a
King (2010)	Accounting-based model for representative bank, uses multicountry dataset.	15.0	n/a

Source: OFR analysis

development. An additional advantage of this type of analysis is that the authors are able to demonstrate that these tools often work even better in combination with monetary policy.

Research on macroprudential policy is still quite new. Although the current consensus is that these tools can hit their targets, the magnitude of the effect appears to depend on the country's financial system.

What Are the Drawbacks?

Some might argue that policymakers should take any actions necessary to prevent future crises, given the material decline in economic output associated with the financial crisis. But costs and other drawbacks also matter.

Cyclical policies that achieve the goal of reducing credit in a particular sector will have at least a short-term effect on borrowers and the economy. Through-the-cycle policies that promote the resilience of the financial sector may have greater permanent effects on economic output than cyclical policies or automatic stabilizers.

For example, activating a countercyclical capital buffer might require banks to raise equity capital. An analysis of that policy's impact would begin with an estimate of banks' equity cost of capital and then predict a range of possible responses by the banks, such as reducing lending and passing on their higher funding costs to borrowers. Such an analysis could reveal the potential effect on the economy, as well as the possibility of uneven impacts across different types of companies — in particular, smaller corporate borrowers tend to have fewer choices than larger borrowers.

Analysts use a range of macroeconomic models to estimate the effects of macroprudential tools on output. Analysts need to predict whether monetary authorities will adjust their tools to support the goals of the macroprudential tool or counteract the effects of the tool by easing credit overall when policymakers decide to limit credit in a particular sector.

Are There Any Unintended Consequences?

Financial activity tends to migrate to markets or institutions that face less strict regulation, a phenomenon often described as regulatory arbitrage. Countercyclical measures designed to stem a certain type of lending may simply lead to the development of new markets and products that perform a similar function outside the scope of regulation. In that way, creating a policy to address one risk may lead to a shift from banks to nonbanks or market-based credit intermediation. Similarly, without international policy coordination, new regulations in one country may lead global financial firms to move risky activity to less regulated countries.

Because of arbitrage risk, having the ability to broaden the scope or boundaries of regulation can be critical for authorities in some cases. In the U.S., supply-side tools such as reserve requirements and interest-rate ceilings have been more susceptible to arbitrage in the past because increasing the cost of lending for banks creates an opportunity for other types of companies to step in. In earlier eras, the United States had success with demand-side tools like LTV limits and margin requirements, but only when the Federal Reserve had authority to apply those tools to all or most lenders and borrowers.

Other countries have learned similar lessons in more recent macroprudential policy experiments. Multinational studies show that the effectiveness of macroprudential policies is both general and robust, although there is some evidence of unintended consequences. For example, Arregui and others (2013) found that LTV, DTI, risk weights, and reserve requirements dampen credit growth, but reserve requirements may be more subject to regulatory arbitrage as companies not affected by the requirements respond by increasing their lending.

An IMF study noted that when Croatia capped credit growth by banks, banks sold securities and cut unused credit lines to continue extending new loans. When South Korea imposed tighter LTV limits on banks in 2009, nonbank institutions expanded their lending (see IMF, 2013b).

Regulatory arbitrage can also have a cross-border dimension. For example, when Britain's Financial Services Authority set bank-specific minimum capital ratios for banks under its jurisdiction during the 1990s and early 2000s, domestic banks' lending fell (see Aiyar, Calomiris, and Wieladek, 2012). But the policy's overall effectiveness was lessened because foreign banks operating in Britain were not subject to the requirements and increased lending.

Conversely, international coordination can increase a macroprudential tool's effectiveness. When the Basel Committee agreed in 2011 to add a countercyclical capital buffer to the new global capital standard, the committee included a reciprocity principle: If U.S. regulators require U.S. banks to hold capital buffers, foreign regulators will require their regulated banks to hold similar buffers on U.S. exposures. But the liquidity coverage ratio rule included no such coordination mechanism — a U.S. decision to ease liquidity requirements in a crisis would not provide relief to a foreign bank operating here, unless that bank's home regulator were to also ease.

Policy changes can also create risks. For example, the narrower the range of assets included in banks' liquidity buffers under the liquidity coverage ratio, the more prone the banking system may be to fire sales because large institutions hold similar assets. Additionally, a mispricing of risk in capital risk weights can incentivize institutions to become over-exposed to a particular asset class. An example of mispricing risk can be seen in the case of European banks that were allowed to carry sovereign debt from a eurozone member country with a zero risk weight. This also happened with U.S. banks' ownership of preferred shares of Fannie Mae and Freddie Mac, whose prices fell to near zero in September 2008. Although equity securities are generally not permissible investments for depository institutions, regulators allowed banks to hold shares of Fannie Mae and Freddie Mac because of the perceived special status of the government-sponsored enterprises and the assumption of a government guarantee. Losses on those securities during the crisis played a role in an estimated 15 U.S. bank failures and two distressed mergers (see Rice and Rose, 2012).

Finally, policies can be complementary or they can conflict, and predicting how a new tool might interact with existing or future policies can be difficult. Some policies can be mutually reinforcing. For example, after the recent financial crisis, a number of regulatory changes were aimed at realigning the definition of bank regulatory capital more closely with market-based measures that focused on tangible common equity, in which investors had greater confidence.

Policies can also push in different directions. The liquidity coverage ratio requirement will obligate large U.S. banks and bank holding companies to build up substantial buffers of liquid securities in their available-for-sale (AFS) portfolios to reduce the likelihood of funding difficulties and asset fire sales. The new rule also requires the same companies to immediately credit unrealized AFS gains and charge AFS losses to regulatory capital. Together, the changes could increase the volatility of large banks' regulatory capital ratios. Under previous capital rules, banks only recorded gains or losses when they sold securities.

Picking the Right Tool

Monetary, microprudential, macroprudential, and other economic policies can influence financial stability. Policymakers should assign the right tool to each vulnerability, following the "assignment principle" described by Mundell (1962). In the example Mundell presented of a country with a fixed exchange rate, failure to follow this principle with respect to the use of monetary and fiscal policies to address external and internal threats to its macroeconomic stability could result in a situation worse than before the policy changes were introduced.

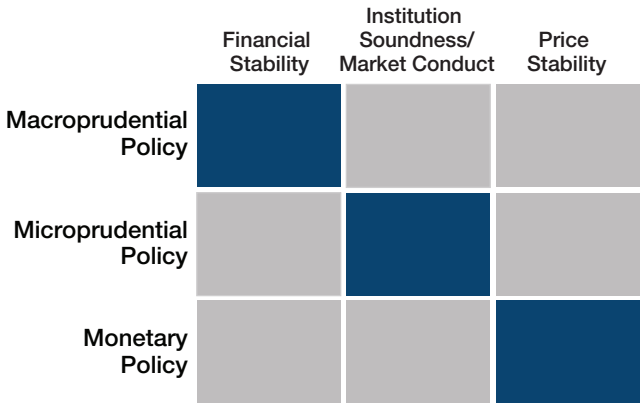
Policymakers should select policies based on the objectives that they can most influence — the ones with the biggest bang for the buck. Targeted policies with clear, direct effects on a financial stability threat (such as minimum universal haircuts for securities financing transactions) are preferable to general policies with diffuse effects (such as the impact of monetary policy or activating a countercyclical capital buffer).

Policymakers cannot achieve financial stability objectives without specific tools to address potential sources of distress — macroeconomic, market, credit, funding, and contagion risks — across various types of institutions and points in the credit cycle. Developing a complete set of macroprudential policies before a financial crisis is critical.

What About Monetary, Microprudential, and Other Financial Policies?

Once threats or vulnerabilities to financial stability have been identified, policymakers should consider whether using monetary policy, a microprudential response, or a macroprudential tool is the best approach. Monetary and microprudential policies can contribute to financial stability, but the assignment principle suggests that they are — and should

Figure 29. Macroprudential Toolkit: How Does It Relate to Others?



Source: OFR analysis

be — focused primarily on their assigned goals of price stability and safety and soundness, respectively (see Figure 29). These policies can be in sync with macroprudential policy or they can create challenges (see Stein, 2013a). At the very least, macroprudential policymakers need to take monetary and microprudential policies into account.

As a corollary, authorities generally should not rely on monetary policy alone to address potential threats to financial stability for several reasons (see IMF, 2013a, and CGFS, 2010):

- Monetary policy targets price stability and full employment and cannot be fully dedicated to addressing financial stability concerns.
- Monetary policy tools are blunt; they act on general credit and liquidity conditions and cannot necessarily address excesses in specific sectors of the financial system.
- There are questions about the effectiveness of monetary policy in responding to systemwide financial risk in an environment of stable inflation.

Monetary policy may also have unintended effects on financial stability, suggesting the need for a targeted macroprudential response.

Microprudential supervision is an important complementary tool for promoting financial stability. Over the past 10 years, U.S. bank supervisors have taken the lead in creating and strengthening microprudential tools, for example, through capital and liquidity regulations. The Federal Reserve recently issued guidance incorporating macroprudential considerations into the supervision of large bank holding companies (see Board of Governors, 2012a).

Bank supervisors have also strengthened supervisory stress testing and developed other structural tools affecting both large banks and nonbank financial institutions, such as enhanced prudential standards and resolution regimes. But because microprudential policies are aimed at making specific institutions safe and sound, they do not address the buildup of risk across the financial system. Additionally, microprudential policies may not be able to address vulnerabilities to the three types of shock described in Chapter 2: default of a major market participant, sudden loss of confidence in a particular asset or firm, or a disruption or failure in market infrastructure.

Following these principles rigidly may also be problematic. Macroprudential tools are untested and microprudential tools alone are unlikely to restrain credit booms. The setting of monetary policy may also need to take financial stability considerations into account. Indeed, Federal Reserve Governor Jeremy Stein has noted that, "while monetary policy may not be quite the right tool for the job, it has one important advantage relative to supervision and regulation — namely that it gets in all of the cracks" (see Stein, 2013a).

An OFR working paper on the history of U.S. macroprudential policy pointed out that, as macroprudential policies fell into disuse in the U.S. in the mid-1980s, supervisors continued to issue supervisory guidance on risks (subprime lending in 1999, home-equity lending and commercial property in 2005, and nontraditional mortgages in 2006). But these warnings did not have much impact on credit growth, partly because so many lenders were not regulated as banks. But, the paper noted, the period was also the first major credit expansion in recent history when supervisory guidance was not backed up by direct policy actions such as tighter monetary policy, interest-rate ceilings, or credit controls (see Elliott, Feldberg, and Lehnert, 2012).

What Gaps Exist in U.S. Macroprudential Policy?

The development of macroprudential policies in the U.S. is ongoing. International experts have argued that policymakers need to develop macroprudential tools during non-crisis periods. A broader macroprudential policy toolkit can offer higher net economic benefits

and reduce the cost of mitigating future crises. It also can improve policymakers' ability to tailor solutions to emerging risks and changing market practices. An incomplete toolkit can be ineffective and inefficient.

The U.S. macroprudential policy toolkit is growing, but it still has gaps. First, there is an unresolved debate about the relative benefits and costs of cyclical and structural tools. Certain cyclical policies and automatic stabilizers may address cyclical vulnerabilities in a more targeted way than structural policies, but they may be harder to implement and involve long-term costs. Second, there are gaps in the toolkit for post-crisis stabilization and recovery. Better monitoring tools can improve policymakers' ability to limit the frequency and severity of crises.

Important measures to address vulnerabilities in the activities of nonbank financial companies have been implemented since the crisis. The Council has designated several nonbank financial companies and financial market utilities for heightened oversight by the Federal Reserve. The SEC has revised its rules regarding money market funds, and proposals for further reform are being considered.

Supervisory stress testing of large bank holding companies in the United States has become a valuable and important supervisory tool that contributes to regulatory capital and liquidity planning at these institutions. A recent OFR working paper described current stress-testing practices as Version 2.0, representing a generational improvement over pre-crisis practices, and recommended a research agenda to better align stress testing with macroprudential goals. The paper argued that supervisory stress testing could be enhanced by increasing the number of stress scenarios or running "reverse" stress tests that seek to determine what type of shock would lead to the failure of a firm. The paper also argued that the next generation of stress tests could incorporate funding risks and potential spillover and feedback effects (see Bookstaber and others, 2013).

Another OFR working paper described how agent-based models could contribute to stress testing by modeling how a crisis would develop based on the reactions of individual market participants (see Bookstaber, 2012). Two OFR papers in 2013 also addressed the problem of designing stress test scenarios and developing reverse stress tests (see Glasserman, Kang, and Kang, 2013, and Flood and Korenko, 2013).

Supervisors have made important progress in achieving these goals. As in previous years, six bank holding companies with large trading operations will include a global market shock in their stress scenarios in 2014. And for the first time, supervisors will require eight bank holding companies with substantial trading or custodial operations to include a counterparty default scenario in their stress test results.

Tools are lacking to address vulnerabilities in SFTs, such as in the triparty repo agreement market, which can give rise to runs or fire sales. Federal Reserve Governor Jeremy Stein recently noted that, although many of these tools, such as capital and liquidity requirements, "are likely to be helpful in fortifying individual regulated institutions — in reducing the probability that, say, a given bank or broker-dealer will run into solvency or liquidity problems — they fall short as a comprehensive, marketwide approach to the fire-sales problem associated with SFTs" (see Stein, 2013b).

From an institutional perspective, broker-dealers and other nonbanks lack two funding backstops that banks enjoy: deposit insurance and access to the lender of last resort. As a result, their funding is vulnerable to runs and fire sales. Federal Reserve Bank of New York President William Dudley in February raised the question of whether, to make markets for SFTs more stable, such entities should be given access to a permanent funding facility, or even the discount window, with the quid pro quo clearly being appropriate prudential oversight (see Dudley, 2013). The Bank of England recently took a step in that direction with broader lending arrangements, or liquidity insurance, for banks, and a commitment to investigate extending the facility to nonbanks (see Bank of England, 2013).

Other tools are needed to address threats that arise outside the banking system. To address threats arising in short-term, wholesale funding markets, one option is to require higher levels of capital at institutions reliant on short-term wholesale funding. Another option would be to increase capital or liquidity requirements for assets related to such securities financing transactions.

Beyond the perimeter of prudential bank regulation, the Financial Stability Board (FSB) has proposed

haircut floors for certain SFTs to limit the extent to which banks and nonbanks can obtain leverage through these transactions. (A haircut is the percentage amount subtracted from the market value of a security to determine its value as collateral.) In August, an FSB proposal took the first step toward such a framework. The board argued that "these measures, if appropriately implemented, would help counteract pro-cyclical fluctuations in securities financing" (FSB, 2013c).[6] Federal Reserve Governor Daniel Tarullo recently noted, "Like minimum margin requirements for derivatives, numerical floors for SFT haircuts would be intended to serve as a mechanism for limiting the buildup of leverage at the security level, and could mitigate the risk of procyclical margin calls" (see Tarullo, 2013).

More analysis of how to implement such tools is needed, however. As a practical matter, the low proposed levels for such floors make it unclear how much they would deter leverage. Moreover, the scope of proposed application in the FSB proposal is limited to a subset of institutions and asset classes, so application could promote migration of activity elsewhere in the financial system — in other words, regulatory arbitrage. Such minimum haircuts likely should be universal to be effective.

We will work in 2014 to evaluate such proposals.

3.2 Emerging U.S. Macroprudential Tools

Two key policy tools have been created since the financial crisis, the countercyclical capital buffer and the liquidity coverage ratio. The Federal Reserve and the Office of the Comptroller of the Currency (OCC) announced the final U.S. rule on countercyclical capital buffers in October 2013; the FDIC issued an interim final rule in July (FDIC, 2013). As noted earlier, the Federal Reserve, FDIC, and OCC released a proposed liquidity coverage ratio rule for public comment in October 2013; comments will be taken through January 2014 (Board of Governors, 2013d).

Countercyclical Capital Buffer

The final U.S. rule implementing the Basel III accord created a countercyclical capital buffer for large banks and bank holding companies, subject to a phase-in beginning January 2016 (OCC and FRB, 2013). The new U.S. rule gives regulators the ability to require the largest banks to hold between zero and 2.5 percentage points in extra common equity tier one capital as a countercyclical capital buffer during a period of heightened concerns about credit growth. The countercyclical buffer has been designed to supplement the capital conservation buffer, which is fixed at 2.5 percentage points.

U.S. regulators have not announced the metrics they will use to decide whether to trigger activation and release of the countercyclical capital buffer. In the final rule implementing the buffer, they say they may activate it based on "a range of macroeconomic, financial, and supervisory information indicating an increase in systemic risk including, but not limited to, the ratio of credit to gross domestic product, a variety of asset prices, other factors indicative of relative credit and liquidity expansion or contraction, funding spreads, credit condition surveys, indices based on credit default swap spreads, options implied volatility, and measures of systemic risk."

The Basel Committee on Banking Supervision noted that regulators need to exercise judgment when activating the countercyclical capital buffer within their jurisdictions, but suggested using deviations of the ratio of nonfinancial private-sector credit-to-GDP from long-term average trends in determining whether or not to activate it (see BCBS, 2010a). An analysis by Drehmann, Borio, and Tsatsaronis (2011) across 36 countries showed the divergence in credit-to-GDP to be a more effective leading indicator than several other possibilities (including credit growth, GDP growth, real estate prices, measures of banking system performance, and funding costs).

Other analysts have noted weaknesses in the indicator. First, it ignores the potential for excess growth in lending to the financial sector itself, or to the public sector, including government-sponsored enterprises, municipalities, and foreign governments. Second, it misses the potential for excessive lending by U.S. banking organizations overseas, which was an important element in the debt crisis in less-developed countries during the 1970s and 1980s.

In January 2013, the Bank of England's Financial Policy Committee published 17 core indicators that it will use to assess bank and nonbank balance sheets, and

financial market conditions, in considering whether to activate its countercyclical capital buffer.

Another challenge in developing alternative metrics is that they need to be sufficiently forward-looking to allow supervisors to announce an increase in the countercyclical capital buffer requirement about one year ahead of its implementation (see BCBS, 2010a, and OCC and FRB, 2013).

The definition of country exposure also raises some concerns about effectiveness. If U.S. supervisors activate the buffer requirement, only U.S. exposures are directly affected. The rule establishes reciprocity for foreign supervisors' activation because U.S. regulators will require banks to hold a countercyclical capital buffer on exposures in that foreign jurisdiction, consistent with the buffer level set by the foreign supervisor. U.S. supervisors cannot independently use the countercyclical capital buffer as a mechanism to slow excess foreign credit growth.

U.S. banks and bank holding companies are required to determine the contribution weight assigned to a jurisdiction's countercyclical capital buffer requirement by dividing the total risk-weighted assets for the banking organization's private-sector credit exposures located in the jurisdiction by the total risk-weighted assets for all of the banking organization's private-sector credit exposures. Exposures to government-sponsored enterprise securities, sovereigns, and other public sector entities are not included in the measure of private-sector credit exposures.

Figure 30 shows how the countercyclical capital buffer would be calculated for a covered bank's exposures across multiple jurisdictions. A capital requirement of 140 basis points (1.4 percent) would be applied to all of the bank's risk-weighted assets.

Is the Countercyclical Capital Buffer an Effective Tool?

The countercyclical capital buffer may bring important benefits to financial stability by promoting capital-raising when the cost of issuing equity is relatively low. By requiring banks to maintain higher levels of capital, the buffer can make the financial sector more resilient by increasing banks' ability to absorb losses.

Still, there are a number of reasons to question the effectiveness of the buffer at curtailing lending during a credit boom. It applies only to certain banks and may be less able or unable to slow credit growth given the capacity and incentives for nonbanks not subject to the buffer to offer credit.

The benefits of the countercyclical capital buffer as a macroprudential tool may be limited to pre-crisis prevention. It is unclear whether the countercyclical capital buffer requirement will be able to act as a post-crisis tool and encourage banks to continue lending during an economic downturn. Once firms are forced to hold a capital buffer, banks may choose not to release this capital even when allowed to do so because raising capital later could be difficult and costly. This behavior could dampen any expansionary effect.

Figure 30. Example of a Large U.S. Bank's Countercyclical Capital Buffer Calculation (percent)

	Countercyclical Capital Buffer Set by National Supervisor	Risk-Weighted Asset for Private-Sector Exposures	Contributing Weight	Countercyclical Capital Buffer Requirement
Non-U.S. Jurisdiction 1	**2.0**	**250**	0.29	0.6
Non-U.S. Jurisdiction 2	**1.5**	**100**	0.12	0.2
United States	**1.0**	**500**	0.59	0.6
TOTAL		**850**	1.0	1.4

Sources: Office of the Comptroller of the Currency, Federal Reserve (2013)

The effectiveness of capital-related tools also depends on the design of regulations that weight capital according to risk. The countercyclical capital buffer may be less effective when risk weights are not correct or when opportunities exist for banks to optimize their risk-weighted assets.[7] For example, when faced with higher capital requirements, banks may over-invest in assets with relatively low regulatory risk weights, such as credit to the public sector or corporate bonds on the cusp of investment grade.

Finally, the countercyclical capital buffer is a broad tool to manage the supply of credit. If policymakers are concerned about excess credit growth to a specific sector, banks could still increase lending to that sector while reducing lending to other sectors. Although the overall supply of credit could decrease when the buffer requirement is activated, credit growth in the areas that most concern policymakers may not slow. In this regard, the Swiss National Bank's activation of a sector-specific countercyclical capital buffer requirement of 100 basis points targeted at mortgage loans financing residential real estate in Switzerland is worth further study (see SNB, 2013).

Liquidity Coverage Ratio

The proposed liquidity coverage ratio could be used as a macroprudential tool. A Basel Committee paper noted that during periods of stress, supervisors could take appropriate action to allow banks to draw down their liquidity buffers, falling below the minimum liquidity coverage ratio (see BCBS, 2013a). The paper, however, did not elaborate on possible triggers for supervisors to consider, or guidance on whether such drawdowns below the minimum liquidity coverage ratio should be sanctioned only for systemic stress events. Effective communication of a policy decision to waive the required liquidity coverage ratio for one or more large banks could be essential to market confidence.

Unlike the reciprocity provisions for the countercyclical capital buffer, the liquidity coverage ratio requirement lacks an international coordination mechanism. If U.S. supervisors decided to waive liquidity coverage ratio requirements, other jurisdictions supervising the foreign operations of U.S. banks would have no obligation to follow suit.

The liquidity coverage ratio may also have unintended consequences on financial stability. The unwinding of collateral swap transactions as cash inflows included in the ratio could allow institutions to circumvent the cap on less liquid buffer assets. In addition, banks and bank holding companies could have an incentive to undertake repo or reverse repo transactions to alter their liquidity coverage ratios. This provision could lead firms to use secured funding markets more, thereby increasing interconnectedness.

The countercyclical capital buffer and liquidity coverage ratio requirement affect only large U.S. banks and bank holding companies. The limited scope of these tools could affect risk-taking within the financial sector in three ways. First, it could encourage nonbank credit intermediation, which limits the effectiveness of these policies on financial sector risk-taking. Second, it could lead to greater risk-taking by mid-size and smaller banks, which are exempt from the requirements. Third, it could encourage banking holding companies to continue to engage in excess credit creation or liquidity risk-taking through their nonbank legal entities. Such risk-taking would pose financial stability risks, given other legal and regulatory limits on the ability of depository institutions to support nonbank affiliates in the United States.

4 Research on Financial Stability

Unlike most members of the Financial Stability Oversight Council, the Office of Financial Research has no policymaking or supervisory responsibilities. That allows the Office to focus on providing independent basic research, necessary and usable data, and policy and market analysis for the public and to support the work of the Council.

4.1 Research Agenda

Our research agenda supports our statutory mission as the Office (1) monitors and develop metrics for reporting on potential threats to financial stability, while continuing to improve our understanding of how the financial system evolves in providing basic services; (2) assesses the causes and consequences of financial instability; (3) evaluates regulatory policies and risk management practices, particularly stress tests; and (4) contributes to improvements in the scope and quality of data used for financial stability monitoring.

Although our mandate complements those of the other member organizations in the Council, our goal is not to duplicate their efforts. Rather, our goal is to fill gaps in their analytical and empirical work, because none of them individually has the responsibility to look across the entire financial system. The Office's unique perspective helps assure the comprehensive nature of work across the Council to identify and monitor threats to financial stability and to evaluate stress tests and other macroprudential policy tools.

Our research agenda has four components:

1. **Financial stability monitoring and metrics.** Financial stability metrics have proliferated in the academic and regulatory communities since the financial crisis. Some attempt to provide forward-looking indicators of financial stress. Others try to explain current financial conditions and vulnerabilities.
2. **Causes and consequences of financial instability.** The crisis highlighted the fact that neither regulators nor market participants sufficiently understood the causes and potential consequences of financial instability.
3. **Regulatory policy and risk management practices.** As part of our research function, we are required to analyze the impact of policies related to financial stability. We conduct, coordinate, and sponsor research to help improve regulation of financial entities and markets. We also conduct studies and advise on policies related to systemic risk. In addition, the Office is required to promote best practices for financial risk management and evaluate and report on stress tests and other stability-related evaluations of financial entities supervised by Council member agencies.
4. **Scope and quality of financial data.** Our research supports the Office's statutory responsibility to improve the scope and quality of financial data (see Chapter 5 and Chapter 6).

Recent Research Projects

We are improving our understanding of the financial system through original analysis and novel use of data. We are also developing and fine-tuning metrics that can provide insights on emerging threats to financial stability.

Our first working paper gave an overview of such metrics and our *2012 Annual Report* evaluated the performance of 11 metrics in four financial crises — 1929, 1987, 1998, and 2008 (see Bisias and others, 2012; OFR, 2012).[1] In December 2013, as a service to the academic and regulatory communities, we published the source code for the metrics described in that paper on the OFR's website.[2]

The Office also has several research tracks that focus on understanding how financial crises emerge and

DEVELOPING A FUNDING MAP TO HELP UNDERSTAND FINANCIAL CONNECTEDNESS

Researchers often represent the dynamics of the financial system, including its vulnerabilities, as a network, with financial entities as the nodes and funding linkages at the edges.

As a first step in developing a funding map for the broader financial system, the OFR has initially focused on a typical bank or dealer (see Figure 31). For the largest and most complex financial institutions, these activities can be conducted through a variety of legal entities, including a broker-dealer to house the prime brokerage and a bank to take deposits and enter derivative contracts. The Office began working on the map after the Financial Research Advisory Committee presented a recommendation along with a prototype funding map committee members had developed at its second meeting on Aug. 1, 2013 (see FRAC, 2013). There are a wide range of uses for the funding map, as follows:

1. Determining Data Needs. Because the map depicts detailed funding flows, it can highlight key data needs, gauge the size of flows, and — most important for spotting emerging vulnerabilities in the financial system — identify flows that are dominating or growing.

2. Assessing Financial Vulnerabilities. The funding map may be a valuable resource for understanding the routes to a financial crisis because a firm's interactions with its customers and funding sources are pathways to broader risk. For example, the path between hedge funds and a prime broker is critical to fire sales; the paths connecting the cash providers to the financing desk and the trading operations of banks or dealers are critical to understanding funding runs. A central component of the funding map is the durability of funding, that is, the degree to which funding can be relied on in the face of stress. Flow analysis, coupled with an awareness of the durability of those flows, helps show ways to reduce vulnerabilities by highlighting alternative routes, illustrating how one pathway for critical flows might substitute for another.

3. Modeling the Financial System and Its Vulnerabilities. The funding map can provide a framework for building network models that rely on the flows of securities and funding, as well as agent-based models that focus on the agents on each end. Once populated with the necessary data, the models can show the possible paths of contagion. For example, in the face of a drop in liquidity, the financing desk may reduce financing to the prime broker, leading the prime broker to pull back its funding operations. The funding map is essentially a visual representation of the financial system. Visual approaches can augment modeling and be useful as a higher-level tool for policymaking and crisis management.

4. Expanding the Funding Map. The funding map can be developed along three lines: (1) entities such as hedge funds and money market funds can be mapped; (2) entities and actions can be added, including clearing and settlement, markets, exchanges and other trading venues, insurance companies, mortgage originators, credit insurance, the central bank, and international linkages; and (3) more detail can be added. For example, detail on durability of funding, its liquidity, and credit quality could be shown.

What the Funding Map Shows

Figure 31 shows the flows of funding and securities from entities that represent the bank's primary business activities and funding sources into the bank or dealer, as well as the flows between functional units within the bank or dealer. The bank or dealer is at the center. Flows come into the bank or dealer from other banks or dealers and from clients and depositors.

This funding map shows, in detail, specific functional areas within the bank or dealer where the connections occur, internal workings of the firm, and how funding and securities move between key elements of the firm:

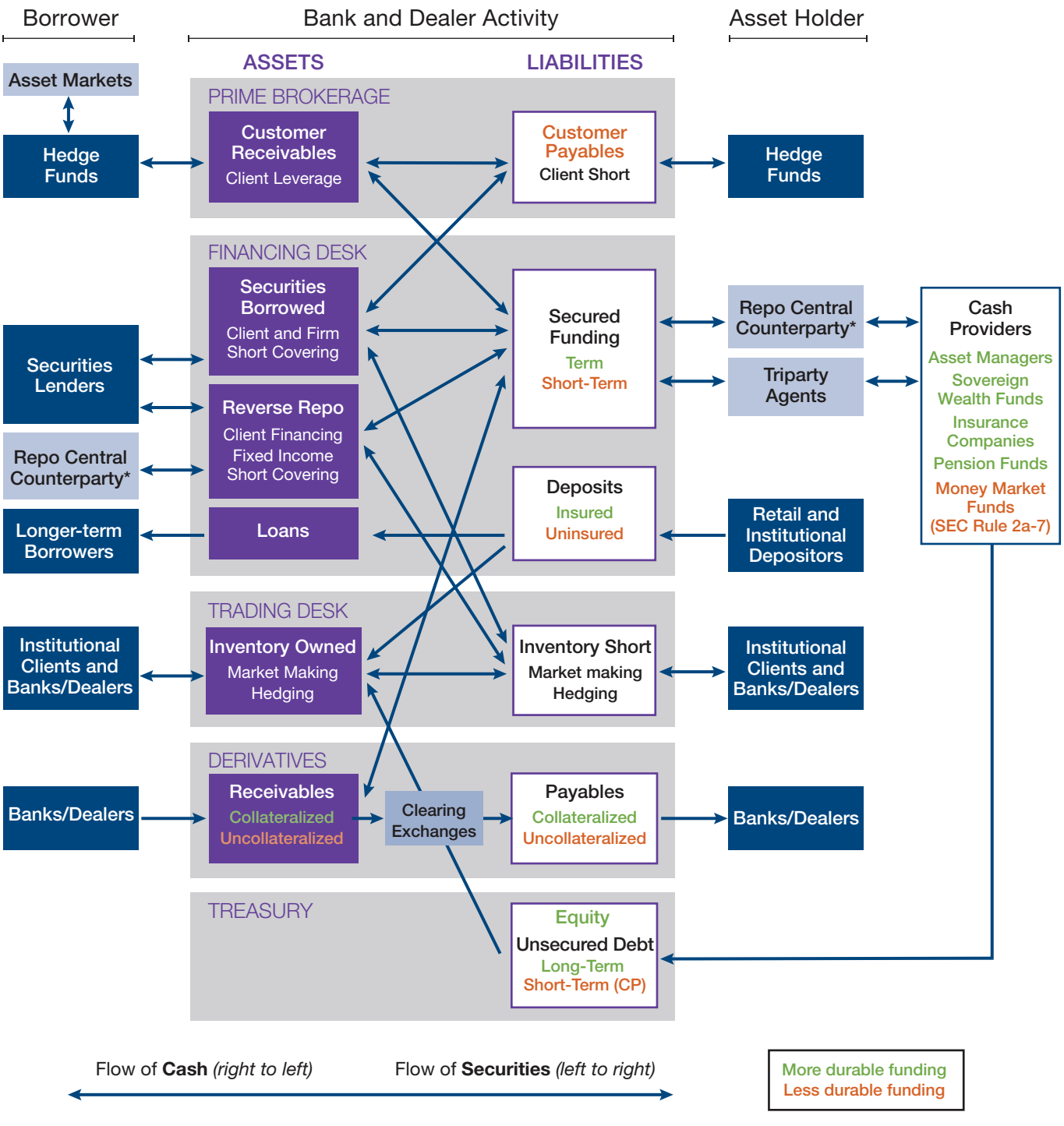
- prime brokerage - sells financial services to hedge funds, including leverage through margin loans and securities for short-selling activity;
- trading desk - supplies liquidity through its market-making activity and gives clients leverage for fixed income products;
- financing desk - borrows and lends cash with high-quality securities used as collateral (secured funding) and also takes unsecured debt, such as deposits, from retail and institutional investors;
- derivatives transactions; and
- treasury function - provides the longer-term financing of the bank.

The financing operation is key. Here, securities received in the form of prime broker receivables become collateral to obtain funding through repurchase market transactions, and securities are obtained through the reverse repurchase market.

The funding map also shows the connections of the bank or dealer to various types of financial institutions, including institutional customers such as hedge funds, cash providers such as money market funds, security lenders, and other banks or dealers.

The map properly shows the bank operating within the interbank market as one part of the broader financial landscape. The bank also is connected to entities in its role as provider of funding and securities, often the same types of entities that provide the bank with its funding and securities.

Figure 31. Funding Map



NOTE: Lighter valued boxes indicate intermediaries such as markets, exchanges, or clearing centers.

* The funding hierarchy addresses the general risks involved with different funding sources. These risks are not associated with specific counterparties, because different counterparties may have varying degrees of risk as a source of funds.

spread. The funding and liquidity map described on the preceding pages charts the flows of cash and securities through a large financial institution with banking and dealer operations and could be useful for that purpose.

To better understand the effects of contagion during financial crises, we also use new datasets and employ network analysis. Section 4.4, based in part on an OFR working paper (see Glasserman and Young, 2013), shows how interconnectedness among financial institutions can amplify the effect of negative shocks to their balance sheets. Another research track highlighted in a working paper (see Bookstaber, 2012) explores how agent-based models can investigate the behaviors of individual firms (agents) to explain outcomes in complex systems.

In the area of policy, recent working papers analyzed proposed contingent capital rules (see Chen and others, 2013) and described the historical use of macroprudential policy in the U.S. to moderate the credit cycle (see Elliott, Feldberg, and Lehnert, 2013). Two recent working papers discussed scenario design in regulatory stress testing (see Glasserman, Kang, and Kang, 2013, and Flood and Korenko, 2013). Another paper discussed how stress testing could be adapted to support financial stability monitoring and to incorporate feedback effects during crises (see Bookstaber and others, 2013).

In addition, the Office recently produced a working paper about the need for data standards for the mortgage market. Standards might encompass identifiers for mortgage products, loans, and specific properties (see McCormick and Calahan, 2013). This initiative, which emerged from a group of Council member agencies that supervise mortgage originators, relates to the Legal Entity Identifier initiative (see Chapter 6).

Agenda Ahead

We continue to evaluate proposed metrics and develop new metrics for possible inclusion in our monitoring efforts. One project, highlighted in Section 4.3 of this chapter, entails developing metrics for monitoring market liquidity in different types of financial markets. The Office is working to incorporate nonpublic data in its analytical tools, while protecting the confidentiality of those data so that the results can be shared.

Our current agent-based modeling work is exploring two prominent dynamics in financial crises: fire sales and funding runs. The first project models the interaction among leveraged hedge funds and other market participants to understand how fire sales develop and what determines their severity. The second project models the interactions among banks and market-based funding sources, such as money market funds and repurchase (repo) markets, to better understand runs and their dynamics.

An important focus of our research agenda is on the forces that promote the migration of financial activities into unregulated or lightly regulated institutions and markets involving the creation of money-like liabilities. Section 4.2 analyzes the supply and demand for short-term funding. Concerns about risks in these markets have driven the Office's early data collections and analyses (see Chapter 5). We have devoted resources to analyze and develop monitoring capabilities to keep track of developments in hedge funds and money market funds, using data that market regulators now collect. To understand vulnerabilities in short-term funding and derivatives markets, we are also analyzing and monitoring repo and credit derivatives markets.

4.2 The Supply and Demand for Short-Term Funding

Investor runs on short-term funding instruments played a critical role in the recent financial crisis. Private sources provided liquidity and credit backstops in short-term funding markets. When investors doubted the safety of those guarantees, they quickly withdrew their funding, and this stress was transmitted and amplified through the financial system. Although those markets have stabilized, they remain vulnerable to runs and fire sales. Analysis is important to ascertain the nature of such vulnerabilities.

This section describes a preliminary analysis of the supply and demand for short-term funding instruments and markets. Following tradition, we analyze the uses or demand for short-term funds — the ways that issuers use money-like liabilities to fund longer-term assets. We also analyze the sources or supply of such funds — the characteristics of the purchasers and the nature of their preference for such money market instruments. Focusing on both sources and uses highlights gaps both in the available data and in the

analysis of economic forces that drive the market for money market instruments.

Financial intermediaries often finance long-term, illiquid investments with short-term, liquid liabilities, such as commercial paper and repos. Nonbank financial companies using such short-term funding vehicles may be exposed to runs and other vulnerabilities as the activities of liquidity and maturity transformation create potential mismatches, and their funding instruments aren't protected by deposit insurance or access to liquidity from the central bank. Creditors worried about the creditworthiness of their claims may withdraw funding, potentially resulting in significant losses that can lead to fire sales and failure. The recent financial crisis highlighted these vulnerabilities.

To reduce the apparent risk and cost of credit in such liquid funding vehicles, issuers made use of private credit and liquidity guarantees — such as bank-provided, standby lines of credit for commercial paper. During the crisis, investors realized that those guarantees could be withdrawn or had doubts about the capacity of private firms to provide such guarantees. Liquidation of opaque, risky collateral by nonbank intermediaries promoted fire sales, which were intensified by runs on their funding sources, resulting in a dramatic, rapid deleveraging, and contraction in both sides of balance sheets.

Despite that shrinkage, securitization and short-term, wholesale funding vehicles remain important features of a market-based financial system. More than 60 percent of credit transactions are intermediated outside insured depository institutions. New requirements for higher capital and liquidity by traditional banks and their parent holding companies may create incentives to move activities to more lightly-regulated institutions. Accordingly, analysis of short-term funding markets remains an important aspect of financial stability monitoring.

In this preliminary analysis, we examine both the borrowers who use short-term funding and the investors who supply it. However, the data available to describe and quantify the short-term funding marketplace are not sufficiently detailed to create a complete picture of both supply and demand. We identify the nature of these gaps and suggest ways to fill them.

Market-Based Financing and Money Market Instruments

Market-based financing, or credit intermediation outside the commercial banking system, gave rise to financial stability concerns during the crisis.[3] In this analysis, we focus specifically on the demand for, and supply of, money-market instruments that were considered "cash-equivalents" before the crisis. Investors held such assets in their portfolios because of their apparent low risk and high liquidity. Nonbank financial intermediaries conducted transformation of maturity, credit, and liquidity by creating or issuing such money-like liabilities. As noted earlier, however, these entities do not have explicit access to central bank liquidity or public sector guarantees (see Pozsar and others, 2012). So when these nonbank firms came under stress, investors ran. Analyzing both the demand for, and supply of, such instruments helps in understanding the risk of runs in short-term, wholesale funding markets.

Such shadow banking activities before the crisis can be illustrated by the creation and financing of a mortgage-backed security without a government guarantee. Credit transformation occurred when mortgages were pooled and long-term, AAA-rated bonds were issued and used as collateral. Maturity transformation occurred when those long-term bonds were financed through the issuance of short-term liabilities, such as asset-backed commercial paper. Liquidity transformation occurred when the commercial paper was purchased by a money market fund promising a stable net-asset value to its investors. Liquidity transformation creates an instrument akin to a bank deposit; investors expect to be able to withdraw their funds at any time without a loss of principal.

Money market instruments are large-denomination debt instruments with low credit risk and short maturity (less than one year, and often less than one week). Demand for these instruments reflects a natural preference by many investors for liquidity, the ability to exchange their investments for cash on short notice at a particular price. Because of their short maturity and low credit risk, money market instruments are treated by many investors as though they guarantee payout at full or par value.

Investors in money market instruments include retail investors. They also include institutional cash pools

— large, short-term cash balances of nonfinancial corporations and institutional investors (see Pozsar, 2011). Institutional cash pools allow a wide variety of financial firms, nonfinancial companies, foreign official sector investors such as central banks, and institutional investors such as mutual funds and pension funds to invest their surplus cash. Money market instruments include short-term obligations of the U.S. Treasury (Treasury bills) and commercial banking short-term obligations, such as uninsured certificates of deposits (large CDs), as well as short-term liabilities of shadow banks.

From the perspective of investors in money market instruments, Treasury bills and short-term obligations of commercial banks are close substitutes for the short-term liabilities of shadow banking. However, there is a crucial difference: Treasury bills are backed by the full faith and credit of the U.S. government, and even uninsured large CDs of commercial banks are backstopped by access to the Federal Reserve's discount window. In contrast, shadow banking liabilities, which typically offer higher yields, are usually backed only by private — not public — guarantees. In some cases, these private guarantees may be provided by commercial banks, but even in such cases, nonbank liabilities are more distant from public sector backstops.

Run Risk

Investors in money market instruments run when shocks trigger fears of default and prices of these instruments decline sharply, undermining the belief that the instruments can be redeemed at par. To avoid the adverse effects on the real economy from historical bank runs and subsequent failures of banks, governments have long chosen to provide banks with access to the lender of last resort and deposit insurance, while subjecting them to prudential regulation to reduce the moral hazard associated with this access.

Absent such backstops, run risk is present in any short-term liability that finances a (even slightly) longer term asset. But different types of short-term instruments — commercial paper, repos, money fund shares — have different degrees of run risk. For example:

- If even a small money market fund breaks the buck, it can trigger a run on similar funds, which occurred with the Reserve Primary Fund on September 16, 2008.
- Runs can also occur in repo markets (see Gorton and Metrick, 2012). Run risk is more prevalent in the triparty than in the bilateral repo market (see Begalle and others, 2013). A key driver of contagion early in the financial crisis was the unwillingness of money market investors to finance mortgage-related securities in the repo market.
- In contrast, the short-term debt issued by Fannie Mae and Freddie Mac, the two largest housing-related government-sponsored enterprises (GSEs), was less subject to run risk partly because of a widespread belief that these entities had an implicit government guarantee.
- Some run risk still exists in depository institutions for liabilities that aren't federally insured. For example, there was a "silent run" by uninsured deposits and other wholesale creditors on Wachovia Bank in September 2008. After the failure of Washington Mutual, Wachovia lost $5.7 billion of uninsured deposits and $1.1 billion of commercial paper and repos in a single day, according to government officials (see FCIC, 2011). Concern about the possibility of further runs led the Federal Deposit Insurance Corporation (FDIC) to extend temporary unlimited insurance coverage to all noninterest bearing transaction accounts at insured depository institutions and temporarily guarantee senior unsecured debt newly issued by insured depository institutions and bank holding companies. The same concern prompted Congress to increase the FDIC's insurance limit from $100,000 to $250,000.

Understanding such differences in run risk — based on properties of the instrument (such as collateral), properties of the issuer, and the risk preferences of investors — may lead to better mitigants to runs.

Sources and Uses of Short-Term Funds

We use an accounting framework to help identify the sources and uses of short-term funds. A key source of funds in the money market (from the buyers of the debt or investors) are institutional cash pools. The primary uses of funds (issuers of debt or the borrowers) are the U.S. Treasury, commercial banks, nonbank financial companies, and highly rated nonfinancial companies.

We track the sources and uses of short-term funds to understand developments in short-term funding in general and shadow banking specifically. A key

objective is to evaluate how different investors may respond to changes in relative prices of these instruments. We eventually would like to test the hypothesis that investors who provide cash in short-term funding markets vary in their sensitivity to prices and other factors. The research summarized here begins this effort by identifying and tracking the components over time.

The Demand for Short-Term Investments (Sources of Funds)

The sources of short-term funds are investors (nonfinancial and financial firms, households, and institutional investors) that want to hold money market instruments. Investors hold these instruments for three reasons:

1. to help achieve their preferred trade-off between portfolio risk and return;
2. as a liquidity buffer that reduces the costs of financial transactions; and
3. for regulatory or tax purposes.

The Federal Reserve's Flow of Funds accounts, which map the flow of money within sectors of the economy, reveal information about borrowers and lenders in short-term funding markets and the forms of the lending. We aggregated Flow of Funds data related to investors and lenders into broad sector categories. To gauge their relative sizes and growth over time, we reported their total short-term investments for the end of the second quarter of 2007 and the end of the second quarter of 2013. Data limitations prevented us from drawing a complete picture of sources of short-term funds (see Chapter 5).

Total institutional cash pools stood at $7 trillion at the end of the second quarter of 2013, according to our measurements, essentially unchanged from $6.9 trillion at the end of the second quarter of 2007. In sharp contrast, bank deposits held by households soared by 35 percent to $7.3 trillion at the end of the second quarter of 2013 from $5.4 trillion at the end of the second quarter of 2007.

The following is a breakdown by investor type:

- **Nonbank financial intermediaries**, including securities lenders, held $1.2 trillion in short-term investments in the second quarter of 2013, down substantially from $1.9 trillion in 2007. Intermediaries hold short-term instruments to satisfy their liquidity buffer requirements. Return considerations are secondary. Two important changes have affected this sector's liquidity needs. First, the liquidity coverage ratio requirement introduced under Basel III (see Chapter 3) has prompted broker-dealers to increase their liquidity buffers, even prior to implementation. Second, securities lending activity has declined substantially since 2007, reducing the short-term investments held by securities lenders.
- **Equity and bond mutual funds** held $0.6 trillion in short-term instruments in the second quarter of 2013, or 5 percent of total assets, up from $0.3 trillion in 2007. Note that these are short-term holdings of funds with primarily long-term assets such as stocks. Short-term holdings provide a liquidity buffer to accommodate redemptions and new investments. Here, too, return considerations are secondary.
- **Foreign central banks** held $1.3 trillion in the second quarter of 2013, up from $1 trillion in 2007. These holdings are calculated using data from the Bank for International Settlements and the Flow of Funds (see McCauley and Rigaudy, 2011).
- **U.S. nonfinancial corporations** held $1.6 trillion in the second quarter of 2013, up from $1.3 trillion in 2007. Many multinational firms hold cash in foreign subsidiaries to defer or avoid taxes associated with paying the funds to shareholders. The investments also serve as a liquidity buffer for future business investments.
- **Other institutional investors**, such as state and local governments and pension funds, held $1.3 trillion in short-term instruments in the second quarter of 2013, up slightly from $1.2 trillion in 2007. These investments are motivated by cash needs of these investors, as well as their portfolio preferences.
- **Households** held $1 trillion in prime funds in 2013, down slightly from $1.1 trillion in 2007. We treat household prime money market fund holdings as institutional cash pools because investment allocations are made by fund managers, just as they are with other institutional cash pools. This is a portion of the $8.3 trillion that households held in money market investments (up substantially from $6.5 trillion in 2007), mostly in bank deposits.

The Supply of Short-Term Investments (Uses of Funds)

The short-term funds supplied by households and institutions are used to make long-term investments. These investments are made either directly by the issuers of the short-term debt — primarily Treasury bills issued by the U.S. Treasury — or indirectly, through financial intermediaries that issue the short-term debt.

Figure 32 shows the uses of short-term funds in the second quarters of 2007 and 2013. For 2007:

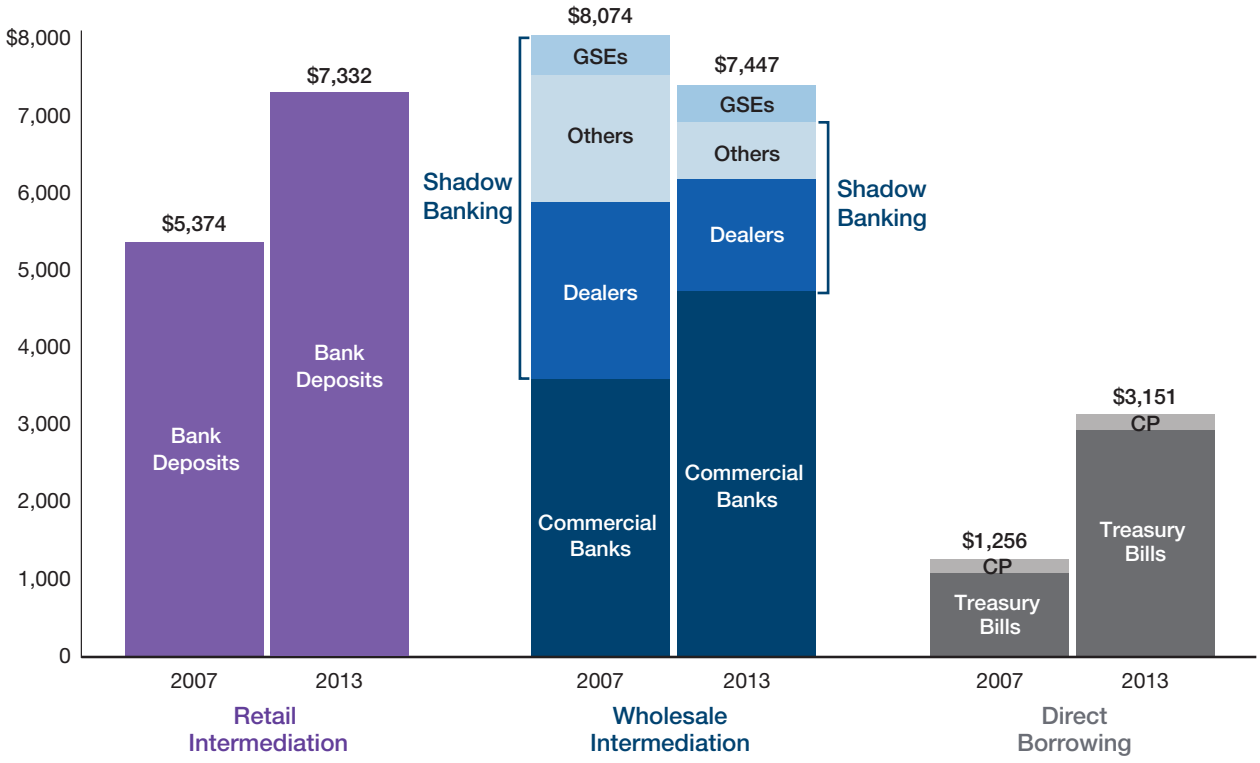
- The first column represents more than $5 trillion of retail commercial bank deposits held by households.
- The second column shows the $8 trillion stock of wholesale money market instruments issued by financial intermediaries.
- The third column shows direct issuance of short-term debt by nonfinancial entities. This includes $1 trillion of U.S. Treasury bills, as well as commercial paper issued by nonfinancial corporations.

Wholesale money market instruments are created largely by commercial banks and the shadow banking system. The second column shows that in 2007, commercial banks issued approximately 45 percent of this short-term debt in the form of institutional checking accounts, institutional time deposits, repos, and commercial paper. By our definition, shadow banking accounted for the remaining $4.4 trillion of the $8.1 trillion.[4]

Repos issued by broker-dealers, including those that are parts of bank holding companies, accounted for about half of shadow banking activity. Asset-backed commercial paper and discount notes issued by Fannie Mae and Freddie Mac are major components of the remainder.

This $4.4 trillion represents a measure of the core of the shadow banking system in 2007. From a financial stability perspective, this is a critical metric because it represents runnable funds (although run risk in shadow banking varies by component). And for investors in money market instruments, it also contains the primary alternative to insured commercial bank deposits and Treasury bills.

Figure 32. Short-term Funding by Source in the Second Quarters of 2007 and 2013 ($ billions)



Sources: Federal Reserve, U.S. Treasury, Haver Analytics, Securities Industry and Financial Markets Association, OFR analysis

Figure 32 also shows a snapshot of a much different market for short-term funding in the second quarter of 2013, more than five years after the crisis began. Four major changes are apparent since 2007:

1. Short-term liabilities of commercial banks became a much larger share of total short-term debt. The increase in total bank short-term liabilities likely reflects several factors, including the need to fund an exceptionally large expansion in bank reserves (bank assets) because of expansionary monetary policy. In addition, retail and institutional checking deposits increased by more than $1.5 trillion, influenced in part by the increased deposit insurance provided by the FDIC during the crisis.
2. Wholesale intermediated short-term debt excluding commercial bank debt dropped $2 trillion, from $4.4 trillion to $2.4 trillion.
3. GSE short-term debt is not only smaller by $350 billion, but also has less run risk since Fannie Mae and Freddie Mac entered conservatorship in September 2008.
4. The quantity of Treasury bills in private hands increased by $2 trillion. The Treasury increased issuance of bills to support large deficits during and after the crisis. In addition, the Federal Reserve has reduced its holdings of Treasury bills by more than $250 billion since mid-2007.

The Evolution of Short-Term Funding

As shadow banking activity contracted sharply during the crisis, investors fled from unsecured money market instruments to the safety of Treasury bills, short-term debt of the housing GSEs, and insured bank deposits. As financial and economic conditions continue gradually to improve, the allure of safe Treasury bills and bank deposits may fade, and improving creditworthiness may lead to a rebound in shadow banking.

A key point of our analysis is that the magnitude of the rebound will depend on both supply and demand: the ability to issue money-market instruments on economically-attractive terms, and the appetite of investors (mainly the institutional cash pools) for these instruments.

One significant limitation of this analysis is that it does not look closely at what determines the size of institutional cash pools. We have taken the first step of measuring these pools and their evolution over time. The next step is to analyze the factors that drive the size of cash pools and different types of investors in such pools to learn how sensitive they are to relative risk and return.

We plan to investigate these questions to form a more complete picture of supply and demand for short-term debt and a better understanding of how and why shadow banking activity varies over time. By monitoring sources and uses of short-term funds, we can establish a better early warning system for shadow banking activity and associated run risk.

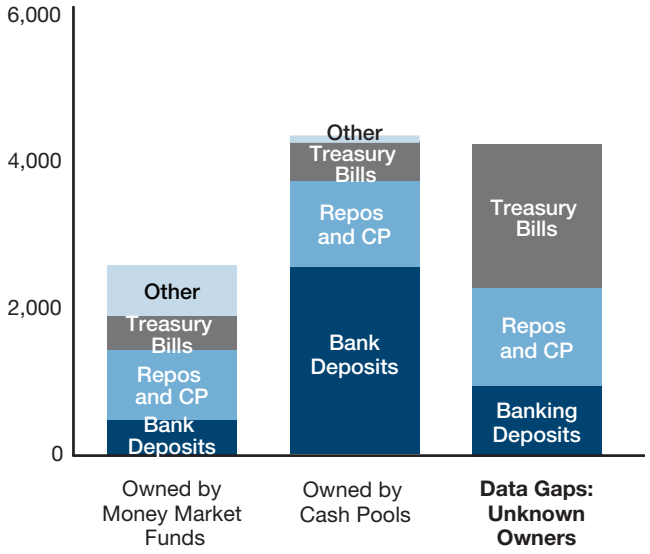
An Important Caveat: Data Gaps

The sources of short-term funds should equal the uses of short-term funds. And to clear markets, yields will adjust so that supply equals demand. However, according to the calculations in this chapter, the sum of the uses of short-term funding substantially exceeds the sum of the sources of short-term funding. Excluding household retail deposits, uses add up to just under $11 trillion, while sources equal only $7 trillion.

This mismatch stems from the methodology of the Flow of Funds accounts. This is not a construction flaw in these accounts, and the money is not missing. The problem is that reported data are insufficiently detailed to determine who holds the debt. The level of detail about debt issuance exceeds the detail about asset holdings.

Detail is lacking across two dimensions. First, for some types of entities, short-term financial assets are not broken out separately from long-term financial assets in the Federal Reserve's data collection. Second, certain types of funds, notably hedge funds and separate accounts (see Chapter 5), are lumped together with households. The difference between reported sources and uses is created by the inability to allocate the ownership of some money market instruments among banks, hedge funds, and separate accounts. About $4 trillion in issuance cannot be matched with holders of the debt.

Figure 33. Short-Term Funding Data Gaps ($ billions)



Sources: Federal Reserve, U.S. Treasury, Investment Company Institute, Haver Analytics, Securities Industry and Financial Markets Association, OFR analysis

Although we do not know who owns this $4 trillion, we can determine the types of debt instruments that make up the data gap. For each type of debt instrument in the uses of short-term funds reported in Figure 32, we subtract the amount for which ownership is known. The remainder is the data gap for that instrument (see Figure 33).

The Flow of Funds report has detailed information on asset holdings of money market funds. The first column in Figure 33 shows the breakdown. Missing are the asset holdings of funds similar to money market funds but not regulated under the SEC's rule 2a-7, which sets requirements on money market funds, including for liquidity and disclosure. The Flow of Funds does not collect that information. Institutional cash pool investments in these funds are lumped together with direct holdings of short-term assets.

The second column in Figure 33 breaks down the measured direct holdings of money market instruments by the uses of short-term funds. For most types of institutions, Flow of Funds data do not break down Treasury holdings into Treasury bills and longer-term securities. Our calculations assume that all Treasury securities held by nonfinancial corporations are Treasury bills, which is consistent with the idea that corporate treasurers prefer to hold their cash in short-term investments. In practice, some large firms also invest their cash in longer-term instruments. This adds a layer of noise to the calculations we perform with Flow of Funds data. We also assume that institutional holdings of large time deposits and bank CDs equal banks' issuance of these instruments, an assumption that introduces additional noise.

The third column of Figure 33 represents the $4 trillion data gap in Flow of Funds. It displays the short-term instruments without a home that can be identified with the data. The largest component is Treasury bills. A substantial amount of the bills are likely held by commercial banks. We know banks hold approximately $600 billion in Treasury bills, notes, and bonds. The bulk of the remaining short-term instruments are probably held by cash pools of hedge funds and separate accounts. Data from the Securities and Exchange Commission's Form PF, which the Office is currently analyzing, ultimately may help in quantifying hedge fund holdings.

4.3 Measuring Liquidity in the Financial System

Liquidity represents the ability of market participants to execute transactions and meet their obligations in a timely fashion and with minimal transaction costs. Historically, sudden shifts in liquidity have characterized financial crises. This section describes our research to identify changes in liquidity patterns across a wide range of markets using price-impact measures, which assess the ability of a market to absorb large buy-and-sell orders without significantly affecting the price quoted for subsequent trades. This research contributes to the Office's financial stability monitoring program.

Liquidity represents the ability of market participants to buy and sell assets for cash and to deliver cash to meet their obligations. Because the obligations of most financial contracts are stated in terms of cash, this has important implications for the functioning of the financial system. The alternative typically is a costly legal default. Without liquidity, markets cannot carry out their basic function of price discovery by determining fair-market prices for financial assets.

The recent financial crisis demonstrated the costs of a widespread breakdown in liquidity. Short-term funding markets — particularly the repo market and asset-backed commercial paper — experienced runs by nervous investors. Markets for certain assets with uncertain valuations experienced fire sales, exacerbated by margin calls on leveraged investors.

Runs and fire sales reflect shocks to funding liquidity and market liquidity. Funding liquidity describes the ability of core participants in the financial markets to borrow on reasonable terms. For banks that have large broker-dealer subsidiaries, much of that borrowing is in the repo market and other wholesale funding markets. Market liquidity describes the ability of market participants to buy and sell securities and other financial assets over a relatively short time without having a significant price impact.

This section focuses on a price-impact measure that combines daily price, trading volume, and volatility data to measure market liquidity, based on the work of Kyle and Obizhaeva (2011a, 2011b). Our analysis makes two contributions to that research.

First, it covers a broad range of data from 33 financial markets, including equities, volatility index futures, oil futures, and corporate bonds. Second, it applies a statistical method to analyze how markets shift from one state of liquidity to another. The analysis shows a surprising consistency across all of these markets.

Three liquidity regimes — low, intermediate, and high liquidity — were adequate to describe each market from 2004 to 2012. Our analysis also showed significant co-movement across markets. For example, the low liquidity regime described all markets in 2008 during the financial crisis.

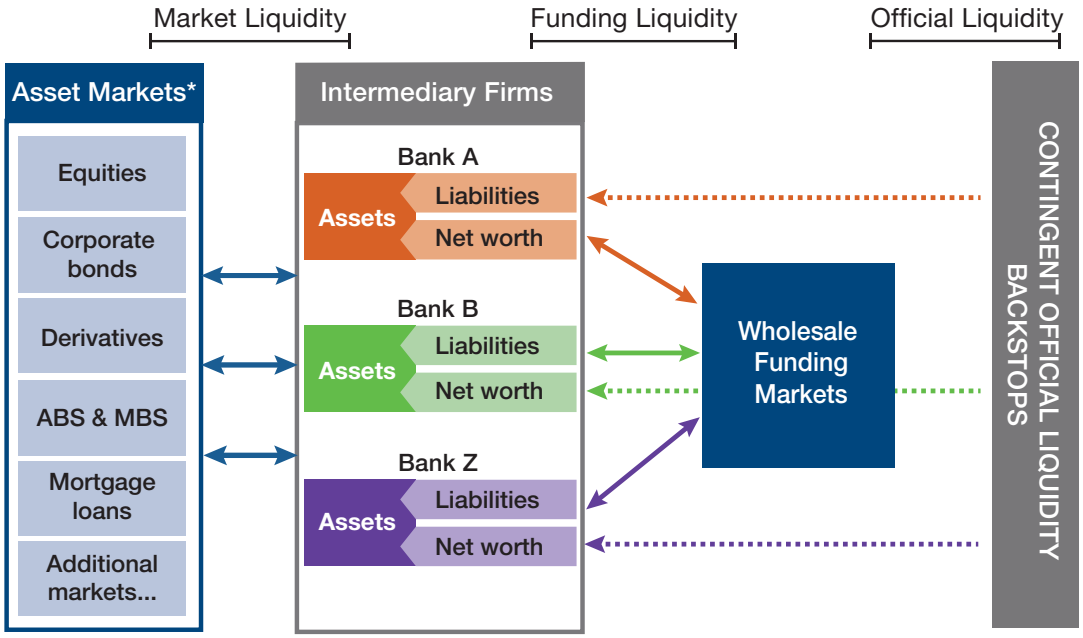
Why Liquidity Matters

Liquidity matters because it facilitates exchanges that would otherwise be more expensive or even infeasible. Firms should be able to borrow easily if they are funding genuine opportunities for investment or trading. But when funding liquidity is limited, financial decisions may be based on arbitrary limits on participants' ability to borrow rather than expectations of economic gains, losses, or risks. These borrowing constraints can arise if the immediate need for funding exceeds the supply of funds available.

Demand can shift suddenly in response to new uncertainties. As a result, episodes of illiquidity can emerge abruptly, often with sharp price adjustments. For example, in August 2007, a broad range of funding markets experienced a run as lenders suddenly questioned borrower creditworthiness and the quality of collateral. The episode was triggered when an absence of trading activity prevented BNP Paribas, a large France-based bank, from marking to market several of its investment funds backed by subprime mortgages.

A key element in liquidity is the market structure, including the number, type, and size of market participants, as well as institutional rules for transactions. In a robust and transparent market, multiple market participants are available and willing to buy and sell, and institutional arrangements are fair, reliable, and well understood. Shortcomings in market structure can damage liquidity. For example, uncertainty about the solvency of particular firms may scare away potential investors or counterparties, even when that uncertainty is not grounded in fact.

Figure 34. Liquidity Transformation via Financial Intermediation



* This is an arbitrary sampling of markets.

Source: OFR analysis
* This is an arbitrary sampling of markets

Funding liquidity and market liquidity are closely connected. Figure 34 uses bank balance sheets to show how funding shocks can lead a bank or other financial intermediary to sell assets, potentially affecting market liquidity (see Brunnermeier and Pedersen, 2009). Central banks can buffer sudden shifts in aggregate liquidity by providing liquidity in their role as lenders of last resort, as they did after Lehman Brothers failed in 2008.

Measuring Liquidity

Price Impact: Combining Prices and Quantities

No single measure of liquidity exists. To assess funding liquidity, market participants typically look at price measures, such as the spread between the three-month U.S. Treasury rate and the three-month London interbank offered rate (Libor); quantity measures such as the aggregate money supply and banking sector liabilities; and institution-level information about the ability of banks to cover expected cash outflows (see Domanski, Fender, and McGuire, 2011). Kyle and Obizhaeva have developed a theory of price impact based on the pace of trading activity, and an empirical implementation that depends only on reported daily prices, returns, and trading volumes. Unlike earlier price-impact measures, such as Kyle (1985), the Kyle-Obizhaeva measure can be calculated at daily frequencies and applies to a wide range of markets.

Market liquidity is typically measured by the discount required to buy or sell a given security in a relatively short time. A number of metrics exist for market liquidity, such as bid-ask spreads (the difference between quoted prices on offers to buy versus offers to sell) and trading volumes, but these tools are typically restricted to a single market (see Goyenko, Holden, and Trzcinka, 2009).

Access to data is a key consideration. Because timely data related to prices are widely available, simple measures based solely on price information have been useful in recent years. For example, the Treasury-Eurodollar (TED) and Libor-overnight index swap spreads capture deviations in the interbank markets for borrowing that is free of credit risk. However, prices can change for a number of reasons. Information on quantities can help distinguish liquidity demand factors from supply factors.

Our price-impact measure of liquidity builds on the Kyle-Obizhaeva research to view liquidity as the impact on subsequent prices of a standard, large transaction

in a given market. The approach uses historical returns, the current price, and daily volume to calculate liquidity.

Price impact refers to the change in market prices caused by a one-directional flow of orders (buy or sell) of a given size. It is always a challenge for an investor or dealer to sell a large block of stock, especially during stressful conditions when crowded trades can generate fire-sale price drops. A key to price-impact analysis of Kyle and Obizhaeva is an "invariance hypothesis" — that there are certain broad behavioral patterns that are repeated across all markets, but with different intensity. The measure carefully adjusts the observed data related to price changes to account for differences in trading volume and volatility.

Understanding and identifying these liquidity events is an important contribution to monitoring financial stability. By design, price-impact measures reveal the nonlinearity of market depth in the face of transaction pressure. Kyle and Obizhaeva proposed a technique that scales the calculations according to the intensity of trading activity, so the price-impact measures are unchanged by institutional arrangements (rules for trading) or by the pace of the trading activity. This approach supports a systemwide analysis by using the same method to calculate price impacts across a range of markets.

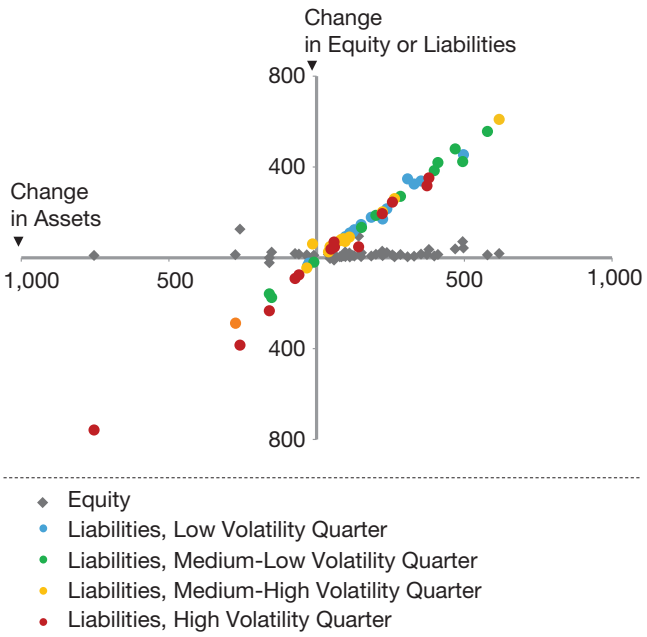
Analysis of Price-Impact Measures

This analysis adds to the Kyle-Obizhaeva price-impact measure by calculating the measure on a daily basis across 33 markets, covering thousands of individual securities in four distinct asset classes.

The Office's analysis has a greater scope than earlier studies. By casting a wide net across diverse instruments, this approach has a better chance of detecting emerging anomalies in liquidity, identifying key liquidity indicators, and discerning important patterns among the markets being monitored.

Our analysis also adds to the Kyle-Obizhaeva measure by using a statistical method known as the "hidden Markov chain" to determine whether different markets follow similar patterns as they switch from one state of liquidity to another. The analysis showed a surprising consistency across all of these markets.

Figure 35. Change in Total Leverage and Volatility for Selected Banks for Q2 2000-Q1 2013 ($ billions)



Note: Population includes Bank of America, Bank of New York Mellon, Bear Stearns, Citigroup, Goldman Sachs, JPMorgan Chase, Lehman Brothers, Merrill Lynch, Morgan Stanley, U.S. Bancorp, and Wells Fargo.

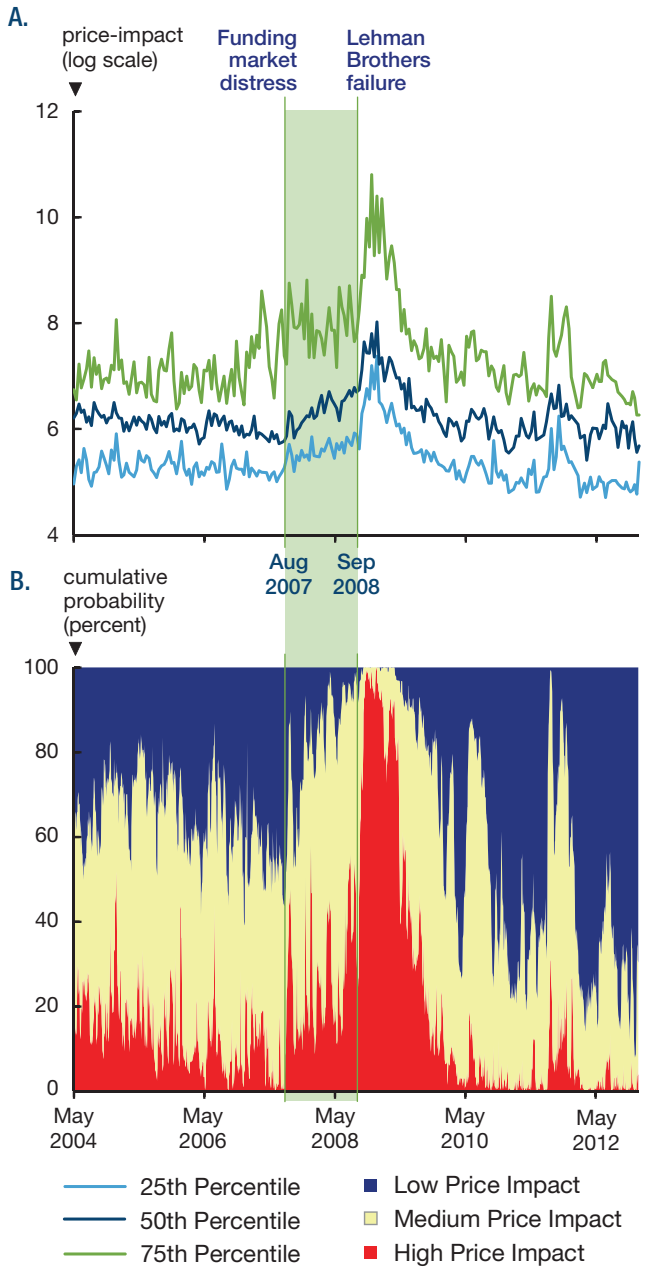
Sources: Bloomberg L.P., OFR analysis

We used the hidden Markov chain method because it enables the estimation of latent or unobserved processes that govern how the price impact behaves under changing market conditions. These methods allow for the identification of the number of liquidity states and the probability that the markets are in any particular state at a given time.

Latency means that liquidity problems are often not observable until the availability of liquidity is actually tested. Latency is a well-known challenge in measuring liquidity to capture the prices of recent trades, or the current best bid and offer, to gauge how deep or resilient the markets may be. A number of trading mechanisms restrict information availability with closed limit-order books, anonymous brokerage, and special trading venues for large block trades. To hedge against these and other liquidity surprises, financial firms frequently arrange for contingent liquidity in the form of lines of credit or derivative contracts.

The Markov analysis also addresses nonlinearity — the fact that not all changes in transaction size have

Figure 36. Daily Price-Impact Range and Probabilities of Liquidity States (Part A and B)



Sources: Center for Research in Security Prices, Bloomberg L.P., Mergent, Inc., Wharton Research Data Services, Financial Industry Regulatory Authority, OFR analysis

a proportionate impact on prices — by identifying the number of liquidity states necessary to describe the relationship. The more complex the relationship between transaction size and price impact, the more liquidity states.

Several studies have shown that large new buy or sell orders can move prices significantly before additional liquidity providers arrive to dampen the effect (see Kyle and Obizhaeva, 2011a and 2011b). Nonlinearity hampers the ability to extrapolate from measurement of often observed, small-scale impacts to the rarer, large impacts of greatest concern.

At the systemic level, where interactions among participants can produce self-amplifying feedback loops, the stakes for nonlinearity are even higher. Because banks and other financial intermediaries provide the service of maturity transformation, they are especially vulnerable to liquidity surprises, such as runs (see Tirole, 2011).

Figure 35 shows that vulnerability fluctuates as banks leverage and deleverage their balance sheets through the business cycle (see Adrian, Colla, and Shin, 2012). Increases in aggregate leverage correspond to increases in measures of global liquidity, because bank deposits and other liabilities are key components of liquid assets for other participants in the system. In the recent cycle, bank leverage also correlated with market volatility. In Figure 35, periods of low volatility — shown in green and yellow markers — tend to match increases in bank leverage. Episodes of high volatility — shown in orange and red — correspond to decreases in leverage. Unfortunately, the leverage-liquidity spiral works in reverse as well, leading to debt overhangs as the system contracts, with increases in institutional risk aversion and liquidity hoarding.

Results

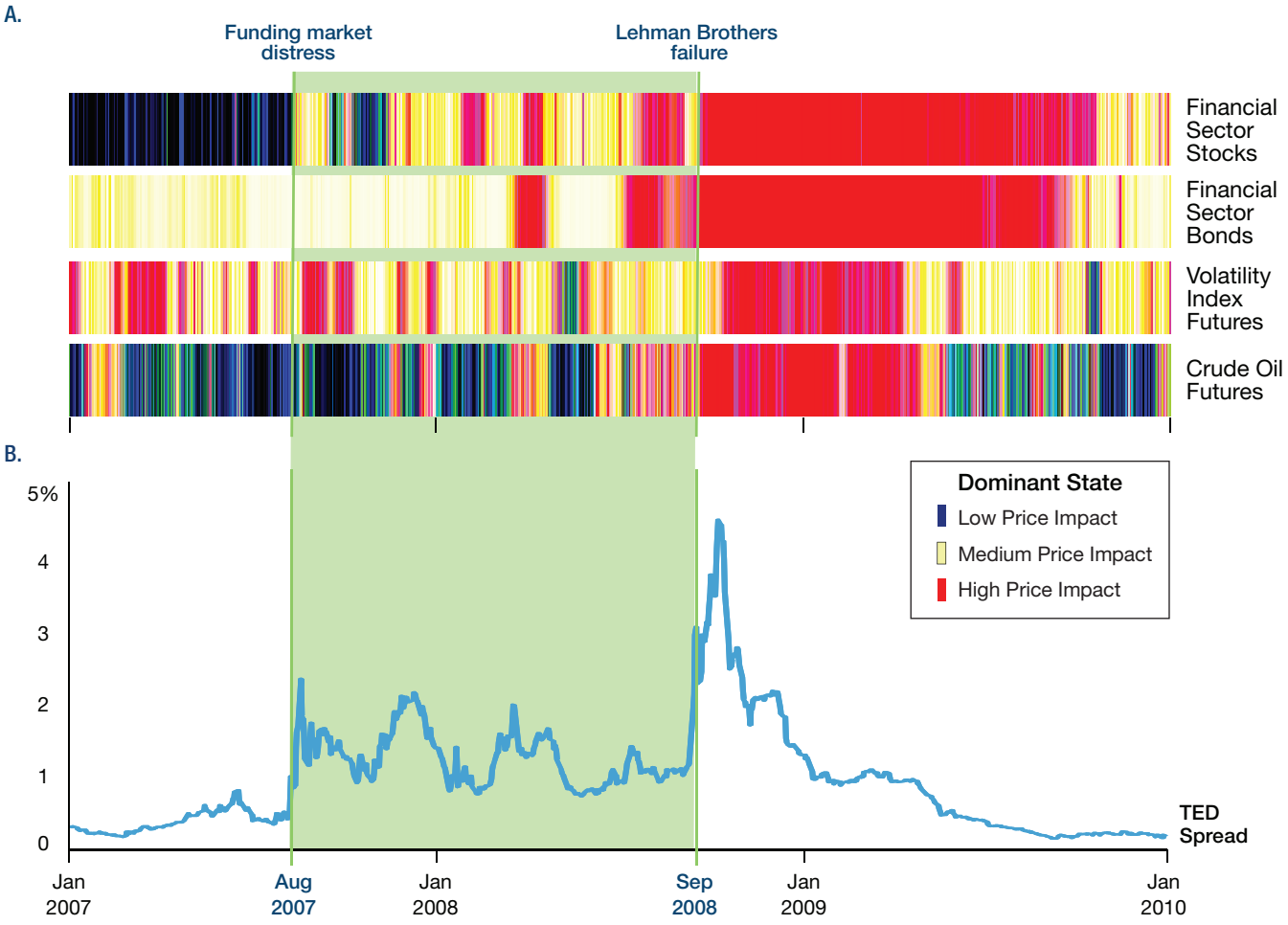
Although our research is in early stages, it already shows promising results. The initial dataset comprises:

- all U.S. equities from the Center for Research in Security Prices
- all U.S. corporate bonds from TRACE (the Trading Reporting and Compliance Engine database), which began in 2002
- light sweet crude oil (West Texas Intermediate) futures from the Chicago Mercantile Exchange; and
- market volatility index (VIX®) futures from the Chicago Board Options Exchange, which began in 2004

The analysis starts with 2004, when all series are available. We grouped the equities and corporate bonds data into nine industry-based market indexes, using one-digit Standard Industrial Classification (SIC) codes.[5]

VIX® futures data are available for nine maturities, and crude oil futures data are available for six, with near-dated contracts more active than long-maturity futures. The combined data cover 33 markets over nearly 10

Figure 37. Daily Observations of Price-Impact Probabilities and the TED Spread (Part A and B)



Note: TED Spread is the price difference between three-month futures contracts for U.S. Treasuries and three-month contracts for Eurodollars.

Sources: Center for Research in Security Prices, Bloomberg L.P., Mergent, Inc., Wharton Research Data Services, Financial Industry Regulatory Authority, OFR analysis

years, including the recent financial crisis. For each market, daily price and volume information were used to calculate daily price-impact measures.

Part A of Figure 36 summarizes the behavior of the daily price impact measures over time. It shows the daily median value of the price impact measure across all 33 series, which typically represents a different market each day, along with the daily cross-sectional distribution between the 25th and 75th percentiles. For comparison with more familiar liquidity measures, Figure 37 shows the TED spread.

As predicted, the price impact measures responded together with the TED spread to the large illiquidity events of the crisis, such as the August 2007 funding market distress, and the 2008 demise of Bear Stearns and Lehman Brothers. But the price impact measures offer two advantages over the TED spread. First, we were able to measure price impact individually across a wide range of markets. When aggregate illiquidity spiked, this collection of metrics helped in identifying the contributing subsectors of the financial system. Second, the framework provided daily liquidity data to support a systematic investigation of reliable patterns in illiquidity across markets. Because these data can be measured in a regular and consistent way, they can be used with well-understood statistical tools.

A preliminary Markov chain analysis indicated that a simple set of three latent liquidity states is adequate to capture the key behavior of each series, including non-linear responses. This insight held across all 33 markets. For each series, the calibration produced an estimate of the probability that the underlying system was in each of these three unobserved states for each day.

Figure 36, Part B, presents the cross-sectional averages across the 33 series of these three probabilities, which must add up to one. Red indicates the likelihood of high price impact, blue indicates low price impact, and yellow indicates the intermediate state. Although market liquidity displayed diversity for these 33 series, there were periods of common behavior. For example, the funding market distress in August 2007 corresponded to a sharp but short-lived spike in the probability of the low-liquidity (high price-impact) state. Similarly, the liquidity crisis after the failure of Lehman Brothers is plainly visible as the steep and more persistent spike in September 2008, preceded by a series of pronounced foreshocks over the course of the year.

Figure 37, Part A, shows a small set of ribbons of daily data related to the liquidity regimes for 4 of the 33 markets, using color to indicate relative levels. It shows the combined probabilities of the three estimated states over time, with blue indicating a high probability of the high-liquidity state, red for low liquidity, and yellow for the intermediate state. The TED spread is included for comparison to a more traditional measure.

A monitoring framework for measuring liquidity on comparable terms across a broad range of markets appears to be feasible. Measurement at relatively high-frequency — daily — is possible.

Figure 37 also shows the following:

- Markets display diversity in their liquidity responses. Equity markets responded strongly and immediately to the run on repo funding market distress, but all markets did not share this reaction. A single aggregate measure like the TED spread cannot capture this cross-sectional variation.
- Liquidity has largely recovered for this sample of market sectors since the financial crisis.
- Liquidity in financial stocks remained depressed throughout late 2007 and 2008, consistent with increased uncertainty about the sector.
- Liquidity was distressed for an extended period following the Lehman failure.
- Illiquidity foreshocks were detectable in financial stocks before the Lehman Brothers failure. This pattern, if reliable, may ultimately help in making liquidity forecasts.

These preliminary results are also notable for what they leave out. For example, the focus here was on price-impact measures, but other common metrics of market liquidity, such as implied bid-ask spreads, can be calculated at daily frequencies. In particular, this analysis focused on market liquidity — the markets for financial firms' assets, shown in Figure 37— as opposed to the wholesale funding markets that play a central role in global liquidity. This omission reflects a data gap. For example, information on daily trading volumes in the wholesale funding markets can be inaccessible. In cases such as bilateral and triparty repo markets, the Office is working with the Federal Reserve Bank of New York to obtain data. In other cases, such as the foreign exchange swap market, no one has assembled the data in one place. If such data were readily available, we could extend our analysis to include markets that provide funding liquidity.

Summary and Future Research

Liquidity is an elusive, yet essential component of the modern financial system. It is elusive because, conceptually, it is hard to define. Empirically, it is hard to measure and predict, especially in times of crisis. Liquidity is essential to convert claims into cash, and almost all claims in the financial markets must be settled in cash. A breakdown in liquidity leads to a breakdown of the financial system.

Our research used daily market data from a wide range of financial markets to create a collection of 33 daily price-impact measures. We modeled each of these daily price-impact measures using a hidden Markov chain model that identifies sudden changes in price impact.

Although we modeled the price impact in each market independently, there was surprising consistency among all these markets. Low liquidity occurred across all markets in 2008 during the financial crisis. Our analysis found interesting differences in markets before and after the crisis, offering potential bellwether markets that can predict the spread of stress in market liquidity and financial crisis.

This framework for tracking liquidity states can be extended in several ways. In the future, we can consider additional metrics for market liquidity, such as bid-ask spreads or summaries of the order book, perhaps combining them with the price-impact measure to create a variable measure of liquidity.

Our future research will broaden the cross section of financial instruments or look at the markets at a more detailed level by disaggregating the equities data to examine liquidity for individual stocks. We can also extend the modeling framework so the changes in the latent or unobserved liquidity regimes are at times driven by common factors, which would give a model-based summary of what causes systemwide constriction in liquidity.

4.4 Contagion in Financial Networks

An important objective of our research is to understand how the structure of the financial system affects its vulnerability to contagion, the spread of severe shocks across institutions and markets. Network analysis provides a framework for studying the effects of interconnections and their role in contagion during financial crises. This section reviews financial stability questions addressed through network analysis and describes insights from a recent OFR working paper.

Network research allows the quantification of contagion and loss amplification generated by interconnections without detailed knowledge of network structure, which is seldom available in practice. Instead, this approach relies on institution-specific information: size, leverage, and the Office's new index of financial connectivity. The work highlights the importance of interconnectedness in the transmission of shocks to the financial system.

Introduction to Network Models

Assessing the interconnectedness of the financial system is essential for understanding how a negative shock to the balance sheet of one financial institution can spread to others, potentially leading to a cascade of write-downs and defaults. A negative shock to asset prices more generally can be amplified through interconnections. Recent examples include the effects of the Lehman Brothers bankruptcy, losses across the system that could have resulted from the failure of insurer American International Group, Inc., and the threat to some European banks from potential sovereign defaults by Greece, Italy, and Portugal.

Rapidly growing research literature shows how contagion can occur and how the financial network can amplify or dampen such cascades. A network model contains a set of institutions, or the network nodes, and their payment obligations, which define the links in the network. For example, a network could be a set of banks, broker-dealers, hedge funds, and nonfinancial actors that have outstanding loans to one another. Networks of payment obligations help financial institutions redistribute risks and provide services to nonfinancial sectors of the economy. However, an adverse shock to one institution may prevent it from fulfilling its obligations to other institutions, and when this occurs, the default spreads through the network to other institutions.

The broad agenda of financial network analysis is to address the following questions: How do financial networks form, and how do the formation processes affect financial stability? What is the vulnerability of an existing network to contagion and which institutions and markets contribute most to this vulnerability? What are the best measures of contagion and loss amplification? Through what mechanisms beyond direct payment obligations can shocks spread through a network? What types of network configurations enhance financial stability?

These questions are listed roughly in order of increasing difficulty, and more progress has been made on the first few questions. The literature is too extensive to permit a comprehensive review here, so this discussion will simply mention a few key references. Eisenberg and Noe (2001) provide a theoretical framework for evaluating default cascades. Furfine (2003) and Upper and Worms (2004) apply network analysis to data from specific interbank networks. Gai and Kapadia (2010) and Haldane and May (2011) explore complex large-scale networks through computer simulations. More references are discussed in Allen and Babus (2009).

Much of this literature assumes detailed knowledge of the interconnections that make up a financial network. But in practice, complete information about obligations between financial institutions is unavailable. A recent OFR working paper offers a framework for quantifying the potential impact of financial networks on default contagion and loss amplification using only information about individual institutions (see Glasserman and Young, 2013).

In the working paper, each institution's size, leverage, and reliance on other financial institutions for funding were combined to measure the systemic importance

of an institution and its connectedness to the rest of the financial system. This research also highlights how mechanisms beyond simple payment shortfalls or bankruptcy costs can increase vulnerability to shocks. Our research identifies credit quality deterioration and loss of confidence as important mechanisms in understanding how financial networks magnify shocks. Alternatives to network measures of connectivity often draw on correlations in market prices (see Acharya and others, 2010, Adrian and Brunnermeier, 2011, and Huang, Zhou, and Zhu, 2011).

Financial Connectivity and Implications for Contagion

This section gives an example of financial connectivity and its implications. The example is first used to introduce network terminology and the Office's contagion index and measure of financial connectivity. The same example is then used to show how networks can amplify losses and how the extent of loss amplification can be gauged through our measure of financial connectivity.

A network model consists of a set of nodes, or financial institutions, and a set of payment obligations linking them. The nodes can represent banks, broker-dealers, hedge funds, pension funds, financial arms of nonfinancial corporations, and others. Payment obligations can arise from financial instruments, including loans, repurchase agreements, swaps, and derivatives.

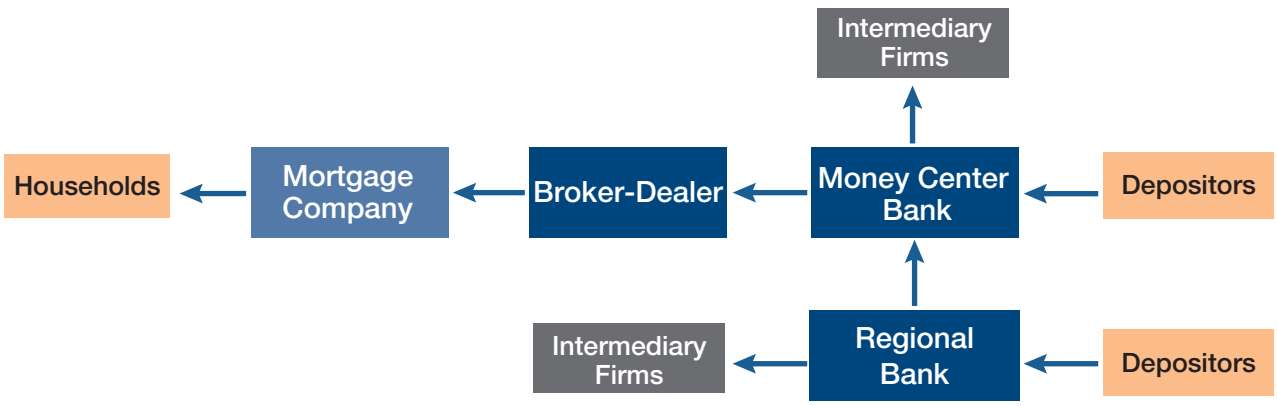
Figure 38 illustrates how such arrangements can create chains of obligations between institutions. In this example, household customers deposit funds in a Money Center Bank and a Regional Bank. The Regional Bank earns interest on loans to nonfinancial firms and other banks. The Money Center Bank lends to firms and to a Broker-Dealer, which funds a Mortgage Company that gives mortgages to households and bundles the loans into mortgage-backed securities. The mortgage securities are used as collateral for the loans by the Broker-Dealer, and they are reused as collateral against loans by the bank. Of course, there are many other possible links and other types of institutions not included in this example, such as money market funds, hedge funds, pension funds, and insurance companies.

Traditionally, a network model focuses on the amounts a given institution owes to others at the end of the relevant accounting period, rather than on the initial loan amounts. That means in a network model the arrows in Figure 38 would be reversed, and the dollar amounts owed at the end of the accounting period would be indicated beside the arrows.

Figure 38 shows a hypothetical example based on the funding chains in Figure 38. Four financial firms are the nodes in this financial network, and depositors, households, and nonfinancial companies make up a generalized external sector. The dollar figures are chosen to keep the example simple.

Each node or financial institution in the network has a set of balance sheet information that can combine to measure the node's significance as a source of contagion. A node's net worth equals its assets minus its liabilities, or the difference between the numbers on the incoming edges and the numbers on the outgoing edges at that node. The outside assets of a node are the total amount owed to that node by households,

Figure 38. Funding Chains



nonfinancial firms, governments, and other nonfinancial depositors. A node's outside leverage is the ratio of its outside assets to its net worth. The financial connectivity of a node is the proportion of its liabilities held by other financial institutions.

The Office has developed a contagion index to measure the systemic importance of a node or financial institution:

Financial Connectivity x Net Worth x (Outside Leverage – 1)
= Contagion Index

In this formula, the larger a node's outside leverage, the more vulnerable it is to a default due to a shortfall in payments from its outside assets. If all outside assets were to default, the node would default as well, creating a shortfall in its payments to its creditors equal to:

Outside Assets – Net Worth
= Net Worth x (Outside Leverage – 1)

The shortfall amount transmitted to others in the financial system is calculated by multiplying this expression by the node's financial connectivity parameter, which yields the contagion index. The contagion index is designed to measure the extent to which shocks that originate outside the financial system — for example, a drop in real estate prices — get amplified through the financial system.

Figure 39 shows these ideas. A Mortgage Company has assets of $100 in mortgage payments and liabilities of $98 in the form of short-term loans from Broker-Dealer. That gives the Mortgage Company a net worth of $2 and outside leverage of 50:1. Suppose that 5 percent of the Mortgage Company's mortgages default. Then the Mortgage Company defaults because it can pay only $95 of the $98 it owes to the Broker-Dealer. Next, the Broker-Dealer defaults because it owes $96 to the Money Center Bank. The cascade ends there because the Money Center Bank can absorb the shortfall without defaulting. The total write-down in asset values is as follows:

$5	(shortfall in payments to the Mortgage Company)
$3	(shortfall in payments to the Broker-Dealer)
$1	(shortfall in payments to the Money Center Bank)
$9	(systemwide loss in value)

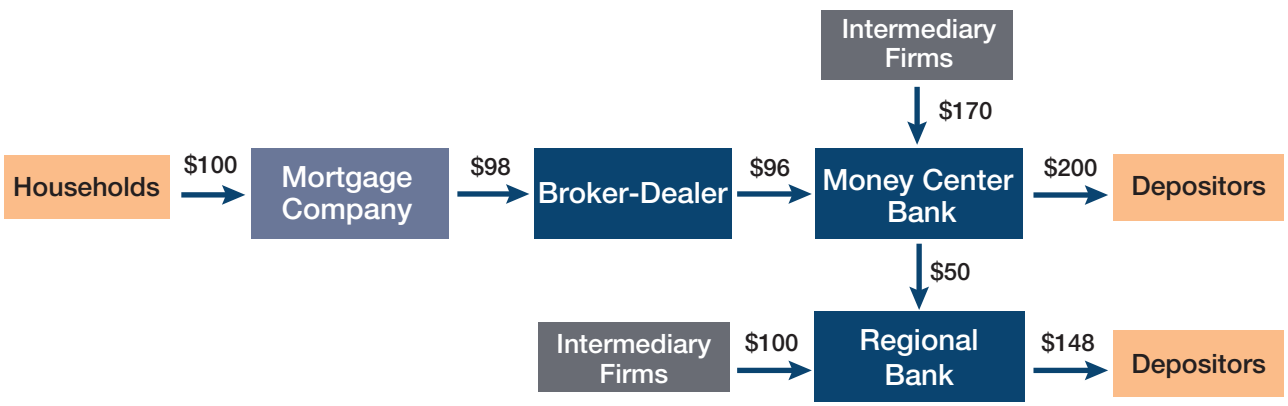
Suppose instead that 50 percent of the Mortgage Company's mortgages default, as shown in Figure 40. This figure shows the actual payments made after the defaults, in contrast to the promised payments shown in Figure 39. As a result of the mortgage defaults, the Mortgage Company defaults, causing a write-down of its obligation to the Broker-Dealer from $98 to $50. This causes the Broker-Dealer to default on its obligations to the Money Center Bank, which defaults in its obligations to the Regional Bank, which defaults in its obligations to depositors. The total write-down in asset values is:

$50	(shortfall payments to Mortgage Company)
$48	(shortfall payments to Broker-Dealer)
$46	(shortfall in payments to the Money Center Bank)
$24	(shortfall in the Money Center Bank's payments to depositors)
$6	(shortfall in the Money Center Bank's payments to the Regional Bank)
$4	(shortfall in the Regional Bank's payments to depositors)
$178	(system-wide loss in value)

This example shows that even a modest write-down in the assets of one node can trigger a cascade of defaults throughout the network and the total loss in value can be substantially greater than the amount of the initial default.

In this example, the Mortgage Company node is particularly sensitive for several reasons. First, it is highly

Figure 39. Example of a Financial Network with Specific Obligations



leveraged at 50:1 which makes it more vulnerable to default. Second, it is highly connected to the rest of the financial system with a financial connectivity value of 1, which means a decline in payments to the Mortgage Company has a large impact on other financial companies.

Contrast this with the Money Center Bank node. It has more assets and greater net worth but is less highly leveraged than the Mortgage Company. Another crucial difference is that the Money Center Bank has relatively few obligations within the financial sector, so a decline in its asset value will have limited effect on other financial companies. The contagion indexes of the Money Center Bank and the Mortgage Company are as follows:

	Money Center Bank	Mortgage Company
Financial Connectivity	0.2	1
Net Worth	$16	$2
Outside Leverage	10.625	50
OFR Contagion Index	30.8	98

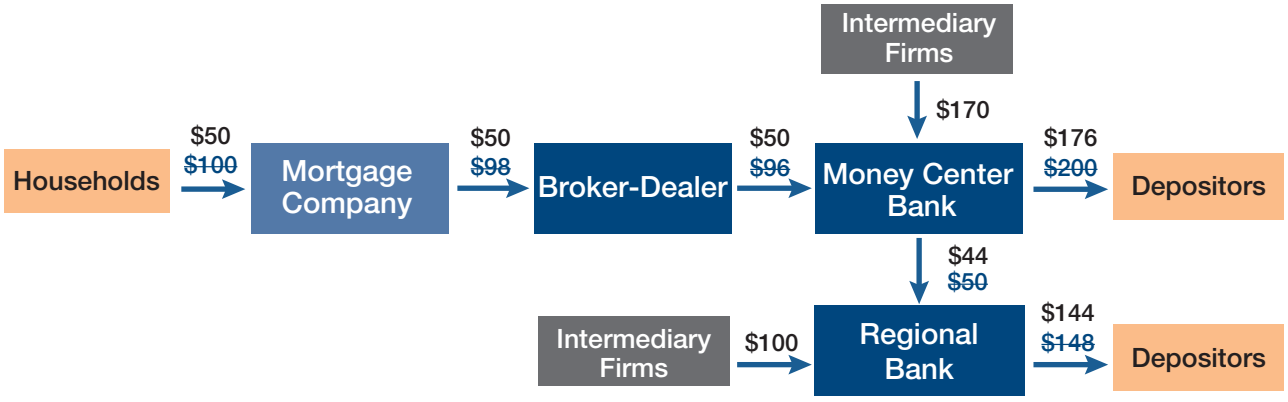
In this example, the Mortgage Company can potentially channel more than three times the losses into the financial system than the Money Center Bank. The degree to which these losses would actually topple other nodes depends on the size and leverage of the downstream nodes to which the Mortgage Company or the Money Center Bank has obligations. However, the analysis highlights how a large degree of interconnections amplify losses by channeling them back into the financial system.

Figure 39 assumes complete knowledge of the financial network for purposes of the example. However, the contagion index for each financial institution or node can be computed without a complete picture of the network, using limited information available from each node. This feature distinguishes our approach from other researchers' network analysis of financial systems.

Loss Amplification and Node Depth

Financial network losses can be amplified through cycles of obligations among financial institutions. For example, if the Mortgage Company places some of its cash in the Regional Bank, then the Regional Bank owes the Mortgage Company, and there is a cycle of obligations shown in Figure 41. (Other amounts in the figure are adjusted to keep the total assets and liabilities at each node equal to their values in Figure 39). If the Mortgage Company's mortgages lose most of their value and are written down to $14, then all nodes in the system default, including the Regional Bank. This means that the Regional Bank cannot repay the Mortgage Company in full, so the Mortgage Company's total assets must be written down further. This shortfall courses through the system, causing deeper write-downs and a further loss of value at all the financial institutions or nodes. As shown by Eisenberg and Noe (2001), a unique set of payments clears the system, with the shortfall at each node allocated proportionately among the node's obligations. The clearing payments are shown in Figure 41. This figure shows the actual payments made following the default of the Households; Figure 41 shows the promised payments.

Figure 40. Impact on Network if Half of the Mortgage Company's Mortgages Default



There is a useful method for estimating how much a financial institution contributes to the amplification of losses within the financial system, whether or not there are cycles of obligations (see Glasserman and Young, 2013). Using the example in Figure 42, we can compute the proportion of each financial institution's obligations to every other node and to the external sector. The result is shown in Figure 43. We would choose a node and place one dollar there. Suppose that, in each period, the dollar is passed to another node with the estimated probabilities shown in Figure 43. These probabilities are simply the proportions of payment obligations due from one node to another.

For example, if a dollar starts at the Money Center Bank, it flows to the external sector with a probability of 80 percent and to the Regional Bank with a probability of 20 percent. From the Regional Bank, it flows to the external sector with a probability of 75 percent and to the Mortgage Company with a probability of 25 percent.

The depth of a financial institution node is the expected number of periods needed for a dollar to exit the financial system starting from that node. A node will be deep if it has a large proportion of its obligations to the financial system and if its obligations are to financial institutions that also have many obligations

Figure 41. Financial Network with a Cycle of Payment Obligations

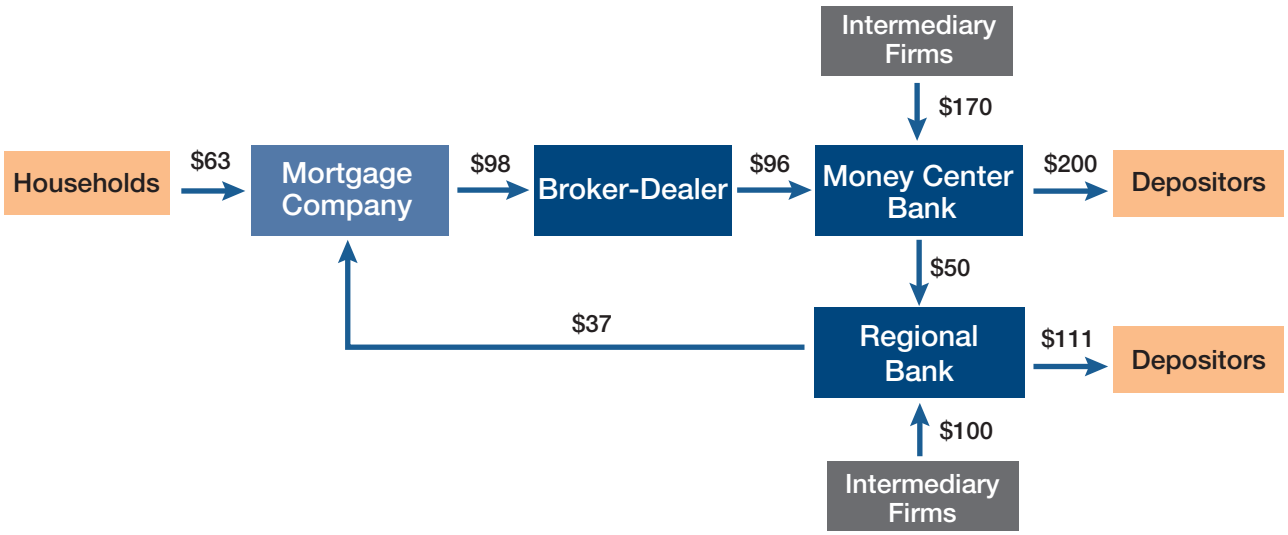


Figure 42. Impact When Households Pay Only $14, Instead of $63 Owed

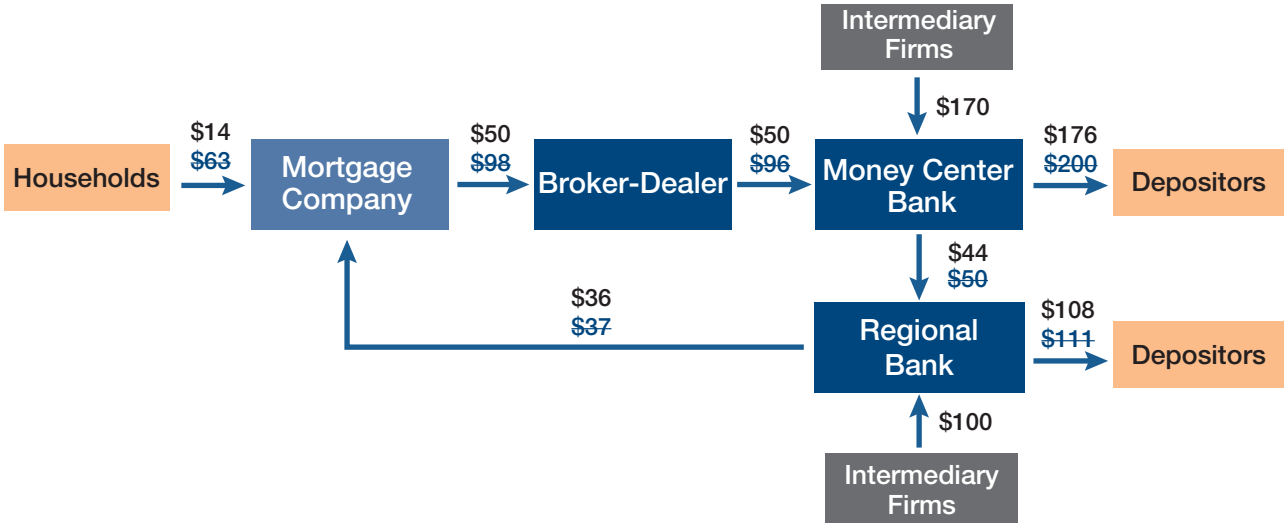
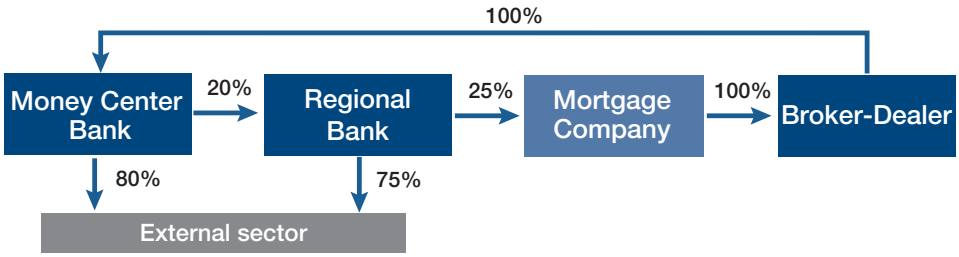


Figure 43. Transition Probabilities Among Network Participants



to the financial system. In a financial crisis, when all nodes default, the node depth gauges the extent to which initial losses at a given node are amplified as they course through the system. In the example of Figure 40, the node depths are as follows:

Mortgage Company	3.37
Broker-Dealer	2.37
Regional Bank	1.84
Money Center Bank	1.37

This example shows that the Mortgage Company is a critical node. It is the most vulnerable to default because it is highly leveraged, and the large size of its outside asset base means the magnitude of losses is likely to be large when default occurs. Also, the Mortgage Company's initial losses are highly amplified because the node is deeply interconnected within the financial system.

This example of a network model leaves out several factors that may contribute to contagion. One is bankruptcy costs. When an institution fails, the amount available to pay its creditors is reduced by legal and administrative costs, and delays would add additional cost if payments were not made promptly. These costs have a knock-on effect by increasing the probability that a given default will trigger further defaults and by magnifying the total systemic losses that result from the default.

Fire sales are a second factor that can increase systemic losses. When one institution gets into trouble, it may have to liquidate assets, which may depress prices and impair the balance sheets of other institutions holding the same assets. The results are more selling, a downward spiral in asset values, and a greater risk that defaults will cascade through the network. (This dynamic is incorporated into a network model in Cifuentes, Ferrucci, and Shin 2005).

A third factor is the spread of mark-to-market losses through the financial network because of credit quality deterioration or loss of confidence. When a financial institution's credit quality is impaired, its liabilities decline in value, transmitting a loss to the holders of those liabilities. Some of those holders may include the providers of backstops and hedging and insurance strategies to the issuers of liabilities. This channel spreads losses through the financial network, even if no financial institution fails initially.

Measuring Financial Connectivity

A financial network's structure affects the probability of contagion and the size of the losses generated by contagion. In practice, details of a network's structure will not be known precisely and are constantly in flux. However, an assessment of the overall vulnerability of the financial system is still possible by examining its interconnectedness, or the degree to which financial institutions have obligations to each other as compared to their obligations to the nonfinancial sector.

Because of the numerous types of transactions financial institutions have with each other, no single measure corresponds exactly to the measure of financial connectivity in the network model above. Nevertheless, several indicators of financial connectivity give insight into trends in network vulnerabilities, particularly when compared across time or across institutions.

Figure 44 offers one approach to estimating trends in the connectivity of the U.S. financial system at an aggregate level. The chart is based on Federal Reserve data related to the composition of assets and liabilities of the 50 largest U.S. bank holding companies, as measured by their asset base in March 2013 (see FRS, 2013). The lower curve shows the ratio of noncore liabilities to total liabilities. Noncore liabilities are calculated following the definition in the Federal

Reserve's Y-9 peer reports and consist of large time deposits, federal funds purchased, brokered deposits, repurchase agreements, and foreign bank deposits. To the extent that the majority of these liabilities are to other financial institutions, we can view this ratio as a conservative estimate of the average financial connectivity of the large bank holding companies taken as a group.

The top curve adds off-balance-sheet liabilities and noncore liabilities as a percentage of total liabilities. The off-balance-sheet items are the gross negative fair values of credit derivatives and derivatives on interest rates, foreign exchange, equities, and commodities. Assuming that most of these liabilities are to other financial institutions, this curve estimates an upper bound on the average financial connectivity of the large bank holding companies.

Taken together, the overall picture that emerges is of increasing financial connectivity in the lead-up to the crisis, followed by a decline. Over the entire period, however, the off-balance-sheet derivative liabilities have increased as a percentage of total liabilities, as is reflected in the increased gap between the higher and lower curves. This gap represents the percentage of total liabilities in derivatives. As seen in the figure, it has grown from slightly over 10 percent of total liabilities in 2002 to more than 20 percent in the first quarter of 2013.

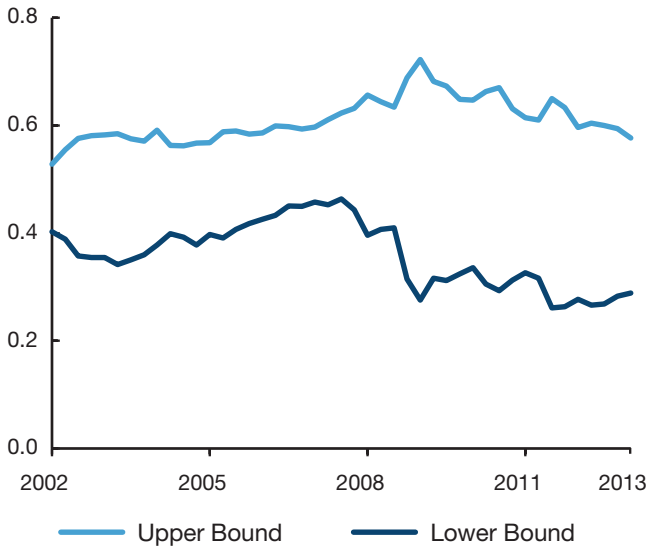
The pattern of increasing connectivity leading up to the crisis underscores the importance of monitoring connectivity as a potential source of vulnerability. Although the trends are clear, the lack of precision in these estimates points to a data gap in financial stability monitoring. Financial regulators do not have, even at an aggregate level, comprehensive measures of what fraction of liabilities of financial institutions are obligations to other financial institutions. The post-2008 declines in the indicators presented here may well reverse with time, and new channels of connectivity are likely to emerge as the financial system continues to evolve.

Next Step: Financial Connectivity Index

The Office is developing a new index of financial connectivity which, together with size and leverage, measures a financial institution's potential contribution to financial contagion without detailed knowledge of network structure. Our research also introduces node depth to quantify loss amplification in a network, shows how financial connectivity determines node depth, and highlights the importance of mechanisms such as bankruptcy costs and credit quality deterioration in spreading losses throughout financial networks.

The financial connectivity index, which measures the how much a financial institution relies on other financial institutions for funding, is a promising tool for monitoring financial stability. The calculation of this index from available data is still at an early stage, in part because of the diversity in institutions in the financial system and because of the diversity of transactions with each other. We plan to continue to develop our theoretical understanding of financial networks and the practical application of network analysis for financial stability monitoring.

Figure 44. Trends in Financial Connectivity of 50 Largest U.S. Bank Holding Companies (ratio)



Note: Top 50 U.S. bank holding companies by assets as of March 2013. Upper bound calculated as (Noncore Funding + Off-Balance-Sheet Derivative Liabilities)/(Total Liabilities + Off-Balance-Sheet Derivative Liabilities). Lower bound calculated as (Noncore Funding)/(Total Liabilities + Off-Balance-Sheet Derivative Liabilities).

Sources: FR Y-9C data from Federal Reserve System (2013).

5 Addressing Data Gaps

This chapter highlights the Office's progress in executing our data gaps agenda, as described in the OFR *2012 Annual Report*. It describes our approach and framework for assessing data gaps, the inventory the Office has compiled of the data collections of Financial Stability Oversight Council member agencies, the regulatory community's recent efforts to improve financial data, and our ongoing data priorities. The final section presents the Office's preliminary research results based on data related to credit derivatives, money market funds, and private funds.

5.1 Data Gaps Agenda

Comprehensive, timely, and granular data are essential to the Office's ability to conduct the financial stability monitoring, analysis, and research described in this report. To ensure sufficient data are available, the Office pursues its agenda through the following process: (1) identify the data needed for financial stability analysis; (2) analyze existing and available data, and determine gaps; and (3) identify the cause of the gaps, prioritize the needs and feasibility of collecting the data, and fill the gaps.

Regulators have significantly improved and expanded their data collections about the financial system since the recent financial crisis.

As financial markets evolve and change, so will the types of data needed to assess risks. As a result, we must continuously review our data gaps priorities. We work with domestic and international regulators to address gaps in data needed to monitor the stability of the financial system by connecting existing data from an array of sources, promoting financial data standards, and collecting new data.

The Council's Data Committee created a working group in July 2013 to explore data gaps and evaluate the feasibility of sharing or collecting data according to the Council's research and policy priorities. To assist in identifying the data currently available and the potential gaps or overlaps, we have compiled a preliminary inventory of the financial data collected or purchased by Council member agencies.

The Office has put a high priority on learning more about the causes and consequences of liquidity risk, runs, and fire sales. To that end, we will work in 2014 to improve the scope and availability of data related to the sources of funds for short-term wholesale funding instruments. We will specifically seek to address data gaps in securities financing transactions, including repurchase agreements (repos) and securities lending. We will explore data gaps about activities that may involve significant financial risks outside the scope of regulatory reporting requirements. This chapter highlights captive insurers, nonbank mortgage servicers, and mortgage real estate investment trusts.

Keeping data safe and secure continues to be the Office's highest priority. The Office is constructing an analytic environment and implementing a robust data and technology infrastructure to further secure, manage, and analyze large amounts of data (see Appendix A). The Office is also exploring ways that nonpublic information can be used for analysis and monitoring by a broad set of experts while protecting confidentiality (see following insert on Techniques to Protect Confidential Data).

Identify Financial Stability Data Needs

The Office identifies data needs through its analytic and monitoring activities. For example, the Office seeks data to measure possible vulnerabilities in the markets caused by linkages and counterparty exposures in new or existing products and activities that develop outside of regulatory supervision. We discuss and refine our data needs agenda in the Council's Data Committee (coordinated by the Office) and Systemic Risk Committee, as well as in our Financial Research Advisory Committee.

Analyze Existing Data and Determine Gaps

The Dodd-Frank Act requires the OFR to rely on data already collected by Council member agencies, when possible, before requesting additional data for financial stability analysis and monitoring. To avoid duplication and take stock of existing data, we have compiled a preliminary inventory of data that Council member agencies purchase or collect. We are sharing the inventory, which will serve as a reference catalogue, with all Council member agencies and will make portions of the inventory public when appropriate (see Section 5.2).

To further assess available data, we review others' monitoring and analysis to determine if data they used would suffice for our needs. We also conduct market research to determine whether commercially available data could fill our needs and whether analytical tools and software could help us use existing data more effectively.

Prioritize and Fill Gaps

Once we identify data gaps, we set priorities and determine a strategy for filling them. Priorities are based on our research and monitoring agendas, and on an assessment of how critical the gap is to understanding threats and vulnerabilities in the financial system.

In determining our strategy, it is important to understand what causes gaps. The data simply may not exist in the form needed for monitoring purposes. In that case, the Office would have to define data requirements, evaluate the feasibility and difficulty of obtaining the data, identify the best way to fill the gap, and develop a collection strategy.

If the data do exist, they may not be accessible due to confidentiality, privacy, or data-sharing limitations. The data may be inadequate because they are not detailed enough for analysis, focused on the wrong items, too limited in scope, or of poor quality. In addition, the data may be impossible to compare or aggregate because of a lack of data standards.

The Office has several ways to fill data gaps. First, we can acquire existing datasets gathered by Council member agencies and integrate them. Second, we can coordinate with Council member agencies to improve the scope, quality, or frequency of data they collect. Third, we can collect new data directly from the industry. Fourth, we can create and promote data standards to improve transparency and comparability among datasets (see Chapter 6).

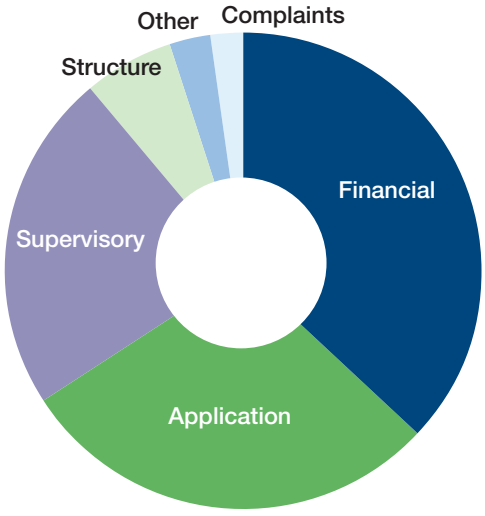
5.2 Regulatory Data Availability

Using the inventory the Office is compiling, we are developing a framework for understanding regulatory data.

There are more than 500 datasets collected by Council member agencies (see Figure 45).[1] These can be broken into six categories:

1. Financial data include financial statements such as Securities and Exchange Commission (SEC) Forms 10-Q and 10-K, asset pricing and valuation data, position or transaction data such as credit default swaps or repos, market and institutional flows, and information on the portfolio holdings of financial institutions.
2. Supervisory data result from bank examinations, surveillance, or other supervisory interaction with supervised companies.
3. Application data are from applications submitted by regulated banks and other firms to engage in mergers, acquisitions, branch openings, or other activities.

Figure 45. Regulators' Datasets by Type



Source: OFR analysis

4. Complaints data reflect complaints from the public about regulated firms' activities.
5. Structure data describe the organizational structure or hierarchy of financial institutions.
6. Other data are miscellaneous datasets that do not fit neatly into the other categories.

The most common dataset types in the inventory (by number of datasets, rather than data volume) are financial, application, and supervisory datasets, as shown in Figure 45.

Financial Datasets. Information reported to banking agencies includes general balance sheets and income statements, capital adequacy reports, and data required under the Home Mortgage Disclosure Act. Some banking agencies also collect information about specific holdings, transactions, or exposures from certain types of institutions. There are also specialized datasets related to each agency's mission, such as the detailed deposit data that the Federal Deposit Insurance Corporation collects to support its deposit insurance function.

The Commodity Futures Trading Commission and the SEC collect transaction data for specific markets and asset classes, trade repository data, and information on specific portfolio holdings, as well as information about balance sheets and income statements. Reporting requirements vary significantly by institution type and asset class.

Supervisory Datasets. Supervisory datasets focus largely on three areas: (1) safety and soundness and other information resulting from examinations of financial institutions, such as supervisory ratings of individual banks; (2) required supervisory filings, for example, on specified financial holdings or events; and (3) records of citations, violations, or enforcement actions. These datasets are mostly confidential.

Application Datasets and Others. Banking regulators' application datasets are largely related to structural changes, such as requests for mergers or charter

Figure 46. Examples of Data Collected by Council Member Agencies

Data Category	Regulator	Form Number	Name	Description
Financial	Federal Financial Institutions Examination Council	FFIEC 031/041	Consolidated Reports of Condition and Income (call reports)	Quarterly balance sheet, income statement, and supplemental schedules
Application	Securities and Exchange Commission	Form TA-1	Registered Transfer Agents	Application to register as transfer agent to keep track of the people and organizations that own its stocks and bonds. The form is submitted to the SEC or to a banking regulator, depending on the applicant.
Examination / Supervisory	National Credit Union Administration	Form 4501	Credit Union Online	Executives' contact information and certification of compliance with security procedures, suspicious activity reporting, and Bank Secrecy Act requirements.
Structure	Federal Deposit Insurance Corporation	Form 5 (6800/05)	Annual Statement of Beneficial Ownership of Securities	Officers and directors disclose transactions and holdings.
Complaints	Office of the Comptroller of the Currency	Online form at www.helpwithmybank.gov	Customer Complaint Form	Consumer complaints about a specific national bank or federally insured thrift.

changes. Market regulators' application datasets often relate to specific registrations and certifications. Complaints datasets reported by Council member agencies involve consumer complaints and investor complaints. Structure datasets, which are mostly reported by banking supervisors, contain hierarchy and ownership data, merger notifications, and company name changes. Datasets categorized as "other" vary in topic, and are often unique to the reporting agency.

The scope of regulatory data varies. Banking agencies collect standardized, publicly available data about balance sheets and income statements, such as the call reports filed by banks and the FR Y-9C reports filed by bank holding companies. Banking agencies also collect supervisory data that cover specific activities and risks, such as off-balance-sheet information and counterparty information, although that information is not always comparable among market participants and is often confidential. Data collections by market regulators vary depending on the financial sector. For example, money market funds report monthly portfolio holdings on Form N-MFP. Broker-dealers submit financial condition information quarterly on Form X-17A-5, also known as the FOCUS reports.

Common Security Classifications to Promote Data Sharing

Council member agencies are forging bilateral data-sharing agreements to assure all participants that shared data will be protected, secured, and treated consistently. Under these agreements, an agency requesting data from another Council member agency must keep the data at least as secure as the agency providing the data. These agreements are consistent with the analysis of data sharing in the Council by the Council of Inspectors General for Financial Oversight (see CIGFO, 2012).

For those data-sharing agreements to work, agencies must first agree on definitions of information security classifications and how to apply them. Historically, for example, different agencies may have had different policies around handling data that they defined as "restricted" or "high security."

The Office led and partnered with the Council's Data Committee to align security classification categories. An interagency working group established a common framework for information security practices, processes, and compliance requirements so that data can be shared with an assurance of equivalent protections among the members.

The working group built upon existing standards and agreements in the protection of the data, but with a focus on communicating and documenting the mutual understanding of the security responsibilities when sharing data. The working group has established principles for data sharing and responsibilities between agencies, procedures that emphasize joint communication and control, and documentation of the data request process, controls, and responsibilities. The National Institute of Standards and Technology assisted the working group in aligning the framework with the Federal Information Security Management Act of 2002 and the Federal Information Protection Standards. These federal standards represent the common base to which all federal agency classifications are mapped.

5.3 Progress in Identifying and Addressing Data Gaps

Improvements in U.S. Regulatory Data Collections

Regulators have improved their data collections in several important ways. Depository institutions are submitting more detailed reports, large hedge funds are filing quarterly information about their portfolios, and money market funds are submitting monthly data. Also, the Financial Industry Regulatory Authority (FINRA), the largest private self-regulatory organization that oversees broker-dealers, has increased its monitoring of alternative trading systems that are commonly known as "dark pools."

The Federal Reserve recently introduced two new forms, the FR Y-14 and FR Y-15, requiring more information from the largest bank holding companies. The FR Y-14 supports the Federal Reserve's annual Comprehensive Capital Analysis and Review, which includes a supervisory stress test to gauge institutions' resilience to shocks. On this form, companies provide more detail than is available on the FR Y-9C reports about their exposures to specific asset classes and

about their income statements. The Federal Reserve began in 2013 to require a stress test summary and scenario information in the FR Y-14 on a semiannual basis, rather than annually (see Board of Governors, 2013c). The Federal Reserve also revised the reporting frequency from three to four times per year for the schedules in the FR Y-14 on which companies report details about their regulatory capital instruments. FRY-14 data are confidential, although the Federal Reserve releases a public summary of the annual stress test results for each institution (see Board of Governors, 2013a and 2013b).

The Federal Reserve uses the FR Y-15 to monitor the financial stability risks posed by bank holding companies that are subject to enhanced prudential standards under the Dodd-Frank Act, and to determine capital requirements for global systemically important banks (G-SIBs). Annual collections began with December 31, 2012 data (see Board of Governors, 2012b). Filers include all bank holding companies with $50 billion or more in total consolidated assets, although the first collection was limited to the eight bank holding companies the FSB designated as G-SIBs in 2012 (see FSB, 2013d). This information is available on the Federal Reserve System's National Information Center website (see FRS, 2013).

Bank regulators made a significant change in 2013 to reports filed by depository institutions. The commercial bank call reports and the comparable FR Y-9C Reports filed by bank holding companies were expanded to include a new schedule — RI-C for banks and HI-C for bank holding companies — to give detailed information about allowances for loan-and-lease losses, effective with the March 31, 2013 filing. Filers must record the allowances they have set aside for losses in six categories: (1) commercial real estate, (2) residential real estate, (3) real estate construction, (4) commercial, (5) credit cards and other consumer, and (6) an unallocated category for unspecified losses. Regulators consider the detailed allowance information more consistent with the methodologies that institutions use to comply with accounting rules. Analysts may also be able to gain a better understanding of institutions' allowance practices and how they change over time.

The SEC now collects information from hedge funds and money market funds.

Advisors for hedge funds and other private funds with more than $150 million in assets under management have been electronically filing annual portfolio information through the SEC's Form PF since July 2012. Hedge fund advisers with at least $1.5 billion in hedge fund assets under management submit quarterly data with respect to each qualifying hedge fund that has more than $500 million in net assets. The form also collects more detailed data from large private equity fund advisers and large liquidity fund advisers.

In July 2013, the SEC issued its first required annual report to Congress describing its uses of Form PF data and providing aggregate information. Detailed information about individual funds and advisers is confidential (SEC, 2013b). In June 2013, the SEC proposed revisions to Form PF that would require large liquidity fund advisers to submit information similar to that collected on form N-MFP from registered money market funds (SEC, 2013a). The Office has a data-sharing agreement with the SEC that allows access to the data on a rolling monthly basis.

Money market funds have been filing monthly financial information with the SEC on Form N-MFP since 2010. The SEC posts this information on its public website 60 days after the end of each month. The SEC has proposed money market fund reforms that would increase the amount of detail in Form N-MFP. The proposed changes would also require money market funds to report legal entity identifiers and at least one other security identifier for each portfolio holding; disclose each investment's fair value, as defined by U.S. accounting rules; and disclose the purchase date, price, and yield of each investment.

FINRA, which collects data under the delegated authority of the SEC, proposed a rule change in September 2013 to require more information to be reported by private trading venues, sometimes referred to as "dark pools" (see SEC, 2013c). These private trading venues, or alternative trading systems, are now required to submit quarterly volume information to the SEC on their activities.

FINRA separately began taking a closer look in July 2013 at controls over high-frequency trading. High-frequency trading uses sophisticated computers and algorithms to analyze several markets simultaneously and execute orders at extremely fast speeds. FINRA is

TECHNIQUES TO PROTECT CONFIDENTIAL DATA

Our research investigates new techniques to enable the analysis of sensitive data while protecting confidentiality.

Regulators must balance transparency and confidentiality of data gathered from financial institutions. Their traditional choice has been either full publication or full confidentiality. New cryptographic tools create the possibility of a middle ground by reliably filtering information that should not be disclosed, as we described in a recent working paper (Flood and others, 2013). These techniques are still at an early stage of research. The OFR is exploring whether they are sufficiently mature to justify more extensive prototyping.

Confidentiality and Statistical Data Privacy

Two tools stand out as potentially useful for balancing confidentiality and transparency of financial data. The first tool of secure multiparty computation is complementary to the second, statistical data privacy.

Secure multiparty computation emulates an incorruptible trusted party that receives secret information from several companies, securely and accurately performs computations, and reveals only the final results. This technique could allow regulatory agencies to compute aggregate statistics jointly without physically pooling data. This would help reduce concerns about security breaches or legal restrictions on explicitly sharing data with other organizations.

The other technique — statistical data privacy — determines whether seemingly innocuous data releases, such as specific summaries, are actually safe to reveal. Statistical data privacy aims to understand and limit what confidential information is released. Even a final product, such as aggregate statistics, can sometimes reveal confidential information regarding individual investors or individual institutions through inferences drawn in combination with other available information. Statistical data privacy tests how different the situation might appear to a thoughtful observer who sees a particular data release.

Three scenarios described in the working paper illustrate how new privacy techniques might be applied to specific challenges for financial regulation and disclosure:

1. domestic supervisory agencies to the public **(Case 1)**
2. domestic agencies to the public and the research community **(Case 2)**
3. domestic to international agencies **(Case 3)**

Case 1: Publication of Aggregated Sensitive Data

Since the financial crisis, a number of financial regulators have begun publicizing financial conditions indices. The indices aim to capture the state of an extremely complex financial system by collecting market and other data, and distilling the information in a single number that can be tracked through time. The Federal Reserve Bank of Cleveland's Systemic Assessment of the Financial Environment (SAFE) and Cleveland Financial Stress Index (CFSI) are two examples.

CFSI uses publicly available data to compute an index that, because it relies on public data, can be released but has relatively low statistical accuracy. By contrast, SAFE blends some confidential data with publicly available data to compute an index. SAFE appears to be more accurate, but may not be published because of worries about disclosing confidential information.

Using techniques for statistical data privacy, it may be possible to confirm that the SAFE index (or some "sanitized" variant of it) has rigorous privacy guarantees for the confidential data and the individual institutions involved.

Case 2: Retail Loan Information to Support Research

Regulators collect datasets from banks about home mortgages, credit cards, and other retail loans. Supervisory analysis would benefit if this data could be shared with the broader research community. But information in these datasets is extremely sensitive, carrying detailed information about accounts and borrowers. Anonymizing the data would be insufficient to protect confidentiality, because so much information about housing loans is available through public records and could be reverse-engineered to reveal private

information. Tools developed for statistical data privacy might be used to certify what sorts of data releases (for example, aggregated or randomized data) might expose the broad patterns useful to supervisors and researchers, while protecting individual borrowers' privacy. The challenges in this area are great, however, and the potential risks and rewards are complex.

Case 3: International Sharing

In April 2009, during the financial crisis, the G-20 (Group of 20) nations launched the Data Gaps Initiative to identify and close supervisory information gaps throughout the financial system. The G-20 is a forum of finance ministers and central bank governors from 19 countries and the European Union begun in 1999 to encourage international cooperation on global economic issues.

An initial report of 20 recommendations included two on sharing data about individual institutions with international groups of supervisors. The Bank for International Settlements has begun centralizing and sharing data, relying on highly restrictive access controls and physical security protocols to maintain confidentiality.

Confidentiality concerns are heightened with international data sharing, because of limited cross-border authority to enforce agreements, resolve disputes, and remedy breaches. Secure computation technologies can help promote international sharing by emulating a trusted party to avoid the need for physical sharing of all the raw inputs to a particular computation. Instead, only narrow outputs — carefully calculated by local agencies — are shared, which are then assembled into the final aggregate. Protocols for statistical data privacy can also address concerns about whether data summaries intended to help decisionmaking by international regulators will reveal private information about individual firms.

These cases show how limited information sharing would improve transparency for the public, promote coordination among supervisors, and enhance market discipline while still protecting confidential and personal information.

tions (see FINRA, 2013). The collection of this information will help market regulators better understand the functioning of high-frequency trading and potential threats it may pose to financial stability.

International Data Efforts

Since the financial crisis, international financial forums have identified critical data gaps, issued policies and guidance for global cooperation to close data gaps, and collected data through international collaboration. The Office participates in these international efforts, recognizing that closing data gaps for monitoring and analyzing threats to financial stability requires global cooperation.

One major project is the Data Gaps Initiative, launched in 2009 by the G-20, a forum of finance ministers and heads of central banks, and coordinated by the Financial Stability Board (FSB). In 2010, the FSB made 20 recommendations to fill critical information gaps to financial stability, connections across countries, and interconnections in domestic economies. In 2013, the Office began participating in FSB work on banks' interactions with money market funds, securitization, securities lending and repos, and other shadow banking entities.

Other international regulatory efforts would make regulatory data more uniform. The Basel III reforms regarding capital and liquidity would standardize reporting among international institutions in key risk areas. The Basel III accord is a voluntary standard for banking soundness devised in 2010 by the banking supervisors and central bank governors of 25 countries who serve on the Basel Committee on Banking Supervision. Although originally scheduled to be phased in from 2013 through 2015, full implementation has been delayed until 2019.

The Basel Committee's January 2013 revisions to the liquidity coverage ratio standard amended definitions to provide clarity and improve consistency regarding

high-quality liquid assets and net cash outflows, improving data quality and comparability (see BCBS, 2013a). In July 2013, the Basel Committee proposed a common set of disclosure standards for banks to assess their liquidity coverage ratios (see BCBS, 2013b).

5.4 Data Gaps Priorities

The research and monitoring of the Office have identified key gaps in our understanding of repo markets, shadow banking, and the asset management industry. This section describes what we know and do not know about these markets because of gaps in data. Other data gaps continue to become apparent as the financial sector evolves; we highlight developments in insurance, mortgage servicing, and real estate investment trusts. Gaps are also created because of the inability to link data from different sources.

Repo Markets

Since the financial crisis, policymakers and academics have recognized the importance of repo markets to financial stability. Short-term funding obtained through repos can be a source of instability if lenders, worried about the value of collateral or counterparty risks, make it difficult for borrowers to roll over their contracts. If a financial company begins to have difficulty in accessing repo markets, either through higher discounting of its collateral pledged for a loan or outright exclusion from markets, the firm may have to sell assets. If these sales are substantial, they can depress the assets' market values, creating fire sales that can transmit the firm's difficulties to others.

Efforts to collect repo market data are complicated by the fact that there are three separate repo markets.

Bilateral repos are the simplest arrangement, in which the lender takes control of the borrower's collateral and promises to return it when the loan is repaid. Data related to this market segment are limited to survey information collected by the Federal Reserve Bank of New York.

Triparty repos involve one of two clearing banks — Bank of New York Mellon Corporation or JPMorgan Chase & Co. — that hold collateral on behalf of the lender and provide collateral valuation and netting services. Borrowers and lenders negotiate loan terms directly with one another and then report them to one or both of the clearing banks. Data about these markets are held in these banks.

The General Collateral Finance (GCF) market is an anonymous wholesale repo market that is almost exclusively dealer-to-dealer. The GCF market is markedly different from the other markets in that the Fixed Income Clearing Corporation (FICC) guarantees each transaction and requires that participating firms meet a high solvency standard, effectively limiting who can participate. Also, unlike the other repo markets, the borrower's creditworthiness does not affect the terms of GCF transactions. FICC collects and maintains data about this market segment.

Anecdotal evidence suggests that the bilateral market suffered the greatest disruptions during the recent financial crisis. Unfortunately, little reliable data are available for this market because of its decentralized structure.

More information is currently available about the triparty repo market than the other two markets. The Federal Reserve Bank of New York publishes summary triparty repo statistics every month, using information provided by the clearing banks.

Figure 47 provides details on different types of collateral used in the triparty market. It shows the ten generic asset classes that are used to secure repo loans in the triparty market, although most transactions involve U.S. Treasuries or agency mortgage-backed securities issued by a government-sponsored enterprise. Included are several types of allowable collateral, such as asset-backed securities, that suffered a breakdown in market confidence and lost value during the crisis. The right half of the figure indicates that collateral margin levels, or haircuts, vary widely, but we know nothing about the correlation between required haircuts and a borrower's perceived credit condition, or about the extent to which repo interest rates and margins complement one another in determining an institution's available repo funding. Information about changes in margins over time would help monitor whether the market is again starting to lose confidence in a particular type of collateral.

The aggregated data in Figure 47 can identify the extent to which repo borrowers are posting less liquid collateral — the sort of collateral that might cause a fire sale if it had to be liquidated in a hurry. But these

aggregate data do not indicate whether the weaker credit risks are responsible for a change in collateral offerings, and so they cannot identify the likelihood that a fire sale might occur. Understanding developments in repo markets and other short-term financing arrangements requires data about the rates, haircuts, length of loan, and collateral type for each large institution.

As an initial step toward better understanding the terms of borrowing in these markets, the Office has done a preliminary analysis of GCF transactions data obtained from the FICC for 42 business days in February and March, 2012. Below are a few observations based on this limited, but still complex, dataset.

Figure 48 shows the daily value of all new trades in this dataset. Over the sample period, the mean gross amount of GCF repo funding was about $193 billion. These data could also provide information about the widely known "window-dressing" effect, in which financial institutions make their quarterly financial statements appear stronger. The extent of this window dressing may be indicated by the repo volume decline

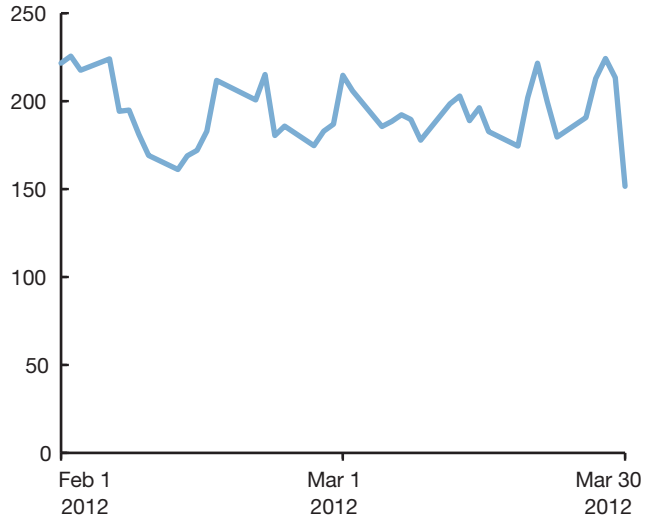
Figure 47. Triparty Repo Statistics as of October 9, 2013

				Cash Investor Margin Levels		
Asset Group	Collateral Value (billions)	Share of Total	Concentration of Top 3 Dealers	10th Percentile	Median	90th Percentile
ABS Investment Grade	$16.70	1.0%	49.7%	5.0%	6.0%	13.0%
ABS Noninvestment Grade	$21.38	1.3%	57.2%	5.0%	8.0%	22.8%
Agency CMOs	$77.92	4.8%	37.0%	2.0%	3.0%	7.0%
Agency Debentures & Strips	$98.06	6.0%	30.5%	2.0%	2.0%	3.0%
Agency MBS[a]	$530.66	32.5%	32.4%	2.0%	2.0%	3.0%
CMO Private-Label (Investment & Noninvestment Grade)	$39.19	2.4%	48.6%	3.0%	8.0%	20.0%
Corporates Investment Grade	$46.27	2.8%	29.7%	3.7%	5.0%	10.0%
Corporates Noninvestment Grade	$19.49	1.2%	36.8%	3.0%	8.0%	15.9%
Equities	$119.54	7.3%	47.2%	5.0%	8.0%	15.0%
Money Market	$23.70	1.5%	52.8%	2.0%	5.0%	5.0%
U.S. Treasuries/Strips	$40.83	2.5%	41.7%	2.0%	2.0%	3.0%
U.S. Treasuries excluding Strips	$574.56	35.2%	27.3%	2.0%	2.0%	2.0%
Other[b]	$22.18	1.4%				
Total	$1,630.49					

[a] Mortgage-backed securities
[b] Other includes credit default obligations, international, municipal debt, and whole loans

Source: Federal Reserve Bank of New York; available at http://www.newyorkfed.org/banking/pdf/oct13_tpr_stats.pdf (accessed November 22, 2013).

Figure 48. Daily Transactions in the General Collateral Finance Repo Market ($ billions)



Source: Fixed Income Clearing Corporation (FICC)

from $213 billion on March 29 to $151 billion on March 30, the last business day of the quarter.

The Federal Reserve Bank of New York also publishes summary information about outstanding repo transactions in the GCF repo market for one day each month. An abbreviated version of this report for February 9, 2012, is in Figure 49. As this chart reveals, more than two-thirds of repo transactions are on a term basis.

However, this table understates the short-term nature of the market. Virtually all term repo trades are rolled over every day, as shown in Figure 50. Many of the trades with indicated maturities of three days were initiated on a Friday and matured three calendar days — but only one business day — later, on a Monday. Similarly, most of the four-day maturity trades were initiated on the Friday before a Monday federal holiday. Categorizing these Friday transactions as "overnight" implies that 95.1 percent of GCF repo dollars traded (and 91.7 percent of the trades) matured in a single day. Longer-term repos in Figure 50 include only newly negotiated term deals.

The available GCF data have other interesting features. As in the triparty repo market, shown in Figure 47, the largest collateral classes by far are the U.S. Treasuries and agency fixed-rate mortgage-backed securities. The data also reveal that only 45 to 50 institutions participate in the GCF market on a typical day. Of these, 5 to 10 lend only cash, 15 to 20 only borrow, and about half act as both borrowers and lenders.

About 300 transactions occur each day, and the mean transaction size is about $650 million. The market is largely over by 8:30 a.m. EST, by which time nearly half of the transactions have occurred, accounting for nearly two-thirds of the day's dollars traded. Finally, quite a few repo transactions occur at rates below the federal funds rate, or in other words, below the cost of unsecured funding for similar institutions. Although this appears to reflect recent limitations in the number of firms offering to lend federal funds, it would be valuable to understand any patterns in these apparent abnormalities.

Although available data provide some insight into the repo markets, there is not sufficient data to explore flows between the three components in the repo market. In addition, more comprehensive data related to bilateral repos are needed to explore market disruptions. Without detailed, institution-specific information about all three components of the repo market, supervisors are handicapped in identifying potential sources of instability originating in this market, or originating with institutions that regularly fund themselves in this market.

Asset Management

Asset Management and Financial Stability, the report that the Office delivered in September 2013 to the Council at the Council's request about the asset management industry and its activities, cited significant gaps in data about the industry that limit the ability to evaluate potential threats to financial stability. The report focused on data gaps associated with securities lending activities and the management of funds in separate accounts (see OFR, 2013).

Securities Lending. Securities lenders include mutual funds, exchange-traded funds, insurance companies, pension funds, and other institutional investors. They lend portfolio securities to earn additional income. The direct borrowers include broker-dealers that most often re-lend the borrowed securities to hedge funds and others for short selling and other permitted purposes.

In a securities lending transaction, a security is temporarily transferred from a lender to a borrower in

exchange for cash or other collateral. In the United States, securities lending cash collateral is typically invested in commingled funds (registered money market funds and unregistered short-term funds) and separate accounts. The cash collateral must be returned to the borrower upon loan termination. Securities lenders often retain agents, typically banks or trust companies, to manage the cash collateral. In addition, many broker-dealers act as intermediaries for hedge funds or other clients that want to borrow the security.

Securities lenders generally consider these transactions low-risk sources of income. In the United States, no single, comprehensive regulatory framework is applicable to all securities lending and borrowing, but numerous regulatory requirements apply to the various types of securities lenders and borrowers, imposed by the relevant supervisory regulators. If a securities lender fears its reinvested cash collateral will lose value due to market stress or that the borrower will be unable to return the securities, the lender may recall the loaned securities. Alternatively, a borrower may seek to return securities if it believes that its posted collateral is at risk.

The unwinding of securities lending transactions contributed to market stress during the financial crisis. In some cases, collateral was invested in illiquid assets, such as structured investment vehicles and Lehman Brothers notes, resulting in losses and forced asset sales as firms sought to raise cash. These losses amplified fire sales and runs, contributing to distress in money markets and other short-term funding markets.

Lack of data related to securities lending transactions and the reinvestment of cash collateral limit the effective monitoring of securities lending activities. Market data provide information on the agent brokers involved in transactions and lending prices, but do not reveal the beneficial lenders and borrowers behind the transactions. It is consequently difficult to know the depth of securities lending in a particular issue at any given time, the extent of counterparty exposures, or the number of times that an issue has been re-lent.

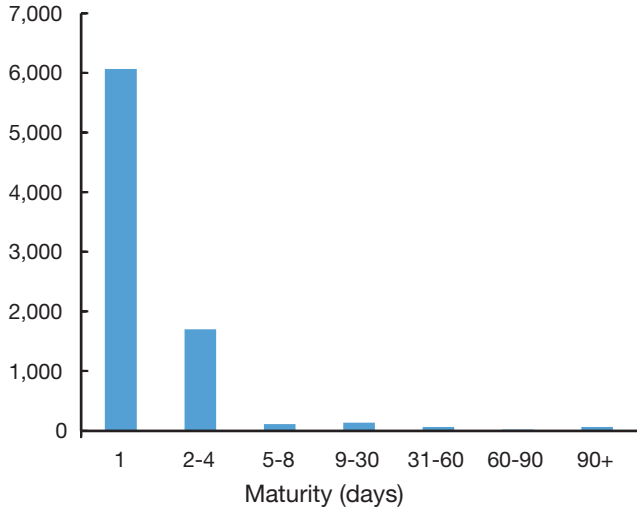
Collecting transaction-level data and position data about securities lending between large international financial institutions, including the composition of the underlying cash collateral reinvestment assets, would give regulators a clearer view of market activities. The Dodd-Frank Act requires the SEC to adopt rules

Figure 49. Value of General Collateral Finance Repos Netted and Traded on or Before Feb. 9, 2012, for Clearing ($ billions)

Collateral Type	Overnight	Term
U.S. Treasuries	$151.2	$292.8
Agency (other than MBS*)	$21.9	$40.2
Agency MBS*	$109.9	$300.7
Total:	$283.0	$633.7

* Mortgage-backed securities
Source: Federal Reserve Bank of New York

Figure 50. Maturity Distribution of New Transactions in the General Collateral Finance Repo Market ($ billions)



Note: Data over 42-day sample period from February 2012 to March 2012.

Sources: FICC, OFR analysis

increasing the transparency of information about securities lending available to broker-dealers and investors. Such rules could also help fill some of these data gaps.

Separate Accounts. The Office's asset management report also highlighted data gaps about separate accounts managed by registered investment advisers, banks, and insurance companies. Together, those accounts total more than $25 trillion and represent about half of assets under management in U.S. markets. For some firms, separate accounts represent a

significantly larger percentage of assets under management than registered funds.

In a separate account, an asset manager selects assets on behalf of large institutional investors or high net-worth individuals under terms defined in an investment management agreement. As separate accounts are privately offered, the investment management agreement establishes investment management restrictions. Clients retain direct and sole ownership of assets under management. Separate accounts are excluded from regulation and reporting requirements under the Investment Company Act of 1940 (1940 Act), and are not subject to the same restrictions as registered funds on investment concentration, leverage, derivative use, or liquidity. Adviser management of these accounts is regulated under the Investment Advisers Act of 1940, state securities regulations, or bank fiduciary regulations.

Some separate accounts have a similar investment strategy to registered funds. For example, a corporate retirement plan may establish a separate account based on an existing strategy that excludes the employer's own stock, or an investor with a social responsibility mandate may establish a separate account excluding stocks from specific sectors. In other cases, separate accounts may have significant investments in illiquid securities or derivatives, securities lending arrangements, or rely on additional leverage.

As we noted in our asset management report, data are limited for analyzing aggregate exposures and asset holdings in separate accounts. Some private data providers gather data about separate accounts, but asset managers provide the data only on a voluntary basis and these data are inconsistent. Some investment management agreements, particularly those for sovereign wealth funds and foreign central banks, prohibit asset managers from disclosing details about strategies and holdings.

Due to these data limitations, regulators cannot evaluate potential ways that separate account exposures or asset sales could affect markets. For example, separate accounts may be significant suppliers of securities in the securities lending market and may include large holdings of illiquid assets.

Other Emerging Data Gaps

This section describes data gaps with respect to data mapping, captive insurers, nonbank mortgage servicers, and mortgage real estate investment trusts. It also describes how historical financial data can help researchers develop financial stability measures, investigate financial crises, analyze policy, and compare alternate institutional and regulatory structures (see insert on Uses and Gaps in Historical Financial Data).

Data Mapping. Regulatory analysis is often hampered by the difficulty of combining datasets obtained from different sources. For example, to study the impact of credit ratings on asset prices, a researcher would need financial statement data, asset price data, rating information from all applicable rating agencies, and organizational information. Before beginning this research, the researcher would need to join these unrelated datasets efficiently over a long period.

The Legal Entity Identifier (LEI) initiative (see Chapter 6) will help facilitate this type of analysis once the LEI system is adopted throughout the financial industry. However, financial stability analysis cannot wait until full adoption of data standards. There is an interim need for mapping entities and financial instruments with different identifiers on different datasets. To support financial stability analysis, the Office is mapping the LEI to regulatory entity identifiers and other proprietary industry identifiers. Mapping entity identifiers requires manual matching of names and addresses and verification of abbreviations and spelling differences, and requires constant updating.

Captive Insurers. Traditional insurance companies submit large amounts of data to state regulators. This is not the case with certain captive insurers. Deficiencies in transparency and concerns regarding the lack of uniform regulatory requirements relating to certain captive insurers are being discussed by state insurance regulators.[2]

Captive insurers were originally created to underwrite the risks of parent companies. However, the use of captives has expanded in different states and jurisdictions over the years. One example is the growth of captives assuming third-party risk from affiliated traditional commercial insurers. In addition, a growing number of special purpose vehicles have also been

licensed under state laws, sometimes called captive laws, to take on risk from affiliates through reinsurance, securitization or reserve financing.

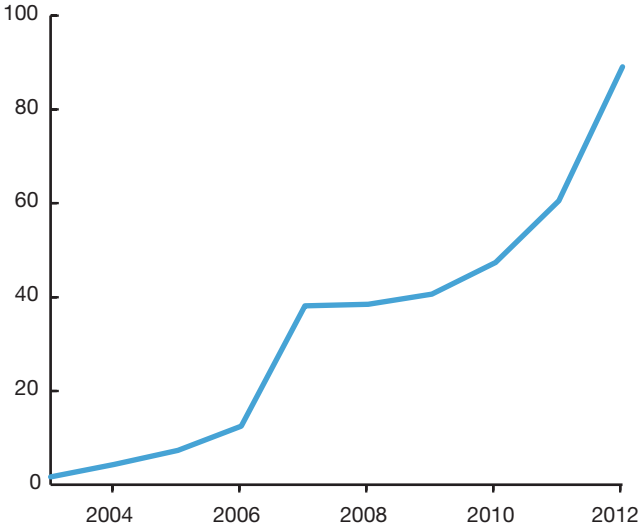
National Association of Insurance Commissioners data illustrate the rapid rise in reinsurance credits taken by traditional U.S. insurers (including property and casualty, life, and health insurance companies) from transactions with affiliated U.S. captives. Figure 51 shows traditional U.S. insurers in 2012 reported nearly $90 billion in reinsurance credits from those transactions, compared to just $1.6 billion in 2003. All state laws allow U.S. insurers to either recognize an asset or reduce the reserve liability on regulatory financial statements for so-called ceded reinsurance transactions, in which a portion of a risk in insurance policies is transferred from a primary insurer to a reinsurer.

The data in Figure 51 do not include offshore affiliate transactions due to the difficulty in determining whether an offshore affiliate was a captive or traditional insurer. Additionally, due to a lack of data, the graph does not include "two-step transactions" that occur when an insurer transfers insurance to another insurer, which then transfers that risk to a captive subsidiary affiliated with the original insurer (see NYDFS, 2013).

Figure 51 shows that more transparency is needed about the financial condition of affiliated captive insurers assuming third-party risk. The need for transparency is supported by other factors, including a growing number of states that allow captive insurers, special purpose vehicles, or both within their borders and the accreditation program[3] of the National Association of Insurance Commissioners (NAIC) that does not address uniform reporting and financial solvency standards for many categories of captives and special purpose vehicles (see NAIC, 2013).[4]

State insurance regulators, through the NAIC, have been exploring options for increasing transparency in the area. These were discussed in a recent white paper by the NAIC's Captives and Special Purpose Vehicle Subgroup. Although there are several ways to achieve this, one option could be to require captive insurers to submit public financial filings. By filling this data gap, policyholders, nondomestic regulators, ratings agencies, investors, and other players in the financial market could benefit in different ways, including greater awareness of potential regulatory arbitrage situations among states where looser regulatory requirements are perceived to exist.

Figure 51. Reinsurance Credits Taken by U.S. Insurers ($ billions)



Note: Credits are a result of transactions with affiliated U.S. captives

Source: National Association of Insurance Commissioners, OFR analysis

Nonbank Mortgage Servicers. Significant data gaps persist in the mortgage finance industry. Although the Office of the Comptroller of the Currency (OCC) requires information on mortgage loan servicing from large national banks, the data do not include a representative sample of riskier subprime loans or loans serviced by smaller banks (see Dugan, 2008).

The OCC data also exclude the growing number of nonbank companies that service mortgage loans. No federal, state, or industry entity is responsible for ensuring the safety and soundness of nonbank mortgage servicers. For banks with significant servicing operations, banking regulators analyze those risks as a part of the overall examination process. However, the expansion of nonbank servicers means an increasing share of the market is not subject to this scrutiny.

SEC-registered nonbank servicers file quarterly and annual financial statements that disclose some information about their operations, but the information is aimed at investors and does not contain detailed risk data about their mortgage servicing. These financial statements and other disclosures provide a snapshot of a servicer's health, but lack the data needed to analyze

USES AND GAPS IN HISTORICAL FINANCIAL DATA

Filling gaps in historical financial data could help the Office design financial stability measures, investigate the causes and nature of financial crises, analyze the effects of government policy on financial stability, and compare the strengths and weaknesses of alternate institutional and regulatory structures.

Historical analysis plays a special role in our understanding of financial stability. Panics and crises, the most notable episodes of instability, fortunately occur rarely. But over long intervals, episodes of instability reveal a range of vulnerabilities. The cause and appropriate policy response can differ markedly from one episode to the next.

Investigations of historical financial crises are forensic exercises. After a shock has occurred, questions focus on why and how events unfolded. Past crises and responses to them can provide useful lessons for assessing vulnerabilities in the financial system in the context of evolving market and regulatory forces. Such analyses depend on good data.

Our ***2012 Annual Report*** analyzed four historical financial crises — in 1929, 1987, 1998, and 2007-09 — using 11 measures that researchers have proposed to help authorities monitor threats to financial stability. Two measures of the interconnectedness of large bank holding companies reacted much more strongly in 2007-09 than in 1998, reflecting that banks and their leverage were more central to the recent episode (see OFR, 2012). A key lesson from that analysis was that more complete and higher-quality data would help in developing better measures to improve monitoring capabilities in the future.

Historical analysis of financial data can support our understanding of how financial crises emerge and spread. Although past crises followed familiar patterns, each episode had unique features. The 20 minor and 8 major banking panics in the United States between 1830 and 1935 varied significantly in their origins, as well as in the relative role of credit and the nature of the official response (see Jalil, 2013).

The Panic of 1907 contains interesting parallels and contrasts to our own crisis a century later. Both involved runs on wholesale collateral markets, which many banks relied on for their short-term funding. In 1907, equities were the collateral. In 2007, the collateral consisted of a broad array of securities including complex securitizations backed by subprime mortgages (see Gorton, 2008). In 1907, in the absence of national deposit insurance, runs by retail depositors also played a role.

Long-horizon studies demonstrate the power of comparing a wide range of financial arrangements, stresses, and policy responses. The classic work of Friedman and Schwartz (1963) used annual data about banks and the money supply, aggregated at the state and national levels, to track broad patterns in monetary developments and policies over the course of decades. More recently, Schularick and Taylor (2012) compared annual aggregates for money, credit, and output over more than a century. They identified two broad eras divided by World War II and distinguished by dramatically different crisis dynamics that apply to 14 developed economies from 1870 to 2008.

Although these studies show the strength of historical analysis, they also suggest the possible benefits of more detailed data. The abrupt crisis phase of a stress episode typically stabilizes within days or weeks. Annual observations cannot depict these events in any detail. Similarly, national or statewide aggregates miss the dynamics of a crisis as it spreads through certain institutions but not others.

Comparisons among firms could help answer the question of how much leverage is too much. Augmenting bank-by-bank data with information on correspondent relationships connecting regional banks and country banks to the large clearing banks in reserve cities might help policymakers understand the implications of interbank funding networks in a crisis. For example, such analysis could illuminate to what extent depositors are able to withdraw from specific banks targeted for their risk exposures or whether they tend to run indiscriminately during signs of stress.

Better historical data are also needed for analysis of proposed macroprudential policies. One of our recent working papers analyzed the impacts of macroprudential policy tools that the Federal Reserve and other agencies used to curb credit market excesses over 100 years (see Elliott, Feldberg, and Lehnert, 2013). The analysis was limited by aggregate data. More detailed data about banks and other companies would enable analysis of the effects of policy changes on individual institutions and the extent to which nonbank lenders step in when policy constrains banks.

Analysis of historical data can also allow us to consider the effect of policies over time. For example, comparing banking today with banking before deposit insurance and lender-of-last resort facilities may shed light on the impacts of reforms on short-term funding markets, augmenting research that shows how various tools may reduce the probability of runs (see Begalle and others, 2013).

Addressing Historical Data Gaps

Under the Office's data gaps framework, the first step in filling historical data gaps is to assess the prominent features of past financial crises that may hold lessons for today and decide what data are needed to describe and analyze them. The second step is to take an inventory of existing collectible data.

For many years, regulators, news organizations, information vendors, and others have captured and published financial data. This record includes traditional accounting reports and market data related to prices and volumes, survey data, credit ratings, traditional news, and documentary materials, such as meeting minutes.

Some historical information is already publicly available.[5] The Federal Reserve's ***All Bank Statistics***, for example, is available online; portions have been digitized and are readable by computer software. These data have been instrumental in furthering our understanding of the role of banks in the crash of 1929 and the subsequent Great Depression.

Other significant data sources exist but have not been digitized. For example, most state banking departments have published bank accounting reports for years, typically annually, but many still exist only in print.

The recently released internal archives of the Federal Reserve banks can also provide valuable insights. For example, Jaremski (2013) used these data to show that, prior to the creation of the Federal Reserve in 1914, banks that were members of private clearinghouses were less likely to fail during panics, but more likely to fail during other periods.

In some cases, historical data may not exist. Data are limited by what was collected. For example, until recently bank regulatory reports focused on the details of funding sources rather than lending portfolios, hampering any analysis of banks' exposures to credit risk and how they adjusted their lending in response to policy changes or financial crises.

Gaps generally exist because researchers have been unable to locate the aging hard-copy reports that could be sources for digital collections. Closing these information gaps is challenging because of the high cost of digitizing and validating the data. Although many economists have assembled historical data related to financial markets and institutions, these datasets are costly and time-consuming to compile, and, as a result, they tend to remain closely held to support individual researchers' ongoing work.

In recent years, constructing datasets has become cheaper and easier. Institutions, such as the Federal Reserve Bank of St. Louis and the HathiTrust Digital Library, have digitized historical documents and released them to the public. New technologies, such as better optical-character recognition software and new outsourcing services for data entry, have also made the process easier.

adverse scenarios and evaluate how well a nonbank servicer is prepared to weather an economic downturn.

These data gaps could have implications for policy proposals. A mortgage finance reform bill proposed in the U.S. House of Representatives in July 2013 includes language to address conflicts of interest by preventing loan servicers that hold a junior lien on a property from servicing other loans on the same property (see H.R. 2767, 2013). But because regulators do not currently collect comprehensive mortgage servicing information, evaluating the effects of such a policy on financial stability is not possible because we cannot accurately determine how often this conflict occurs across the United States. An expanded collection of mortgage servicing data from banks and nonbank servicers identified consistently over time as mortgages were transferred and sold could address this data gap.

Mortgage Real Estate Investment Trusts. As noted in Chapter 2, mortgage real estate investment trusts (REITs) are leveraged investment vehicles with large holdings of agency mortgage-backed securities (MBS). The sector depends heavily on the repo market and is highly concentrated, with two firms accounting for about 60 percent of sector assets. In May and June 2013, mortgage REITs shed roughly $45 billion of MBS as interest rates rose, due to their exposure to duration risk and basis risk. These sales likely contributed to rapid increases in yields and volatility in the MBS market.

Sparse data are available to evaluate the risks posed by mortgage REITs. Although most mortgage REITs are publicly listed companies, the depth of data presented in public filings varies widely across firms, and on the whole the data are inadequate to assess the risks they pose to financial stability. Mortgage REITs are generally excluded from reporting requirements of the Investment Company Act of 1940. Although the Dodd-Frank Act increased the reporting requirements of hedge funds and private equity funds, the requirements on mortgage REITs remain unchanged.

More data are needed to understand the risks posed by mortgage REITs. Information describing the distribution of their portfolio holdings, borrowings, and derivative positions across tenors, rates, haircuts, and other instrument-specific parameters would contribute to a greater understanding of the vulnerabilities of mortgage REITs. Stress tests against shocks to borrowing rates, MBS yields, haircuts, and funding runs could help evaluate mortgage REIT performance through a variety of adverse scenarios. The Office is exploring avenues for gaining a better understanding of this market.

5.5 Preliminary Research Based on Recent Data Collections

Ongoing data collection and sharing initiatives broaden the Office's access to valuable information concerning financial stability. However, there is no perfect real-world dataset. Part of the research process is learning what can be done with available data. How reliably do the data reflect the quantities that they are supposed to measure? How noisy are the data? What questions can be readily answered? What questions can be addressed only indirectly?

This section summarizes the beginnings of research programs that use three newly available datasets. Two of the datasets contain information about money-fund asset holdings and credit default swap transactions that is high-quality, comprehensive, and separated into components, or disaggregated. The other dataset contains information about hedge funds and is more limited. In our analysis, we discuss what we can learn and cannot learn from these data. Each of the following sections begins by posing the main question our research attempts to answer.

Active Management of Money Market Funds

How do managers of money market funds adjust the composition of fund assets at times of financial market stress?

Money market funds play a significant role in the financial system. The soundness of the funds and investor confidence in their soundness are important to financial stability. The strategies funds use to manage their risks affect other asset markets. For example, a sudden shift by money market funds out of a particular asset class can disrupt other markets.

In 2010, the SEC required money market funds to file a monthly report on portfolio holdings as of the last business day of the previous month on its new Form N-MFP (see Rule 30b1-7 under the 1940 Act). Form N-MFP reports help regulators understand risks faced by money market funds and the Office actively monitors the filings. But gaps remain.

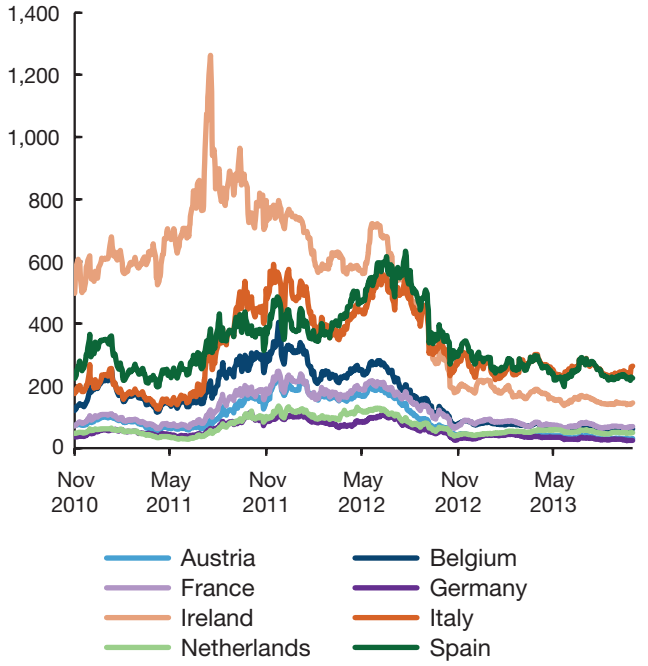
If there were no gaps in available data, regulators could monitor the price volatilities of all assets held in fund portfolios on a real-time basis. In practice, regulators face a time lag when monitoring asset holdings. Although asset holdings are available from the SEC through Form N-MFP, the Office has limited information on the secondary-market trading of money market fund assets because some market data are available only to registered traders.

We use information from other sources to draw inferences about the risks embedded in money fund assets and the asset-allocation strategies funds used to control these risks. In particular, we closely watch developments in the eurozone and the potential effects on money fund risks and possible spillovers to U.S. financial markets.[6] One barometer of risk in the eurozone is the market for credit default swaps (CDS or swaps), financial instruments that insure against a government defaulting on its debt. Investors can buy sovereign default CDS to hedge against risk, or to bet on a country's future.

The Office used money fund data from Form N-MFP to examine how the eurozone sovereign debt crisis spilled into prime money funds. Prime money funds are required to invest in high-quality, short-term debt securities, and typically do not hold eurozone sovereign debt. However, the funds have an indirect exposure to eurozone sovereign debt because they may invest in some short-term corporate debt issued by European banks and financial firms. That corporate debt is sensitive to the risk of sovereign debt default because the issuing firms are based in the region or invest in the foreign debt.

Figure 52 displays the costs of insuring against the failure of sovereign debt, as measured by CDS spreads for eurozone countries. Spreads for Ireland, Italy, and Spain were high and rising throughout 2010. Prime money funds were largely unaffected by this trend because their eurozone exposures were concentrated primarily among entities based in Germany and France. Spreads for these countries were low and stable through the end of October 2010, averaging about 38 basis points for Germany and 65 for France. These spreads rose slightly in early 2011, but then returned to spreads of about 40 and 75 basis points respectively, by mid-2011. However, spreads increased through the remainder of 2011. The figure shows that several

Figure 52. Five-Year Credit Default Swaps Spreads for Select Eurozone Countries (basis points)



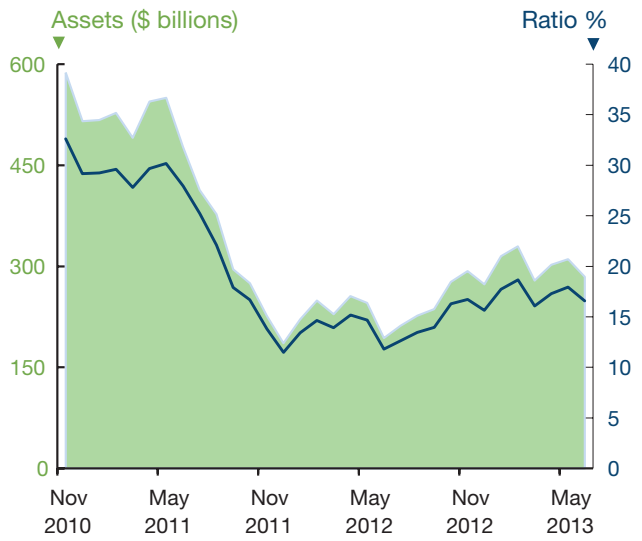
Source: Markit Group, Ltd

eurozone CDS spreads, including those of Germany and France, began to rise in mid-2011.

Data collected on Form N-MFP indicate that prime money market funds reduced their holdings of debt issued by eurozone financial institutions while eurozone CDS spreads were rising. Figure 53 shows that from late 2010 through the middle of 2011, prime money funds held about $500 billion in debt issued by banks and financial institutions in eurozone countries, or 30 percent of total prime fund assets. By the end of 2011, prime fund exposure to these institutions dropped by half.

Was this decline the result of investors running from particular funds? In other words, did investors sell their holdings of prime money market funds with heavy eurozone investments and increase their holdings of prime funds with low eurozone investments? Or was the change the result of individual fund managers shifting the composition of their portfolios away from eurozone investments? The financial stability implications of events such as the sovereign debt crisis heavily depend on the reason for the decline in the overall eurozone exposure of prime fund assets.

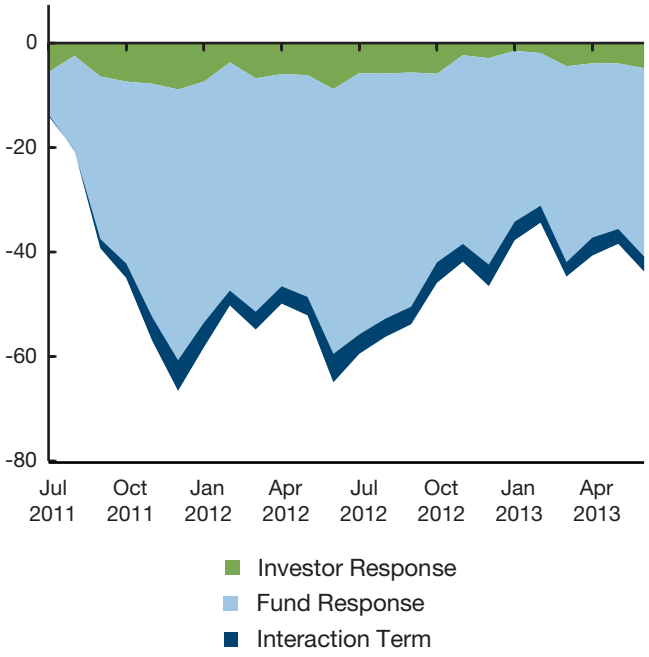
Figure 53. Eurozone-Based Assets of Prime Money Market Funds



Note: Assets equal aggregate principal value. Ratio equals eurozone/Total Prime.

Sources: OFR analysis of Form N-MFP data; filings for individual funds are available on the SEC's EDGAR website (www.sec.gov/edgar.shtml).

Figure 54. Change in the Eurozone Holdings of Prime Money Market Funds (percent)



Note: Percent change in eurozone assets is calculated by the percentage change in principal value since June 2011.

Source: OFR analysis of Form N-MFP data

The Office concluded that this decline was almost entirely attributable to prime funds pulling assets out of the eurozone, rather than investors fleeing those prime funds with relatively high eurozone exposures.

Figure 54 shows the total change from June 2011 in money funds' eurozone-based assets. The change is separated into two components. The first component is the investor response of pulling money out of some funds and putting money into other funds. The figure shows this component is negligible. The second component is the response by fund managers of changing portfolio compositions of individual funds, which accounts for almost all of the change in eurozone-based assets. (There is also a third component, which is a tiny interaction term representing the change in net asset values multiplied by the change in portfolio composition).

Our research also shows that prime funds altered their portfolios in two other ways in response to rising risks in the eurozone. First, funds shifted their holdings into eurozone assets with significantly shorter maturities. The average maturity of eurozone-based assets held by prime funds dropped from about 45 days in mid-2011 to only 20 days by the end of 2011 (see Figure 55).

Second, prime funds shifted the composition of their eurozone-based assets away from countries with higher perceived risks of sovereign debt default, such as Belgium and Spain, and bought more assets in less-risky Germany.

One way to visualize this shift is to compare two monthly measures of CDS spreads. The first measure acts as a baseline, weighting each country's monthly CDS spread by the fraction of fund assets associated with that country in October 2010, when spreads were relatively low and stable. The light blue line in Figure 56 shows this weighted average rises from about 70 basis points in mid-2011 to about 200 basis points at the end of 2011.

The second measure in Figure 56 weights each country's monthly CDS spread by the fraction of prime-fund assets associated with that country as of that same month. That means if fund assets gradually shift toward a particular country, the weight on that country's CDS spread gradually increases over time. The actual weighted average line, in dark blue, shows an increase from about 70 basis points in mid-2011 to

only 120 basis points at the end of 2011. The difference between the two weighted averages in Figure 56 shows that funds shifted assets toward issuers in countries with less-risky CDS spreads.

One interpretation of the shifts is that they show fund managers actively reacting to default risks. The portfolio adjustments that took place through the end of 2011 support this interpretation. However, the figures show that fund managers did not return to eurozone assets after 2011, when sovereign default risks fell. As of mid-2013, eurozone CDS spreads had declined to the lower levels of late 2010, but fund investments in eurozone assets remained less than 20 percent of total assets. In addition, the average maturity of these assets was noticeably shorter (less than 40 days) than the average maturity of non-eurozone assets held by prime funds (about 50 days). An alternative interpretation consistent with this evidence is that fund managers have pulled back from eurozone exposure because of the events of 2010 and 2011.

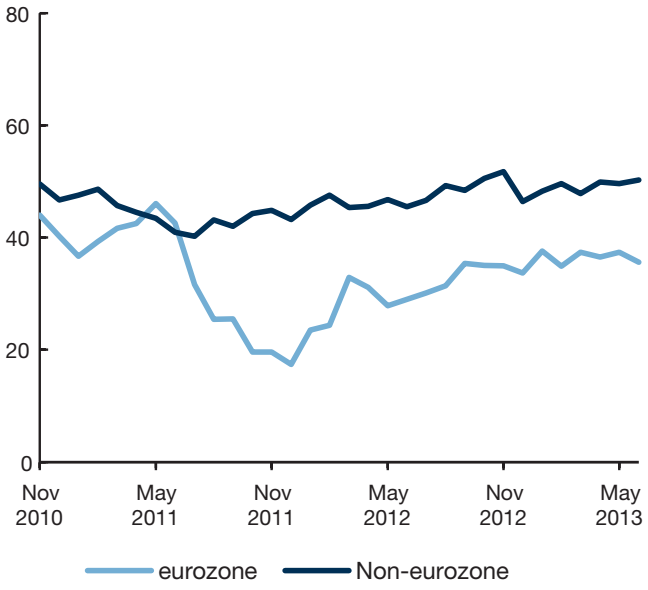
Activity in the Sovereign CDS Market

If external events caused one or more major players to withdraw from the sovereign debt CDS market, how vulnerable would the market be? With newly acquired data in hand, we set out in 2013 to answer that question.

In the OFR *2012 Annual Report*, we highlighted the work of the Office to fill data gaps in derivatives, such as CDS. The Office now has position, transaction, and pricing information about CDS contracts from the Depository Trust & Clearing Corporation (DTCC), a firm that provides clearing and settlement services for financial transactions. A close look at the market for sovereign CDS shows the value and limitations of these data.

The sovereign debt CDS market is an example of an over-the-counter dealer market. Trades in this type of market, unlike an exchange, are individually negotiated between participants and subsequently reported to DTCC. A dealer market consists of market makers and end users. End users are firms or other entities, such as governments, that want to take a particular position — in this case, either to buy or sell protection against default. End users contact dealers, who act as intermediaries, buying protection from some end users and selling protection to others. If a dealer's trading

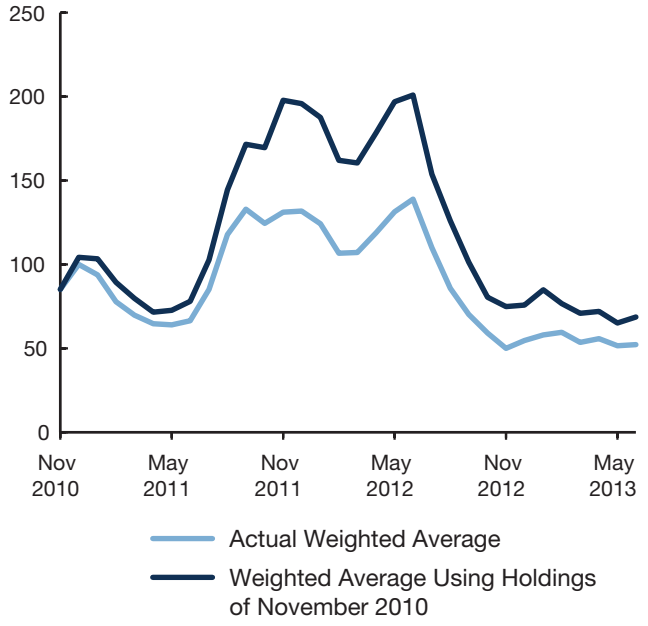
Figure 55. Weighted-Average Maturity of Assets in Prime Money Market Funds (days)



Note: Assets equals aggregate principal value

Source: OFR analysis of Form N-MFP data

Figure 56. Weighted-Average Sovereign Five-Year CDS Spread for Prime Money Market Fund Eurozone-Based Assets (basis points)



Note: Weighted by aggregate principal value. CDS spreads are monthly averages by country. Analysis includes Austria, Belgium, Italy, France, Germany, Netherlands, Spain, and Ireland.

Sources: Form N-MFP, Markit Group, Ltd, OFR analysis

volume from end users is predominantly on one side of the market, the dealer will often enter into offsetting trades with other dealers to hedge its market exposure.

We analyzed millions of records, beginning with high-level snapshots of market activity. We summarize trading activity in seven sovereign CDS contracts (Germany, France, Italy, Portugal, Spain, Ireland, and Greece) from January 1, 2010, through April 26, 2012. Figure 57 reports the number of firms that traded in the sovereign CDS market, how frequently they traded, the size of their trades, and a measure of the aggregate positions traders have taken through CDS contracts.

Trade size was measured by notional principal, which is the face amount of a hypothetical bond. A firm can buy protection against the default of a hypothetical $10 million bond. Similarly, aggregate positions are measured by aggregate notional principal. Gross notional principal adds up across all existing contracts.

For example, if a firm purchased default protection with a notional principal of $10 million and sold default protection with a notional principal of $5 million, the firm's gross notional exposure would be $15 million. The other side of these contracts would also have an aggregate gross notional exposure of $15 million. The aggregate notional principal calculations reported here are one-sided. For this example, aggregate notional exposure is $15 million, not $30 million.

Statistics in the table are summed across the seven contracts and calculated separately for each calendar year. In the table, a "trading pair" is made up of two firms that trade with one another. For example, if four of the 1,421 market participants in 2010 traded CDS contracts with all of the other 1,417 market participants, there would be 5,668 (4 multiplied by 1,417) trading pairs in 2010.

An immediate conclusion to draw from these statistics is that trading activity was fairly light. The average market participant traded about two-and-a-half contracts per month. But in a dealer market, there is no "average" participant. Dealers are much more active participants than end users. Because the dataset does not explicitly identify dealers, we could not distinguish dealers from end users. Instead, we broke down market participants by their overall line of business. We first grouped commercial and investment banks together, and checked whether characterizing them as market makers would be reasonable.

Banks Are Market Makers

The exposure of U.S. banks across all sovereign CDS contracts is shown in Figure 58. The green lines at the top and bottom of the graph show end-of-week total gross exposures and the blue lines show the same information after netting, or offsetting, trading positions involving the same bank and sovereign. Buy-protection positions are separated from sell-protection positions. For example, if a bank bought protection of $10 million on Spain and sold protection of $10 million on Spain, the two contracts would net to zero. If the buy-protection positions and sell-protection positions were for different sovereigns, this figure would show no netting. There would also be no netting if the buy-protection positions and sell-protection positions were for different commercial banks.

Figure 57. Trading in Sovereign CDS for Germany, Greece, France, Ireland, Italy, Portugal, and Spain

	2010	2011	2012
Number of Market Participants	1,421	1,674	1,423
Number of Trading Pairs	7,542	10,120	7,911
Average Number of Transactions per Month	3,841	4,721	3,491
Average Notional Principal Traded per Month ($ billion equivalent)	88	93	73
Gross Notional Principal Outstanding at the End of April ($ billion equivalent)	803	1,054	1,033

Sources: Depository Trust & Clearing Corporation (DTCC), OFR analysis

The figure shows that banks have large gross positions on the buying and selling sides of sovereign CDS contracts. Aggregate net positions are about one-fifth the size of aggregate gross positions — strong evidence that the banking sector is engaged in market-making activity in the sovereign CDS market. In April 2012, aggregate positions of banks are larger for sold protection (under $300 billion) than for bought protection (over $200 billion). In other words, banks are providing default protection to other market participants.

Hedge Funds Are Buyers

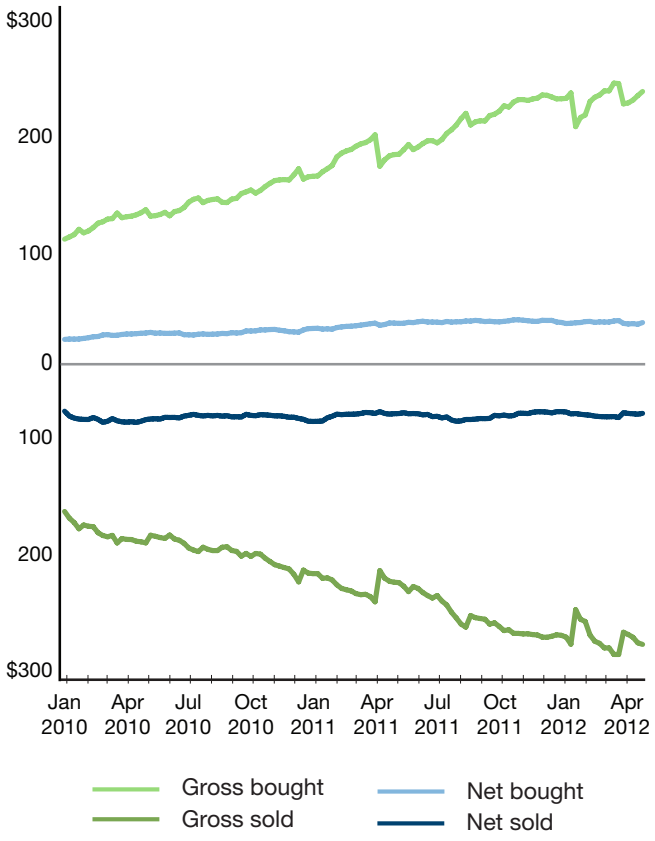
Who is buying the default protection from banks? Our analysis indicates that hedge funds are often on the buying side of these contracts. Figure 59 reports gross exposures for the hedge fund sector, calculated the same way as bank gross exposures in Figure 58. Net exposures are not displayed because they are almost identical to gross exposures. The near equivalence shows that hedge funds are end users in this market, not market makers. For this sample, the hedge fund sector is on average net $30 billion short (buying protection) and almost all hedge funds are on the same side of these contracts.

Hedge funds are the most active participants in the sovereign CDS market, followed by mutual funds. Figure 59 also displays gross aggregate exposures for mutual funds. As with hedge funds, there is no reason to display net aggregate exposures, because they are indistinguishable from gross exposures. Unlike hedge funds, mutual funds largely sell protection in the sovereign CDS market. More importantly, exposures are substantially smaller than those of the hedge fund sector. The peak gross exposure is about $10 billion in sold protection. Exposures for business sectors other than hedge funds and mutual funds are even smaller.

These data do not allow us to conclude that hedge funds are betting that sovereign credit will deteriorate or that mutual funds are betting that sovereign credit will improve. If hedge funds have substantial direct holdings of sovereign debt, they may be hedging some of their exposure through the CDS market. We also cannot infer that the mutual fund sector is exposed to the risk of a decline in sovereign credit quality.

These exposures for hedge funds and mutual funds point to the possibility of destabilization due to correlated trading activity. Correlated trading occurs

Figure 58. Aggregated Gross and Net Notional Exposures for Banks ($ billions)

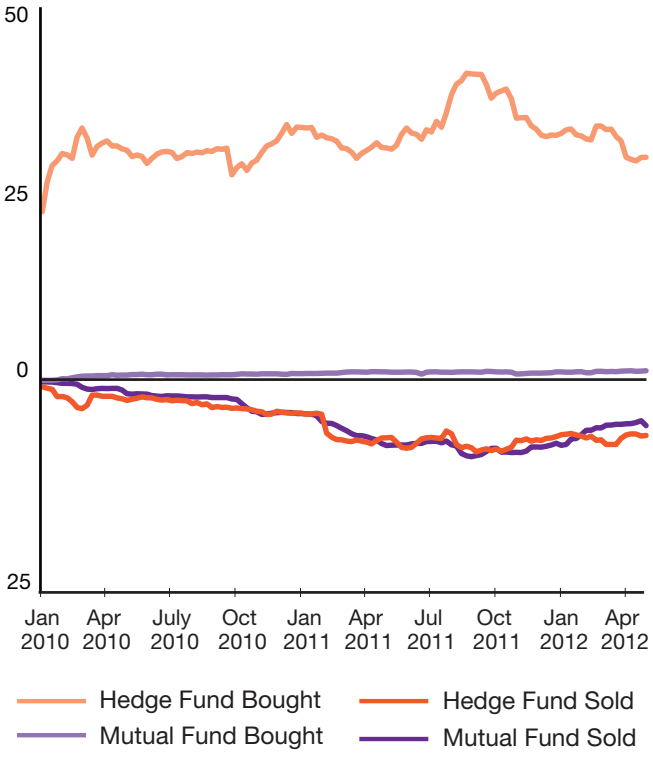


Sources: Depository Trust & Clearing Corporation (DTCC), OFR analysis

when firms in the same sector attempt to trade on the same side of a market. If the same adverse shock hit several large hedge funds and substantially decreased their capital, the funds would likely pull back from risk-taking activities. The funds might sell assets and reduce their positions in derivative markets. Even if the original shock were unrelated to sovereign credit risk, these large hedge funds might simultaneously attempt to unwind their buy-protection sovereign CDS contracts. A shock to hedge funds could spill over into the sovereign debt market.

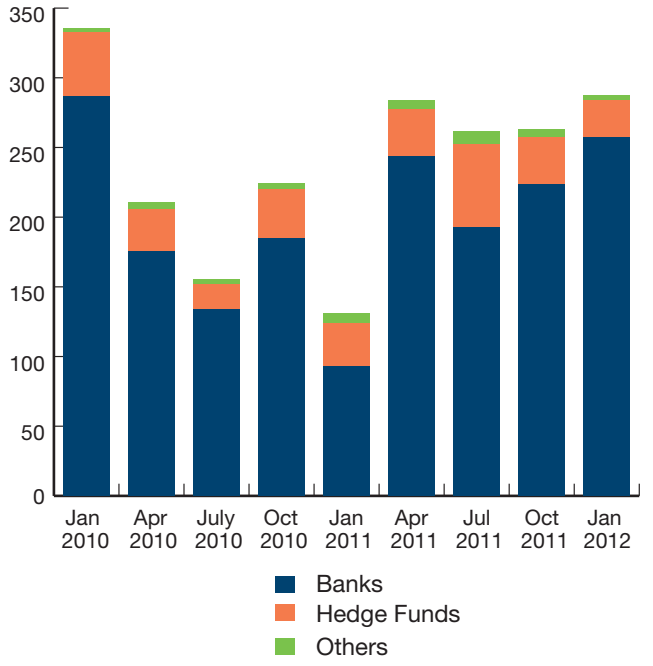
Correlated trading is of particular concern because market makers and end users trade infrequently. Figure 60 displays trading activity in three-month increments. Each column represents the aggregate notional volume of trading for the banking sector. There are no trades in this market that do not have a bank on at least one side of the transaction. A trade between two banks shows up twice in this figure.

Figure 59. Aggregated Gross Notional Exposure for Hedge Funds and Mutual Funds ($ billions)



Sources: Depository Trust & Clearing Corporation (DTCC), OFR analysis

Figure 60. Three-Month Trading Activity as Measured by Notional Amount of CDS Contracts ($ billions)



Sources: Depository Trust & Clearing Corporation (DTCC), OFR analysis

During the three-month period from December 2011 through February 2012, banks were on one side of about $280 billion of notional principal in sovereign CDS trades. Although $280 billion may seem large, most trading was between banks as they reallocated risks among themselves. These trades did not shift risk to, or from, end users. Transactions between banks and all end users totaled only $30 billion during this three-month period. The sum equals the net position of hedge funds as of April 2012 (see Figure 59). If hedge funds collectively attempted to liquidate their positions within the span of a couple of weeks, the sovereign CDS market could suffer considerable strain.

Another concern is that market-making activity is highly concentrated in sovereign CDS. Figure 61 displays the dollar-weighted fraction of trading in this market that is done through the top two market makers, broken down by type of counterparty. For example, during December 2011 to February 2012, 40 percent of hedge-fund trading in sovereign CDS was done through two market-making banks. During the three-month periods between January 2010 and February 2012, between 30 percent and 60 percent of all mutual-fund trading in sovereign CDS was done through two banks. The identities of the top two market makers may change over time and across types of counterparties (see Chen and others, 2011).

Highly concentrated trading has implications for financial stability. If an important market maker pulls back from trading, will the market continue to function smoothly? One way to shed light on this question is to examine whether market makers can be substituted. Does the identity of the most active market makers change over time? Do market makers that dominate transactions with one type of counterparty also dominate transactions with other types?

Figure 62 helps answer these questions by showing the share of transactions over time and across counterparty type involving the two market makers with the largest trading activity over the entire sample.

In Figure 62, the two market makers are the same at all dates and for all counterparties, which differs from Figure 61. A comparison reveals that market making dominance with one type of counterparty did not correspond to dominance with another. For example, hedge funds traded relatively little with these two market

makers. Even for counterparties that traded actively with these market makers, the combined share of the two market makers varied widely over time. The evidence of flexibility in market making activity suggests that the sovereign CDS market may be resilient to the loss of one or two market makers.

As these figures show, transaction-level data help identify aspects of the CDS market that can affect financial stability. However, our research did not explore why end users chose to buy or sell credit protection in the sovereign CDS market. We cannot address that question unless we know more about the portfolios of the end users.

For example, are hedge funds heavy purchasers of protection because they are hedging other positions in their portfolios? Or are they collectively betting on deterioration in a specific country's credit quality? What magnitude of collateral calls could market makers face in adverse conditions?

The Office's future research will integrate these data with other datasets and attempt to answer these questions.

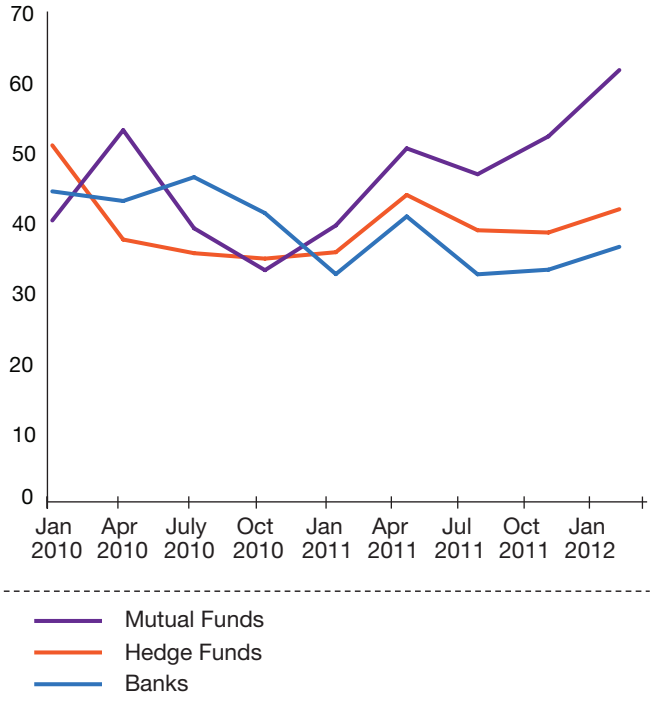
Hedge Fund Leverage

Do highly leveraged hedge funds measure and manage risks differently than hedge funds that are less highly leveraged?

As required by the Dodd-Frank Act, the SEC and CFTC created Forms PF, and CPO-PQR, respectively, to gather confidential risk information from advisers of hedge funds and other private funds. Certain large advisers began reporting information about fund assets, leverage, and risk exposures in 2012. Researchers at the OFR and the SEC are evaluating the quality and coverage of the data from early returns of Form PF. Form PF is a potentially rich data source, one that we plan to use to better understand the role hedge funds play in the financial system, monitor risks in the private fund industry, and research threats to financial stability.

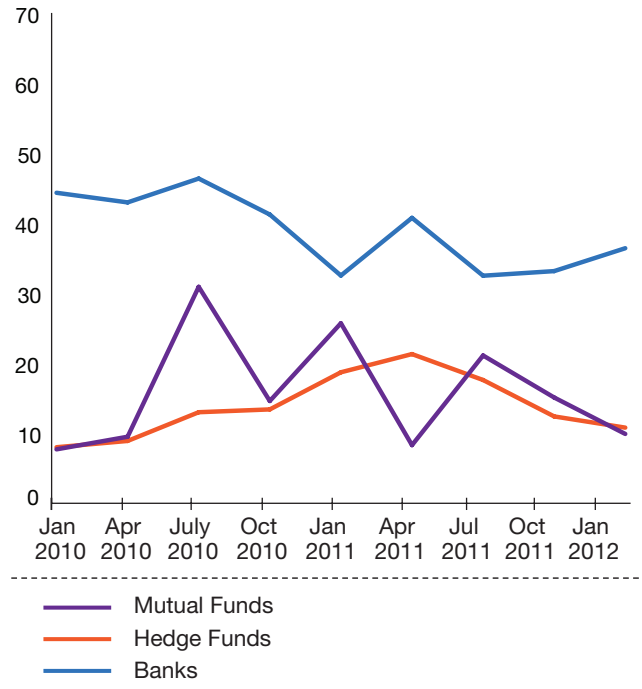
Every new data collection initiative has growing pains, and Form PF is no exception. Filling data gaps begins with data collection, but ensuring complete and accurate data takes time and requires an ongoing assessment of data quality. Because Form PF collection is so new, caution is important in interpreting research

Figure 61. Concentration in Market Making Activity for Trades (percent)



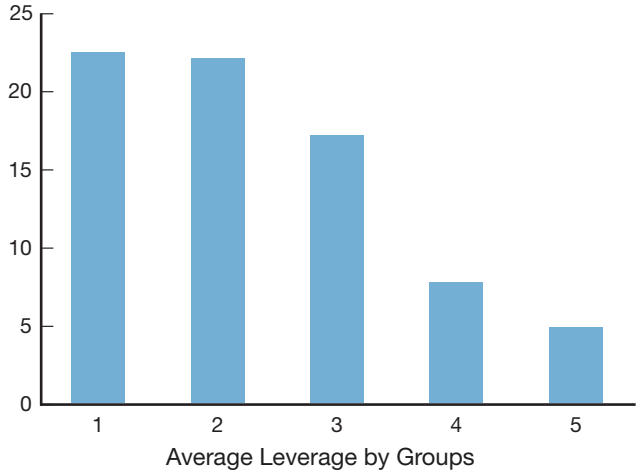
Sources: Depository Trust & Clearing Corporation (DTCC), OFR analysis

Figure 62. Share of the Top Two Overall Market Makers in Trading (percent)



Sources: Depository Trust & Clearing Corporation (DTCC), OFR analysis

Figure 63. The Proportion of Hard-to-Value Assets Based on Leverage (percent)



Note: Group 1 has zero average leverage and is made up of 2,628 hedge funds. Groups 2, 3, 4, and 5 each have 665 hedge funds.

Source: OFR analysis of SEC Form PF data from the 5,288 funds that report relevant information on Form PF.

results at this stage. The following summary discusses the Office's first experience analyzing Form PF data.

The Office received data that approximately 4,000 funds submitted to the SEC during the past year. The filings contain portfolio-level information for about 8,000 hedge funds and 10,000 other private funds. Funds reported gross and net asset values. About 1 percent of the filings reported a gross asset value less than the net asset value. Another 1 percent of the filings reported a negative net asset value. The funds are required to submit annual breakdowns of their assets by the methodology used to estimate fair values. Approximately 5 percent of the filings that should include this breakdown contained zeros for all categories. These findings could indicate data problems.

Out of the 8,000 hedge funds that filed a Form PF, about 1,400 are defined by the SEC as "qualifying hedge funds," each with a net asset value of at least $500 million.[7] Qualifying hedge funds are required to submit quarterly reports that include additional data about how much of their borrowing is secured and unsecured. More than 10 percent of qualifying hedge funds reported total borrowing amounts that differed significantly from the sum of the secured and unsecured borrowing amounts listed.[8] A few filings — approximately 1 percent — reported that secured and unsecured borrowing were zero while also reporting that total borrowings were positive.

We focused our analysis on hedge fund leverage. A fund with higher leverage or debt is typically more vulnerable to adverse events, if all other factors are equal. We wanted to find out if funds with higher leverage hold more transparent assets that are easier to trade, based on Form PF data.

The first step explored the relationship between a hedge fund's leverage and the fraction of its assets that are hard to value. Leverage is measured by debt divided by net asset value and does not include leverage associated with the use of derivatives. Debt is measured by the greater of: (1) the reported total borrowed funds and (2) the reported unsecured plus secured borrowing. The fraction of assets that are hard to value is measured by the ratio of assets that are valued using unobservable inputs, such as modeling assumptions, to the fund's total assets.[9] The liquidity of hard-to-value assets may mean funds heavily invested in such assets are exposed to greater funding risk due to potential fire sales.

We sorted hedge funds into five categories by their reported leverage.[10] The first category contains funds that report zero leverage, which includes about half of the funds. The other four categories contain the remaining funds, broken into quartiles by leverage.[11]

Figure 63 shows that on average, funds with higher leverage have a lower proportion of hard-to-value assets. Hard-to-value assets represent a little more than 20 percent of the assets of funds with no leverage.[12] For the category of funds with the highest leverage (mean ratio of debt to net asset value of about 2.8), the corresponding fraction was less than 5 percent. That suggests funds with larger leverage ratios may be choosing assets that are relatively easier to dispose of during a crisis.

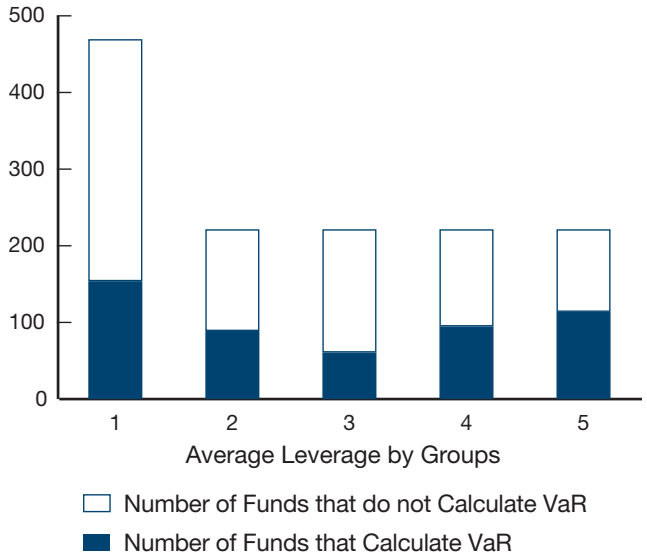
Another important research question is whether highly levered funds are carefully monitoring their risk exposure. A rough way to judge this monitoring is by whether the fund calculates the Value-at-Risk (VaR) of its portfolio. Qualifying hedge funds are required to report whether they regularly calculate VaR as a risk management tool. Figure 64 shows how many of the qualifying hedge funds included VaR calculations, based on leverage in their quarterly filings.

Funds with higher leverage were somewhat more likely to calculate VaR, as shown in Figure 64. For example, although only 33 percent of the hedge funds with no leverage Group 1 regularly estimated VaR, the corresponding ratio was 51 percent for the funds with the highest leverage. This does not necessarily imply that funds chose to calculate VaR owing to their leverage. A more likely link is that funds with more leverage also tended to be larger, as measured by net asset value. Larger funds were also more likely to calculate VaR.

Finally, we examined the relationship between leverage and the level of VaR. We analyzed 510 qualifying hedge funds that reported a VaR measure after dividing them into five categories based on reported VaR. Perhaps the most interesting result is that 87 of these funds reported a VaR of zero. This is another data problem. We do not know what the fund advisers meant by reporting values of zero. These funds are placed in their own category and the remaining funds are placed in quartiles according to reported VaR.

The data in Figure 65 show that on average, funds that reported higher values of VaR also tended to report lower leverage. For example, the group with the highest VaR had an average leverage ratio of around 0.8, about half that of the group with the next-highest VaR. This pattern suggests that funds with more leverage take on less risk. But recall that for most funds, this risk-taking measure is unavailable. We cannot put much weight on this result without alternative measures of portfolio risk to confirm it.

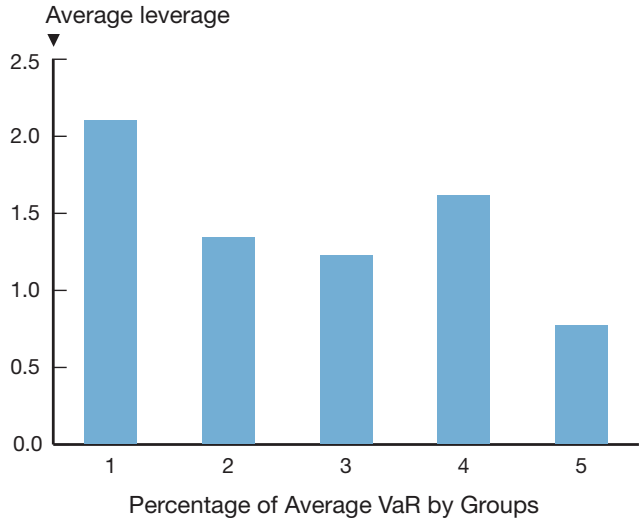
Figure 64. Likelihood of Value at Risk (VaR) Calculation Based on Leverage



Note: The OFR divided the qualifying funds into five groups based on average leverage. Group 1 has zero average leverage; Group 2 has 0.02; Group 3 has 0.33; Group 4 has 0.63; Group 5 has 9.16.

Source: OFR analysis using SEC Form PF data from the 1,338 qualifying funds that responded to the question.

Figure 65. Average Hedge Fund Leverage Based on Value at Risk (VaR)



Note: Group 1 has 87 funds, Group 2 has 105 funds, and Groups 3, 4, and 5 each have 106 funds.

Source: OFR analysis of SEC Form PF data from the 510 funds that reported they calculate VaR.

6 Promoting Data Standards

Data standards benefit market participants and regulators by reducing the cost of data collection and by facilitating the sharing, exchange, comparison, and aggregation of data for analysis and risk management. Congress assigned the OFR responsibility for promoting financial data standards and helping to develop them. Accordingly, for example, the Office has played a central role in the international initiative to establish a global Legal Entity Identifier (LEI) to precisely identify parties to financial transactions. This chapter outlines our broader data standards agenda, summarizes recent trends, and describes recent progress in implementing the LEI and other standards initiatives.

6.1 Data Standards Agenda

To fulfill its statutory mission, the OFR provides advice, support, and leadership in the development, use, and integration of financial data standards. Once the need for a new standard has been identified, we: (1) evaluate whether addressing the need lies within the scope and mission of the Office, (2) determine whether the proposal represents a good candidate for standardization, and (3) determine the Office's strategy.

The financial crisis revealed fundamental deficiencies in the ability of market participants to manage and analyze the terabytes of data generated daily. The lack of consistent standards for precisely identifying financial entities and defining financial instruments prevented institutions from assessing and measuring building risks within and across business lines. Similarly, regulators and supervisors were unable to assess risks comprehensively from firm to firm, much less across firms or segments in the financial system.

Data standards define the format, content, and syntax of data, providing a common language that enables precise identification of entities and instruments, the relationships among them, and the data to describe them (see insert on What Are Financial Data Standards?). Data aggregation is possible only when data standards exist.

WHAT ARE FINANCIAL DATA STANDARDS?

Financial markets rely on data standards to function smoothly. These standards depend on commonly accepted definitions of concepts like "equities" and "swaps."

Entity identifiers identify specific legal entities, which could include parent companies and their subsidiaries as well as off-balance-sheet vehicles.

Instrument identifiers identify financial instruments like stocks, bonds, and loans. For example, there is the International Organization for Standardization (ISO) standard for individual securities known as the International Securities Identification Number.

Standards for financial and business reporting align information reported by companies to the public, for example on financial disclosures and regulatory reports. An important initiative is XBRL, or eXtensible Business Reporting Language, which enables free and open exchange of business and financial information.

Transaction standards align information used in financial transactions. For example, the Mortgage Industry Standards Maintenance Organization developed a language that enables consistency in describing mortgage transactions.

Source: OFR (2012)

Data standards are widely used in numerous industries, such as healthcare and consumer goods. Without bar codes, for example, supply-chain management would be impossible. Financial data standards are less prevalent, but a strong consensus has developed that wider use of data standards is critical for financial-market participants and policymakers.

Why Data Standards?

Standards are needed to: (1) improve reporting and risk management for firms, (2) support prudential supervision and market oversight, and (3) promote and improve the efficiency of macroprudential monitoring by the Council and the Office. In fact, standardization can enable the same data to serve all three purposes.

Data standards allow the exchange of data between systems; aggregation of data from multiple sources; comparison of data among unrelated systems; and automation of processes for storing, reporting, and processing data.

Data standards also enhance data quality and support consistent rules for what metadata are required. Ideally, data standards are adopted when new types of data are introduced, or new requirements are initiated for reporting or transacting data. In practice, the legacy of insufficient financial data standards means new standards must be created for existing and emerging data needs.

Data standards can develop in several ways. Businesses often develop standards without government involvement. For example, the mortgage industry, working through a standard-setting body, voluntarily adopted an automated process more than a decade ago for a manual mortgage application process that was slow, resource-intensive, and often produced inconsistent results (see Hutto, 2003; Pafenburg, 2004). But private-market participants do not always work together to adopt or implement common standards. A standard that is not implemented has no value.

Standards are a public good that benefit users and the community. As with many public goods, the up-front work needed to define and use a standard can be costly for the first user. In addition, some market participants may benefit from the lack of a commonly accepted standard.

Government or industry organizations may support standardization to overcome such obstacles, commonly known as collective action problems. Statutory or regulatory requirements can help develop and implement standards; for example, regulators may need to collect data for policymaking or to investigate an emerging concern. Regulatory oversight can help ensure that standards are adopted and implemented consistently for the benefit of the business and policy communities.

Relevance to Our Mission

By improving data quality, data standards can also improve the Council's and our financial stability monitoring. We can assist Council member agencies in data standardization when a lack of data sources or inconsistent practices among agencies for data classification and collection hampers regulatory sharing. For example, by using the Legal Entity Identifier (LEI), regulators can more easily aggregate and analyze data to evaluate where risks may be building across the financial system.

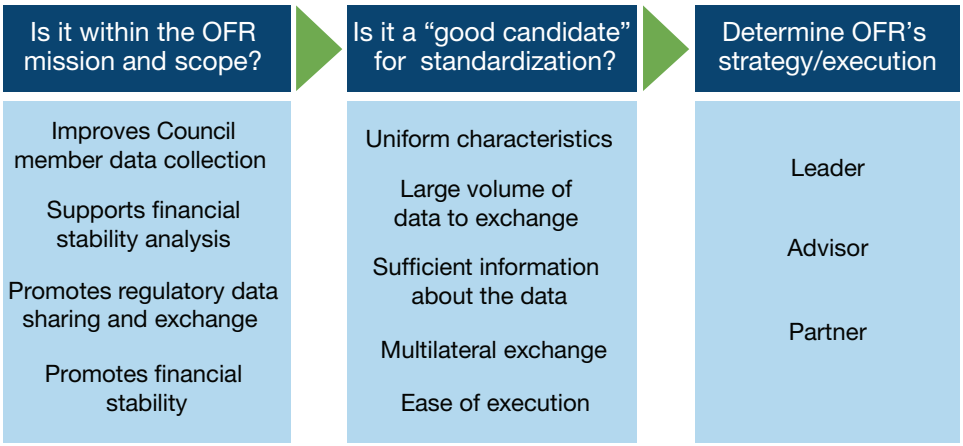
The Office promotes data standards that can add clarity, insight, and common understanding about financial markets. For example, making more information available or establishing new standards could help integrate transactional data within specific markets.

Once the need for a new standard is identified, we analyze whether a standards project is relevant to our mission and scope (see Figure 66). Under the Dodd-Frank Act, the Office is required to standardize the types and formats of data reported and collected on behalf of the Council. We work closely with the Council's Data Committee, with international authorities, and with financial institutions and standard-setting bodies. The Office also benefits from the advice of industry experts on our Financial Research Advisory Committee and the committee's data subcommittee.

We use the following criteria to evaluate potential data standards projects. Such projects must:

1. improve Council member data collection,
2. support financial stability analysis,
3. promote regulatory data sharing and comparing, or
4. promote financial stability.

Figure 66. Data Standardization Considerations



Source: OFR

In 2014, we will continue to provide significant support to the international initiative establishing an LEI for each legal entity participating in global financial markets. This identification will help regulators aggregate, compare, and analyze data better than currently possible (see Section 6.3).

Our agenda also includes moving forward to meet the Dodd-Frank Act mandate to publish databases of financial companies and financial instruments, providing continuing assistance to Council member agencies with data standards initiatives, and beginning to identify opportunities to optimize the collecting and reporting of regulatory data among Council member agencies.

Regulators need to collect data for prudential supervision and market oversight, regulatory compliance, and financial stability monitoring. Improving existing data collections and assisting Council member agencies in their initiatives can help align data standardization among Council member agencies, and thus enhance coordination and data sharing. Also, providing data to regulators is easier and less costly for financial firms if they can draw on the definitions and reporting structures they use internally (see Principles for Data Collection).

The Dodd-Frank Act requires additional financial data collection and regulatory reporting and promotes better financial standards. For example, the Consumer Financial Protection Bureau (CFPB) is required to assess identifiers for mortgages, properties, and legal entities in the mortgage market. Our work on a universal mortgage identifier, in collaboration with the CFPB and other Council member agencies, is described in more detail in Section 6.4 and in a recent OFR working paper.

Another Dodd-Frank provision requires companies to report certain over-the-counter (OTC) derivatives trading to the Securities and Exchange Commission (SEC) or to the Commodity Futures Trading Commission (CFTC). We are working with the CFTC and other regulators around the world to align and standardize derivatives reporting (see Section 6.4).

Is It a Good Candidate for Standardization?

We analyze a range of factors to determine whether a type of data is a good candidate for standardization. Good candidates share uniform data characteristics, involve a large volume of data, have sufficient information available, often involve multilateral exchanges, and are relatively easy to execute.

From initial market inception through maturity, a financial product generates a growing volume of data that must be processed or assessed. A new financial product may have to wait until it wins market acceptance before it becomes a good candidate for data standardization. Large volumes of data with a standard form, or syntax and meaning — such as in the case of corporate bonds — are more easily parsed by computers for business analysis, data distribution, and record keeping. Often, market participants wait to see significant trading volumes from a new financial product — such as a

PRINCIPLES FOR DATA COLLECTION

A successful data collection effort obtains data at an acceptable level of quality for the intended purpose. The data should be electronically parsed, easily stored, and easily used for its purpose. Although each situation is different for data collection, regulatory reporting, or data sharing, the following guiding principles can help as Council member agencies pursue new data collections:

Identify the business purpose for collecting the data. Whether the data are collected by government mandate or incentive, there should be a compelling reason for participants to submit data and a generally valid purpose for its collection.

Understand what specific data are needed and how the data would be produced. If the data are not physically available or do not exist in the detail needed, analyze how the data could be generated. A good understanding of the data definition is needed to ensure that the data are collected at the right point in the business process for the intended use.

Understand that modern data collection is electronic. Today's financial markets use electronic systems to conduct business. Paper forms are yesterday's tool. Data collected will undergo statistical analysis and exploration with computer software. To reduce potential sources of error, transmitting data system-to-system eliminates manual steps on both ends of the data collection process.

Determine if the data can be submitted using the prevailing standard in the market. Open, consensus-based industry standards include feedback from a representative sample of the industry and reflect the systems, data, and business processes already in use. Standards based on market participants' existing practices have a better chance of success. Feedback from an appropriate industry standards group is valuable.

Precisely define what data must be submitted. Publish specifications that include data names and definitions, data typing, acceptable enumerations, and integrity restrictions that market participants need to know when preparing data submissions. Furnish specific examples and user guidance. Set up mechanisms for participants to ask questions and get answers.

Use validation controls at the point of data collection in the form of submittal failures or messaging. Validation controls create some upfront work but ensure that data received are valid, consistent, and usable. Include validation controls when data collection measures are being designed so participants can build this step into their procedures.

Give participants time to test their data formation process and submittal system. An integration period lets both sides test processes without the pressure of a real-time submittal. A testing period helps ensure a data collection project does not stymie a financial company's usual flow of business.

Seek ongoing feedback to refine controls, specifications, and data that are collected. Be prepared to evolve as business needs and processes change, and use feedback to improve.

derivative or swap — before investing in the technology to fully integrate the product's data into their automated systems.

Successful standardization depends on having enough information about the characteristics and business usage of data to standardize them properly. A data standard must be defined in detail to support the intended business purpose.

Data exchanged among multiple parties in the financial marketplace also represent good candidates for standardization. Integrating data with varied definitions and syntax can be expensive and difficult, and costs could increase as more companies participate. Standards can facilitate that integration and help reduce these costs and identifiers are a good example of this (see insert, Why Identifiers?). On the other hand, for projects that are ad hoc in nature, with limited data integration complexity and low volume or frequency, customized work may be appropriate.

WHY IDENTIFIERS?

The word "identifier" figures prominently in discussions related to the financial services industry, in part because the industry has been slow to adopt data-sharing and the efficiencies it can bring. Manufacturing and distribution industries already invested heavily in systems to connect and communicate, and in the process became adept at sharing information to relay business messages. This typically involves some form of shared identification — participants in a given system maintain shared datasets that enable them to be precise in ascribing the results of transactions to parties in the transaction.

Even when data are collected in an organized manner, dataset information comes from a variety of sources and integrating it is a costly and time-consuming process. Moving large blocks of data across a network is almost always slower and more expensive than moving smaller blocks. This leads to the creation of filing and shorthand systems that allow small groups of information to "point" to larger amounts of recorded information. For example, when one firm sends a message to another that refers to GM shares, the assumption is that both parties will look up and identify the issuer as General Motors Co.

An identifier is a form of shorthand, or "smaller representation" in the world of data standards. In the case of a computer representation of an entity, the full description may involve hundreds of individual facts. However, a small subset of those facts may be sufficient to establish the entity's uniqueness.

A shared identification system of any type requires agreement among participants on how to maintain lists of many things (organizations, products, infrastructure, geographies, time zones, and others) necessary to get the job done. This is where the financial services industry has unique challenges. Some companies may have a disincentive to share information.

The financial services industry needs shared identification systems that require standardized definitions, assignment, and maintenance methods. When an identification platform already exists, it typically is specific to a given jurisdiction or asset class and does not meet the industry's current needs. The creation and enhancement of shared identification systems are critical to the OFR's mission to analyze risks to financial stability.

Any project to help regulators collect standardized data from financial institutions should make the process as easy as possible for all users. Standards must be clearly defined, documented, communicated, and supported. Reporting companies need information about the standard itself and written guidance to prevent misunderstandings. Industry participants and regulators must also have the infrastructure to support the technologies, formats, and processes required to submit and accept the data.

A standardization project should consider whether companies in the industry already have the needed data within their business processes, what format the data are in, and how detailed the data are. Aligning data reporting standards to data definitions and structures already in use by the industry is simpler, more efficient, and less likely to increase support costs. This approach also helps prevent errors that can be introduced if existing data must be mapped to different formats, is subject to "prework," or otherwise must be manually manipulated to make the data usable.

Determine the Role of the Office

After a data standardization project is identified, the Office must decide how to participate. Participation can take the form of leadership or collaboration with a regulatory agency or participation in consensus-based organizations. In some situations, we may decide to exercise our rulemaking authority, granted by the Dodd-Frank Act.

Given its statutory underpinnings, the Office is ideally suited to coordinate standardization requiring the involvement of more than one regulator, domestically or internationally. Our role in laying the foundation for a global LEI is a good example.

We may collaborate with industry organizations to develop open standards. Open standards fit with the industry's underlying business processes, technologies, and business knowledge. Standards developed with industry organizations are more likely to be easily integrated into existing systems and processes, and prove less burdensome for companies to adopt.

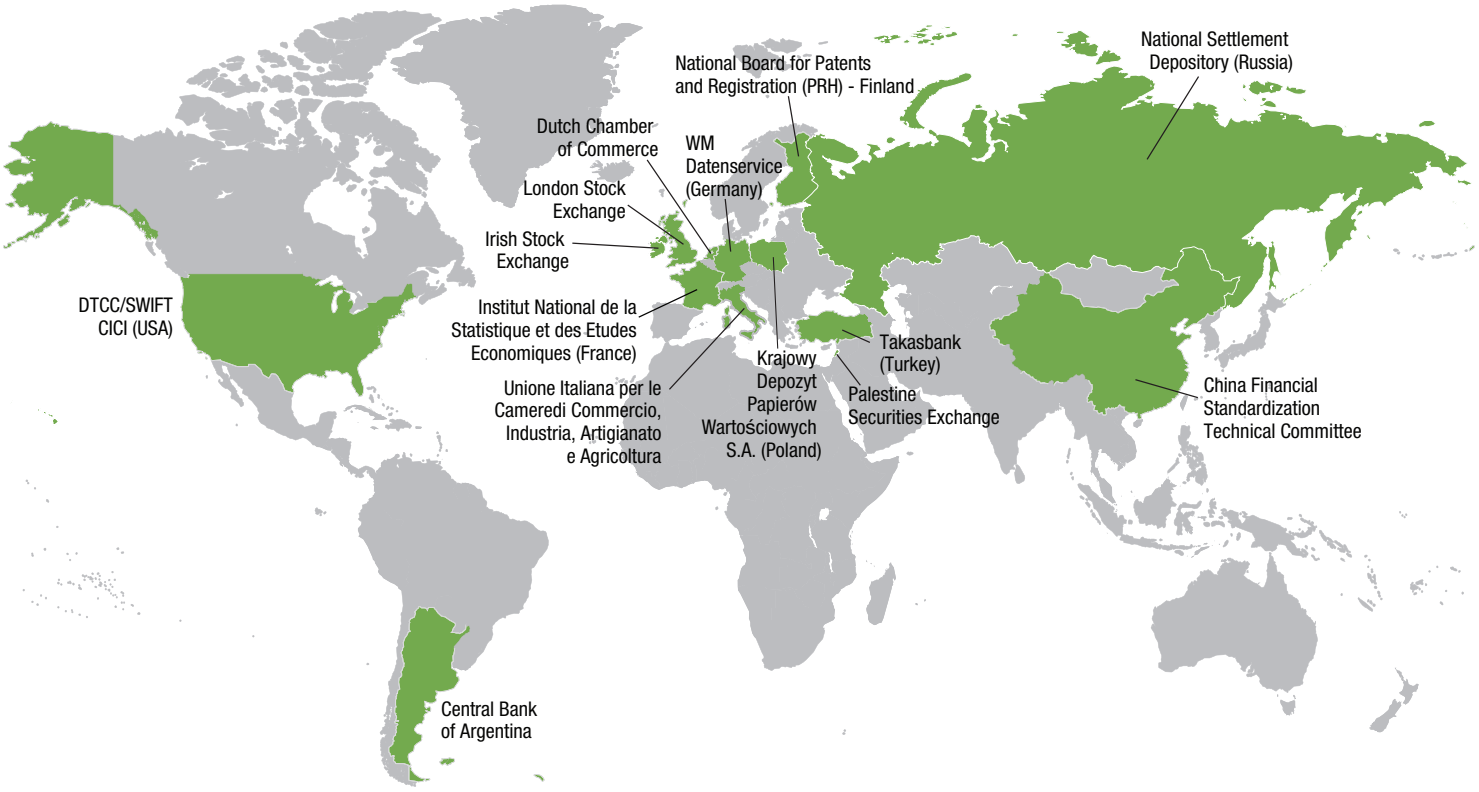
We can reduce some of the data-reporting burden on market participants and regulators by collaborating with Council member agencies on their individual data standardization or data collection projects. By commenting on draft plans and proposed rules, we can also contribute to the data reporting priorities of Council member agencies and reduce the cumulative burden of regulatory reporting on market participants. We have expertise in data standardization, collection, and processing. By advising Council member agencies, we can promote the adoption of open, consensus-based information standards and help agencies align technologies, data uses, and implementation practices.

Under section 153 (c)(2) of the Dodd-Frank Act, the Office has certain authority to propose and finalize regulations requiring Council member agencies to standardize, align, or collect data. As we work to integrate data across sources and across Council member agencies, we are gaining practical experience in determining where standardization is needed for more efficient aggregation and analysis.

6.2 Trends in Information Standards

Information standards are evolving rapidly on several fronts. The G-20 countries are moving ahead to implement a 2009 plan requiring regulatory reporting of OTC derivatives (see FSB, 2013a). Establishment of the LEI infrastructure and operational processes to support it is well underway. The SEC has adopted a rule requiring self-regulatory organizations to submit plans to implement the consolidated audit trail and corporations are adopting the eXtensible Business Reporting Language, known as XBRL, for financial reporting. Internationally, governments are talking about how to align regulatory practices across markets and national borders.

Figure 67. Local Operating Units



Source: LEI Regulatory Oversight Committee

The need to quickly process and analyze large sets of data has become increasingly the norm and requires a digital data stream, which a user can customize to display raw data, a report, a form, or even a Web page. The role of information standards to exchange digital data streams is becoming increasingly important with automated data use. Because regulators need data that are easier to access quickly and integrate with existing data, they have adopted methods the financial industry uses to conduct transactions. Amid the changes in data exchange-and-transmittal methods, industry standards bodies, financial firms, software providers, and others are closely following the development of regulatory reporting initiatives in order to comply with new requirements.

Industry standards organizations are seeing a trend of consolidation, integration, and alignment among standards to simplify reporting and transacting business. Greater integration of standards creates synergies in data definition and structure that can speed up data analysis using several different sources.

However, the amount of time and effort required to launch a new digital data collection initiative should not be underestimated. Adopting new or modified data collection processes can take years, especially in domains with lengthy and complicated supply chains. Success requires preparation and detailed analysis, methodical planning and risk management, and perseverance.

6.3 Legal Entity Identifier

The Office's top data standards priority is supporting the global initiative to assign a unique Legal Entity Identifier (LEI) to every financial market participant. Each LEI is a 20-digit alphanumeric code that precisely identifies parties to financial transactions. When linked to transactional data or reporting, the identifiers help regulators understand market activities and see where risks may be building. The Office and other domestic regulators have used a combination of regulatory compulsion, international regulatory coordination, and consensus-based standard setting to develop the global LEI system.

LEI Update

International efforts to develop the global LEI system made significant progress in 2013. A three-tiered governance structure was finalized and interim identifiers were issued to thousands of financial companies around the world. The Office and other regulators are beginning to work with the resulting data.

Overseeing the global system is the LEI Regulatory Oversight Committee (ROC), made up of 57 central banks, regulators, and other international authorities. In January 2013, the ROC selected the Office's Chief Counsel as its chairman and officials from the Bank of France and the Japan Financial Services Agency as vice chairmen. During the year, the ROC developed procedural guidelines, launched a new website at www.leiroc.org, and continued work on the governance of the global LEI system.

The next level of governance is the Global Legal Entity Identifier Foundation, a Swiss-based

LEI Development Timeline

2010			2011			
July	November	December	May	June	July	September
Dodd-Frank Act creates OFR; requires CFTC, SEC to issue rules for reporting swaps transactions	CFTC, SEC propose rules to report swaps transactions, express preference for a universal identifier OFR issues policy statement advocating LEI	U.S. regulators issue discussion paper about LEI as a linchpin for financial data	Global Financial Markets Association proposes industry requirements for LEI	Canadian Securities Administrators call for swaps traders to have unique identifier based on international standards	Hong Kong Monetary Authority says it will work with Hong Kong Trade Repository to consider incorporating global LEI into reporting	G-20's Financial Stability Board holds public-private sector workshop to begin developing LEI

not-for-profit organization, which will serve as the central operating unit responsible for ensuring that companies and countries that adopt the LEI adhere to its standards for reliability, quality, and uniqueness. In 2013, the ROC began organizing the foundation and is in the process of selecting an international board of directors to run it.

At the grassroots level, a series of local operating units will serve as the registrars to assign LEIs to financial companies and each of their legal entities. Local operating units, which will also validate and maintain reference data, can be established by private firms or by governments, and can be country-specific, regional, or international.

Several interim local operating units already have been created. As of mid-November 2013, an initial group of nine had issued more than 100,000 interim identifiers, or pre-LEIs, to financial companies and their subsidiaries. Notably, five of these local operating units had been "endorsed" by the ROC, meaning that the codes they issue can be used for reporting purposes in regulations issued by ROC member countries. These entities are:

- CICI Utility, created by Depository Trust & Clearing Corporation and the Society for Worldwide Interbank Financial Telecommunication;
- WM Datenservice, a German company;
- INSEE, France's National Institute of Statistics and Economic Studies;
- London Stock Exchange; and
- Takasbank in Turkey.

Because it is critical that these pre-LEIs seamlessly transition into permanent LEIs once the global system is up and running, the ROC has worked to ensure that they meet regulatory needs, are consistent with one another, and are fully compliant with LEI data quality standards. Other pre-local operating units are operational and are expected to be reviewed for endorsement as they apply to the ROC.

Other organizations have announced plans to launch local operating units and are in varying stages of development (see Figure 67).

LEI History

Regulators and market participants use a wide variety of identification methods to keep track of individual financial institutions, but these identifiers are diverse, incomplete, overlapping, and not directly comparable. Some market participants have long identified the risks created by the absence of a universal standard. The financial crisis served as an impetus by demonstrating the urgency of the problem and the potential impacts on financial stability. For example, following the collapse of Lehman Brothers, neither regulators nor private-sector risk managers were able to view the total extent to which important market participants were exposed to Lehman and its legal entities.

Following the crisis, U.S. and global regulators collaborated to study data standards that could have assisted with analysis during the financial crisis and agreed that an LEI system was a foundational need (see LEI Development Timeline). In November 2010, the Office issued a policy statement calling for LEIs and noted the potential for rulemaking requiring the use of an

LEI Development Timeline (continued)

2011		2012				
October	December	January	May	June	July	September
SEC, CFTC finalize rule requiring hedge funds and commodity pool operators to report leverage on Form PF with optional use of LEI	CFTC approves final rule requiring identifier in regulatory reporting of swaps trading, mandates "CFTC Interim Compliant Identifier" until LEI system ready	Bank for International Settlements and International Organization of Securities Commissions urge use of LEI by trade repositories as part of swaps market reforms	International Organization for Standardization issues ISO 17442 specifications for LEI data standard for financial services industry	G-20 leaders endorse plan for global LEI system	Financial Stability Board convenes LEI private sector preparatory group EU adopts Reg. 648/2012 requiring LEI in swaps reporting	National Association of Insurance Commissioners says it will require LEI in regulatory reporting

identifier (see OFR, 2010). The CFTC and SEC each proposed rules that month requiring the use of LEIs if a system was developed through a consensus process and globally adopted. A Federal Reserve white paper followed, calling for a public-private partnership to develop an LEI system that took into consideration the industry standards for data identification (see Bottega and Powell, 2011). Officials took these steps because they considered the LEI necessary for effective regulation, and because private markets had failed to develop one independently.

Public and private efforts helped to push the project along. The International Organization for Standardization (ISO), an independent, nongovernmental organization made up of national standards bodies from 163 countries, served as an important forum to build consensus. In June 2012, that organization adopted ISO 17442 as a LEI standard for financial services companies.

Around the same time, a private-sector preparatory group began meeting to discuss ways to build a global system. The work of the ISO and the private-sector group was critical because private-sector business activities cross jurisdictional lines. A well-designed international standard benefits regulators who want a standard for effective supervision, as well as private-sector organizations that need a standard for risk management and operational efficiencies. As a result, the private sector has played an important role in assuring that the LEI standard and system are fit for industry purposes as well as regulatory purposes.

U.S. regulators also finalized key rules in 2011 that would rely on the LEI. The SEC and CFTC ordered hedge funds and other private funds to begin reporting certain information on Form PF (SEC) and Form CPO-PQR (CFTC) and included optional use of the LEI. The SEC also adopted rules updating investment advisor reports and added the LEI as a reporting element. In early 2012, the CFTC finalized a swaps reporting rule that requires the LEI.

Meanwhile, regulators around the globe began working together on an international identification system. The Office assisted in that work because a global standard would bring greater transparency than a standard used only in the United States.

By the end of 2012, the G-20 had endorsed a final charter for the LEI Regulatory Oversight Committee and designated ISO 17442 as the standard that regulators would use. That allowed the CFTC, which had adopted swaps reporting rules in early 2012, to designate a utility as the LEI provider for its swaps rule, as long as the utility complied with ISO 17442. As a result, the CFTC Interim Compliant Identifiers (CICIs) are being used until the global LEI system is fully operational. At that time, CICIs will convert to permanent LEIs. In Europe, similar rules were adopted, making more urgent the need for a global system. The interim system was established, allowing market participants to receive codes from endorsed pre-local operating units for regulatory reporting in Europe or the United States regardless of where the code was obtained.

Putting the LEI System to Work

For regulators and market participants to realize its benefits fully, the global LEI must be integrated into the economic system. This means extending the use of

	2013				
October	January	March	July	August	October and November
Financial Stability Board implementation group drafts charter creating LEI Regulatory Oversight Committee to govern global LEI system	Regulatory Oversight Committee created to govern LEI system	Regulatory Oversight Committee begins work to form a nonprofit foundation in Switzerland to act as the central operating unit of the global LEI system	LEI Regulatory Oversight Committee issues interim requirements for local operating units in the global LEI system	The OFR's Financial Research Advisory Committee recommends the OFR adopt the global LEI system to meet Dodd-Frank Act mandate for a financial instrument database	Regulatory Oversight Committee formally approves five pre-local operating units, and codes issued by them will be globally recognized for regulatory reporting

LEIs to follow financial transactions, normalize data reporting, and identify corporate hierarchies.

We are working with the financial industry and standard-setting organizations to incorporate LEI data records into the standards they manage. Each LEI data record includes the legal name, location, and other information supplied by an applicant company or subsidiary when it registered for an identifier. We are also collecting feedback to improve LEI practices and to make the data available for transactional flows for financial products, interactions, and regulatory reporting.

Integrating LEI data structures with industry standards will encourage the routine use of the LEI in business. Routine use will require educating market professionals about the LEI system and how it operates, and collaborating with international regulators to align data practices. Working with industry and market participants may also yield information about how to connect markets and data in new ways. As LEIs are integrated into existing or new financial information standards, the Office is encouraging Council member agencies to adopt and use them. We expect new initiatives and proposed rules to require LEI use by legal entities that are parties to, or associated with, financial transactions and regulatory reporting.

One example of LEI integration is in the mortgage industry. The Office worked with the Mortgage Industry Standards Maintenance Organization (MISMO), a data standards body for the mortgage industry, to add the LEI data record to the industry's standard for data exchange. That means a mortgage transaction can carry the LEI of each financial institution involved from the initial loan to securitization to servicing.

Data points and definitions for LEI data were discussed by industry participants and resulted in MISMO equivalents for LEI data to be added in Version 3.3 of the MISMO standard. The Federal Housing Finance Agency (FHFA) and OFR are also working together to support the reporting of the standard's LEI data in regulatory reporting and transaction flows. Adding LEI to the MISMO standard for mortgage transactions will promote transparency and help regulators see risks to financial stability. This partnership is a model for future OFR efforts to support and supplement regulators' initiatives.

Financial Entity Hierarchies

Eventually, the LEI system will include basic hierarchical information. Until that point, as the operational framework for the global LEI system is put into place, regulators are examining how to track the often complex web of legal entities within large financial companies and the relationships among them.

Large banking organizations in the United States are generally organized within bank holding companies, each of which may have thousands of subsidiaries, business units, and legal entities around the world. The complexity of bank holding companies has been increasing for years; some bank holding companies have more than 4,000 subsidiaries globally.

Every bank holding company has multiple, complex interconnections among its subsidiaries through financial guarantees and legal ties, and to other bank holding companies through transactions and commitments. The complexity of the financial network makes understanding potential channels of contagion during a crisis.

U.S. financial regulators collect information on the corporate structures and control of domestic banks and foreign banks with a presence in the United States. For example, the Federal Reserve, which supervises bank holding companies, collects corporate structure and ownership data through its Forms FR Y-6, Y-7, and Y-10 and publishes some of the data on the National Information Center website.

There are differences and gaps among the financial regulators that collect corporate hierarchy information, and data are not always shared easily. For instance, certain entities are not automatically or routinely reported to the National Information Center. Hierarchy relationship data is not collected on broker-dealers, pension funds, and other nonbank financial firms that are not part of a bank holding company.

We are studying the possibility of consolidating and standardizing corporate hierarchy information in collaboration with financial regulators. This approach is similar to the one that regulators of depository institutions have taken in their successful collaboration in aligning regulatory reporting and examination procedures through participation in the Federal Financial Institutions Examination Council. Better information

about corporate hierarchies, coupled with the LEI, will give U.S. financial regulators deeper insight into how large financial institutions are structured internally and how they are connected to each other.

6.4 Identifying Financial Instruments

The Office has also placed a high priority on promoting financial instrument identifiers. We are helping Council member agencies evaluate identifiers for swaps and mortgages and develop strategies for standardizing the collection and aggregation of data in swap data repositories. We are also analyzing the general framework for how financial products could be more precisely identified and developing a strategy to introduce a financial instruments database as required by the Dodd-Frank Act.

A financial instrument can be viewed as an agreement between counterparties to exchange cash flows of specific terms. Mature financial products such as stocks and bonds often have standardized agreements. But innovative financial products have terms and conditions that vary widely. Inside financial institutions, an instrument is usually classified according to characteristics such as ownership rights and terms and conditions. This type of internal classification is used by companies for back-office processing of transactions, front-end analysis, or other roles within the product lifecycle.

However, the financial industry's existing classification system has not kept up with the evolution of complicated new financial products. For example, the ISO standard for Classification of Financial Instruments (CFI) organizes products as equities, debt instruments, commodities, entitlements or "rights," options, or futures. The category "other" is assigned to some derivatives and structured products that have emerged since the most recent update of the CFI standard.

The Office is working with the data standards community to help the ISO update its financial product classifications. As part of that work, we are assessing new methodologies that may help integrate alternative classification approaches recommended by the European Securities and Markets Authority, the International Swaps and Derivatives Association, and other industry groups that are trying to redefine the way products are classified.

Financial instrument identifiers have existed for decades, but still do not uniformly cover all instruments traded in the global financial markets. For example, the CFTC has issued requirements for the construction and use of a Unique Swap Identifier, as called for in the Dodd-Frank Act to fill the gap in clearly identifying swap transactions.

Not surprisingly, product identifiers have generally lagged behind the evolution of innovative new financial instruments into standardized products. As a new financial instrument gains traction in the market, it may evolve from highly customized transactions to more standardized terms that allow the use of electronic trading platforms. As long as the transactions are profitable and the business remains small, private firms will not have an incentive to standardize their language or create costly information collection systems. But as financial instruments become successful in the market, they may move from voice and paper transactions to electronic trading platforms using more standardized definitions and formats.

Derivatives pose an additional challenge with respect to product identifiers. With derivatives or swaps, the distinction between transactions and instruments is less clear — in some cases, because each transaction is unique, the transaction is the instrument. As a derivative instrument becomes popular and widespread, the need for an instrument identifier becomes clearer. When all financial instruments are assigned an identifier, a richer variety of analysis, comparison, and aggregation becomes possible.

Designing a Universal Mortgage Identifier

The recent housing crisis exposed data gaps, risk-management failures, and shortcomings in operational controls throughout the mortgage finance system. Lenders also had problems connecting mortgage origination data to performance data, tracking loan modifications, and verifying loan underwriting practices (see insert on Universal Mortgage Identifier).

Given the size, complexity, and fragmented nature of the mortgage system, regulators need a clear and consistent identifier of each mortgage. Although several

UNIVERSAL MORTGAGE IDENTIFIER

A recent OFR working paper prepared with an interagency working group described how a universal mortgage identifier could improve aggregation, comparability, and analysis in the U.S. mortgage industry. The group agreed that a universal mortgage identifier should have the following characteristics (see McCormick and Calahan, 2013; see also Bottega and Powell, 2011).

Uniqueness and singularity. The identifier should be unique and assigned to one mortgage. No mortgage should be assigned more than one identifier.

Persistence. The identifier should remain with its mortgage until the loan is terminated, regardless of the holder of the loan or any modifications made to it.

Extensibility. The identification system must allow for growth in the number of unique identifiers issued, without having to reuse identifiers.

Neutrality. Identifiers should be neutral and have no information encoded in the identifier itself. This is important for persistence, extensibility, and privacy. For example, embedding a ZIP code in an identifier would limit the number of bits of information practically available. An identifier with an embedded a ZIP code would only be useful so long as the ZIP code with the greatest number of mortgages over time did not run out of identifiers.

Reliability. A universal mortgage identifier must be reliable to be adopted by market participants. The mechanism to assign unique identifiers must be robust, the identifier should not conflict with other systems, and reference databases must be independent of any entity that could go out of existence in the future.

Open Standard. The identifier should be based on an open, voluntary, and consensus standard.

Public Availability. The identifier must be free of any contractual restrictions and available for use by the mortgage industry, regulators, and researchers.

Privacy Protection. A mortgage holder's personal information must be kept private and confidential throughout the life of a mortgage. Beyond simply not embedding information in the identifier itself, the identifier system must be designed to prevent re-identification.

Incentive for Compatibility. As an incentive to invest in the system market, participants should benefit from using the identifier. Regulators should adopt a single identifier for reporting purposes to help encourage coordination between participants in the market.

Registration Process. Identifiers must be promptly assigned during the mortgage application process to prevent disruption to the mortgage market.

Quality Assurance. Errors are often introduced in data in the normal course of doing business. To protect the integrity of a universal mortgage identifier, quality control practices must be adopted, including best practices, such as using checksums and good governance practices, and assigning clear responsibility for acquiring each new identifier.

identification systems exist, no single universal identifier is shared across all government agencies or the industry. As a result, cross-referencing existing identifiers is difficult and inaccurate because of ambiguities and inconsistencies in industry relationships. Ideally, a standard developed by a voluntary consensus standards body would also meet the needs of government, including privacy requirements.

The Office has been working with housing-related federal regulatory agencies to assess the need for a universal mortgage identifier that would promote transparency in the mortgage industry and connect fragmented data from the mortgage lifecycle, while safeguarding personal information. An interagency working group has defined the need and requirements for an identifier and the characteristics it should have, applying lessons learned from our experience with the global LEI project.

Privacy is a top concern, specifically in deciding who has access to the identifier, which mortgage documents must carry the identifier, and how to connect simultaneous or sequential liens taken out by a borrower on a particular property. Another important consideration is how to structure and govern a system of entities that would issue mortgage identifiers and to ensure that each identifier is unique. The Office released a working paper on this subject in December 2013.

6.5 Improving the Integrity of Reported Data

Derivatives Market Reforms

Promoting transparency in the OTC derivatives or swaps markets — including equity, credit, interest rate, foreign exchange, and commodity derivatives — is a priority for international regulators, given the market's decentralized nature and still-developing infrastructure. The lack of information about a buildup in large counterparty exposures to OTC derivatives contributed to the market contagion and the complexity of the workouts associated with the 2008 collapse of Lehman Brothers and the near-defaults of American International Group, Inc. and Bear Stearns (see CPSS and IOSCO, 2012).

Interconnections of participants in the OTC derivatives market and limited transparency of counterparty credit risk exposures contributed to contagion in the recent financial crisis. No central clearing or reporting existed to promote a free flow of market information. The derivatives market has grown since the financial crisis and now totals more than $690 trillion in notional amounts outstanding (see BIS, 2013).

The Dodd-Frank Act amended the Commodity Exchange Act to establish a new regulatory framework for swaps. Derivatives dealers and major swaps participants are now required to register with regulators, meet clearing and trade execution requirements on standardized derivatives products, and comply with recordkeeping and real-time reporting of swaps.

All swaps, cleared or not, must be reported to new entities known as swap data repositories, beginning when a swap is created and ending when it expires. The repositories collect and maintain confidential data about transactions and make the data electronically available to regulators (see CFTC, 2013).

The CFTC issued rules identifying specific data fields that must be reported for every swap and for classes of swaps. The repositories, however, have significant discretion in refining and interpreting the data fields because the fields vary among product groups, such as interest rate swaps and credit default swaps, and between cleared and uncleared transactions. A required format was not defined in detail, and the resulting variations in reporting have hampered regulators' efforts to aggregate and analyze the data. We are working with the CFTC to create additional standards.

The Office is also participating with the OTC Derivatives Regulators Forum and the Financial Stability Board to improve derivatives data reporting, in collaboration with Council member agencies. Global coordination is important in creating standards that will help regulators aggregate and analyze OTC derivative transactions. The Office supports the four principles of data reporting described by the Basel Committee for effective risk aggregation and risk reporting: (1) robust governance and infrastructure, (2) reliable data that reconciles with accounting books and strong controls, (3) accuracy of risk reporting treated analogously to accounting materiality, and

(4) active and engaged role for supervisors in the entire risk reporting process (see BCBS, 2013b).

Financial Instrument Database and Financial Company Database

The Dodd-Frank Act requires the Office to create a financial company reference database and a financial instrument reference database, both accessible to the public. We have initiated a set of projects to fulfill the requirement and to meet internal research and analysis needs for each type of database.

A reference database identifies and describes common formats used to prepare the underlying descriptive data, and contains a broad range of data that must be closely maintained. Some data, such as identifiers and core descriptive material, rarely change while other data, such as market prices, change daily. In between are data that change periodically, such as credit ratings, transfer agents, and variable rate resets.

The global LEI system's assignment of unique identifiers will ultimately make up the financial company reference database mandated by the Dodd-Frank Act. The Office is working with the industry to define a common methodology to consolidate reference files from all local operating units. When the LEI system is fully operational, the Global Legal Entity Identifier Foundation will oversee, coordinate, and maintain a reference database.

Creating a financial instrument reference database poses a different challenge. The Office is assessing approaches to creating the reference tool to standardize descriptive information about the structure and characteristics of financial instruments. There is no common language to define and describe financial instruments because companies, bond issuers, vendors, and other financial market participants use their own terms for data attributes, often based on their business needs.

The Office also received a recommendation from its Financial Research Advisory Committee in August 2013 that we create a financial instrument reference database by developing a way to precisely capture the contract terms of all financial instrument types and to build categories of financial products based on how the underlying transaction data are used. The committee emphasized that the Office should work with financial market participants on a shared industry understanding of terms and concepts.

The advisory committee established a working group to help the Office generate a shared industry understanding of terms and concepts for financial product classification. The group is focusing on how the industry would use a reference database for cross-reference purposes. The group is also examining how the database would relate to standards for financial product transactions already in use, including the ISO's financial industry messaging standards, the mortgage industry's technology standards, and the electronic coding of corporate financial statements. In addition, the working group will assess the processes for registering instrument types and granting public access to the database.

We look forward to the working group's findings and the committee's recommendations based on those findings, as we conduct our own analysis of methodologies, tools, and processes available and suitable for a financial instrument database. In defining and creating the reference database utilities, the Office will take a collaborative approach to ensure the two databases support the use envisioned by the Dodd-Frank Act. We also will continue to work with our advisory committee and the Council to determine the best course forward.

7 Agenda Ahead

In 2013, the Office continued to develop a toolkit for assessing and monitoring threats to financial stability, to evaluate policies for mitigating those threats, to perform fundamental research promoting financial stability, and to improve the scope and quality of key financial data. In 2014, we will extend and expand that work in several dimensions. We will:

- analyze policy issues related to financial stability and provide that analysis to the Financial Stability Oversight Council and the public;
- devote considerable resources to building the infrastructure for managing, cleaning, and protecting financial data;
- augment our secure data warehouse and analytic environment to provide analysts the data and tools to perform deep analysis of the financial system and threats to its stability; and
- enhance the Office's institutional infrastructure to support those activities.

Research Priorities

The OFR has three core research activities: (1) to identify, assess, and monitor potential threats to financial stability, and develop tools for measuring and monitoring those threats; (2) to conduct studies and provide advice on the impact of policies designed to address those threats; and (3) to conduct basic research that contributes to the understanding of financial stability (see the Dodd-Frank Act, Sections 153 and 154).

Monitoring activities in 2014 will focus on improving the prototype Financial Stability Monitor to become a product regularly used by policymakers, as well as developing and testing new tools to help identify and monitor key vulnerabilities and threats. Tools will include quantitative metrics and monitors, as well as qualitative surveillance because not all threats are measurable. We will continue to support the Financial Stabiity Oversight Council in assessing and monitoring the threats to financial stability identified in its *2013 Annual Report,* and on the related threats we identified in Chapter 2 of this report. Key among them are risks in markets for short-term funding and credit, vulnerabilities to an increase in interest rates and volatility, and uncertainty about U.S. fiscal policy.

The Office does not make policy. Rather, our job is to inform the debates about macroprudential policy tools by evaluating their effectiveness and assessing how they may complement or conflict with other types of policy. We are continuing to build our policy analysis team. As noted in Chapter 3, our policy agenda for 2014 centers on fulfilling our mandates to study the impact of policies related to financial stability and to promote best practices in risk management. Projects in the coming year will focus on policies that address vulnerabilities in markets for securities financing transactions.

We will also continue our work on stress testing practices, following up on several OFR working papers in 2013. One paper will further employ agent-based modeling to understand how private decisions affect market outcomes, as described in our *2012 Annual Report* and our third working paper, with specific projects on fire sales and funding runs. At the same time, our ability to evaluate the effectiveness of supervisory stress testing will be greatly enhanced through access to data on the outcomes of those tests and we are in the preliminary stages of working with Council member agencies to determine how best to use those data. The OFR's external Financial Research Advisory Committee has recommended that the Office request access to supervisory stress test data.

Our basic research program for 2014 will complement our first two core activities in several ways. We will pursue further the three research projects highlighted in Chapter 4 of this report: (1) the supply and demand for short-term funding instruments, (2) the development of metrics for monitoring market liquidity, and

(3) the analysis of financial networks. We will publish a working paper describing the methodology used in the Financial Stability Monitor. We will continue to analyze repos, credit derivatives, and money market funds. We will continue to analyze the asset management industry, focusing on risks and vulnerabilities of hedge funds and other private funds using data from Form PF. We will also find ways to incorporate nonpublic data in analytical tools, while protecting the confidentiality of those data so the results can be shared, as described in OFR Working Paper no. 11.

Data Priorities

The Office's data priorities, discussed in chapters 5 and 6, support our research agenda. They include fostering the adoption of the Legal Entity Identifier (LEI) through regulation and market acceptance. We are also evaluating instrument identification. This effort includes beginning work on reference databases for financial entities and financial instruments, and pursuing comprehensive organizational hierarchy data. Another priority is to address data gaps related to repos, the asset management industry, and mortgage real estate investment trusts. In addition, we will begin to identify opportunities to optimize data collection and reporting, while reducing reporting burden when possible. This initiative includes working with other regulators on standards for swap data repositories.

We will continue to provide leadership to the Council's Data Committee, a group of researchers, data scientists, and data policy representatives from each Council member agency. The goal of the committee is to collaborate to improve our collective ability to fill data gaps; promote the use of data standards; share information, while keeping it secure; and promote best practices in data collection, management, and cataloguing. The 2014 agenda for the committee, which meets monthly, will focus on recommendations for filling data gaps and improving data standards. The agenda will also include helping standardize the formats to collect derivatives data from swap data repositories and promoting development of a universal mortgage identifier.

Promoting LEI implementation will remain our top data standards priority for 2014. The global LEI initiative has reached several milestones, including the launching of so-called "pre-LEIs." In 2014, we will help make the Global LEI Foundation operational and continue to encourage adoption of the LEI in reporting requirements.

Institutional Priorities

In 2013, the Office designed and purchased the major components of the secure analytic environment and we are now implementing the system to collect, process, store, manage, administer, and analyze data in a secure fashion. By mid-2014, we expect to deploy all of the functionality for the processing and analysis of large and complex datasets. Other significant activities in 2014 will include developing a suite of data management applications to complement off-the-shelf products to more efficiently and effectively organize, manage, search, and access information in a wide range of formats.

The infrastructure is being built to include extensive tracking of data access and data lineage. Tracking data access increases security over confidential data. Tracking data lineage helps in managing the use of data efficiently, recreating and verifying analysis, and using historical data to conduct policy analysis. The analytic environment will also include robust metadata (descriptive data) to cross-reference and define the data, as well as semantic tagging to enhance the usability of data.

As the Office continues to mature, we will adjust our organizational structure in 2014 to streamline functions, consolidate organizational elements, and better meet the needs of stakeholders. Our staffing efforts will transition from stand-up mode to a steady-state effort as we approach our goal of 275 to 300 full-time employees in 2015. Building a talented staff dedicated to analyzing risks to financial stability means not only hiring and retaining, but also training and developing the staff to enhance skill sets.

A mature organization demands a culture of measurement, performance, and accountability in all aspects of achieving its mission. The Office has established policies and procedures to support sound and efficient operations and rigorous internal controls. In 2014 the Office will undertake a top-to-bottom review of current policies and procedures, improving and adding where necessary.

In addition, the Office will develop a 2015-19 strategic plan that will more fully articulate the vision and mission of the Office, as well as its goals and strategies for the next four years. In collaboration with stakeholders, the new strategic plan will identify key capabilities that the organization will need for responding to changes in the financial system, stakeholder needs, and technology. The plan will help inform our long-term investment in people, processes, and technologies.

We continue our outreach and collaborative efforts through our network of outside researchers, academics, industry experts, and others. We have begun to respond to the initial set of recommendations from our external Financial Research Advisory Committee and we look forward to further work with that group. We will expand the grants program launched in mid-2013 in collaboration with the National Science Foundation and will continue to sponsor conferences and research on financial stability and related topics.

In all our activities, we will continue to work closely with the Council and its member agencies. The Office's efforts to date have been significantly enhanced by the broad and deep expertise of their staffs and by a spirit of collaboration that results from the close alignment of our mission with theirs. Success in all these endeavors will also depend on continued progress in developing strong leadership, attracting and retaining dedicated professionals who strive to create an organization that is a thought leader in its field, and building a support team that provides unparalleled service to enable the organization to accomplish its mission.

Appendixes

A. Progress in Institution Building

At just over three years old, the Office of Financial Research has made substantial progress in building core operational systems and procedures, guided by the need to have a cost-effective, transparent, and accountable infrastructure that reflects best practices. We recognize we have to balance speed with prudence as the organization continues to mature and expand basic functions with ongoing review and improvements based on early experience.

Establishing a Sound Strategic and Operational Framework

The Office outlined its mission, goals, objectives, and implementation priorities in the OFR Strategic Framework: FY 2012-2014. Under that framework, the Office established five strategic goals to help achieve its mission:

1. Support the Council through the secure provision of high-quality financial data and analysis needed to monitor threats to financial stability.
2. Develop and promote data-related standards and best practices.
3. Establish a center of excellence for research on financial stability and promote best practices for financial risk management.
4. Provide the public with key data and analysis, while protecting sensitive information.
5. Establish the OFR as an efficient organization and world-class workplace.

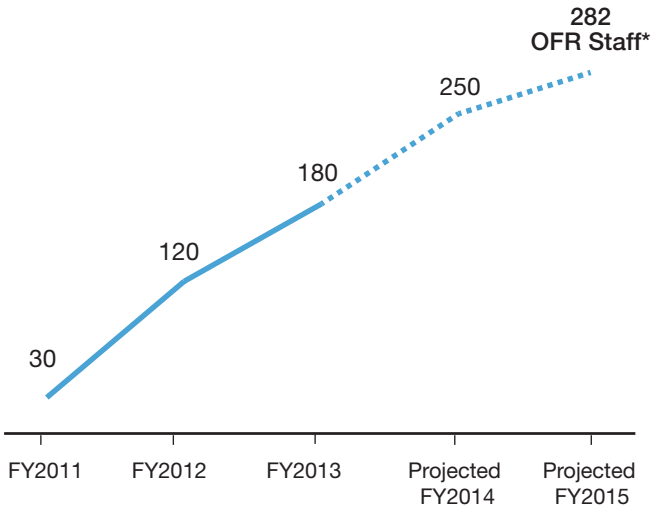
Our day-to-day operations are linked to strategic priorities by policies and procedures, as well as mechanisms for planning and performance management. The Office's financial management follows Department of the Treasury rules; financial activities and controls are reviewed as part of the department's consolidated audit and the budget is developed in line with Office of Management and Budget Circular A-11 guidance as part of the President's Budget. We have also developed additional controls, project review mechanisms, and decision-making protocols to ensure that spending is well targeted and effectively monitored.

The Office of the Inspector General and the Government Accountability Office periodically audit the Office's activities. Our Director testifies before Congressional committees with oversight responsibility, most recently in March 2013 before the House Financial Services Subcommittee on Oversight and Investigations.

Measuring Our Performance

In fiscal year (FY) 2013, the Office established performance measures tied to its strategic goals. The measures are designed to track our performance in achieving goals, such as publishing research and acquiring datasets. These measures are shared annually with the public through the President's Budget.

Figure 68. OFR Hiring and Targets



* Permanant, reimbursable, and detailed staff

Source: OFR

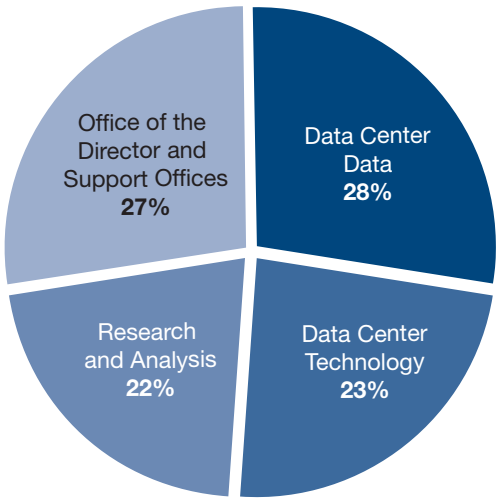
ENABLING LEGISLATION FOR THE OFFICE OF FINANCIAL RESEARCH

The Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank Act) established the Office of Financial Research (OFR) within the Treasury Department.

Section 153(a) of the Dodd-Frank Act charges the OFR with supporting the Financial Stability Oversight Council (Council) and member agencies by:

1. collecting data on behalf of the Council, and providing such data to the Council and member agencies;
2. standardizing the types and formats of data reported and collected;
3. performing applied research and essential long-term research;
4. developing tools for risk measurement and monitoring;
5. performing other related services;
6. making the results of the activities of the Office available to financial regulatory agencies; and
7. assisting such member agencies in determining the types and formats of data authorized by this Act to be collected by such member agencies.

Figure 69. OFR Planned Workforce Distribution



Source: OFR

The Director also sets quarterly priorities for each group within the organization.

We are now developing a new strategic plan for FY 2015-19. In this long-term strategic planning process, we are assessing the organization internally and externally to devise a plan that will more fully articulate the vision and mission of the Office, as well as its goals and strategies for the next four years. We anticipate releasing the new plan in early calendar year 2014.

Organization and Workforce Building

The Dodd-Frank Wall Street Reform and Consumer Protection Act, which established the Office, emphasized the use of efficient and innovative tools to attract and retain a talented workforce, including fellowships and internships. Using multiple recruitment methods, we have built a talented staff dedicated to strengthening the understanding of risks to financial stability.

A critical priority for the Office as we work to achieve full staffing levels is recruiting the specialized and highly trained employees necessary to fulfill our mission.

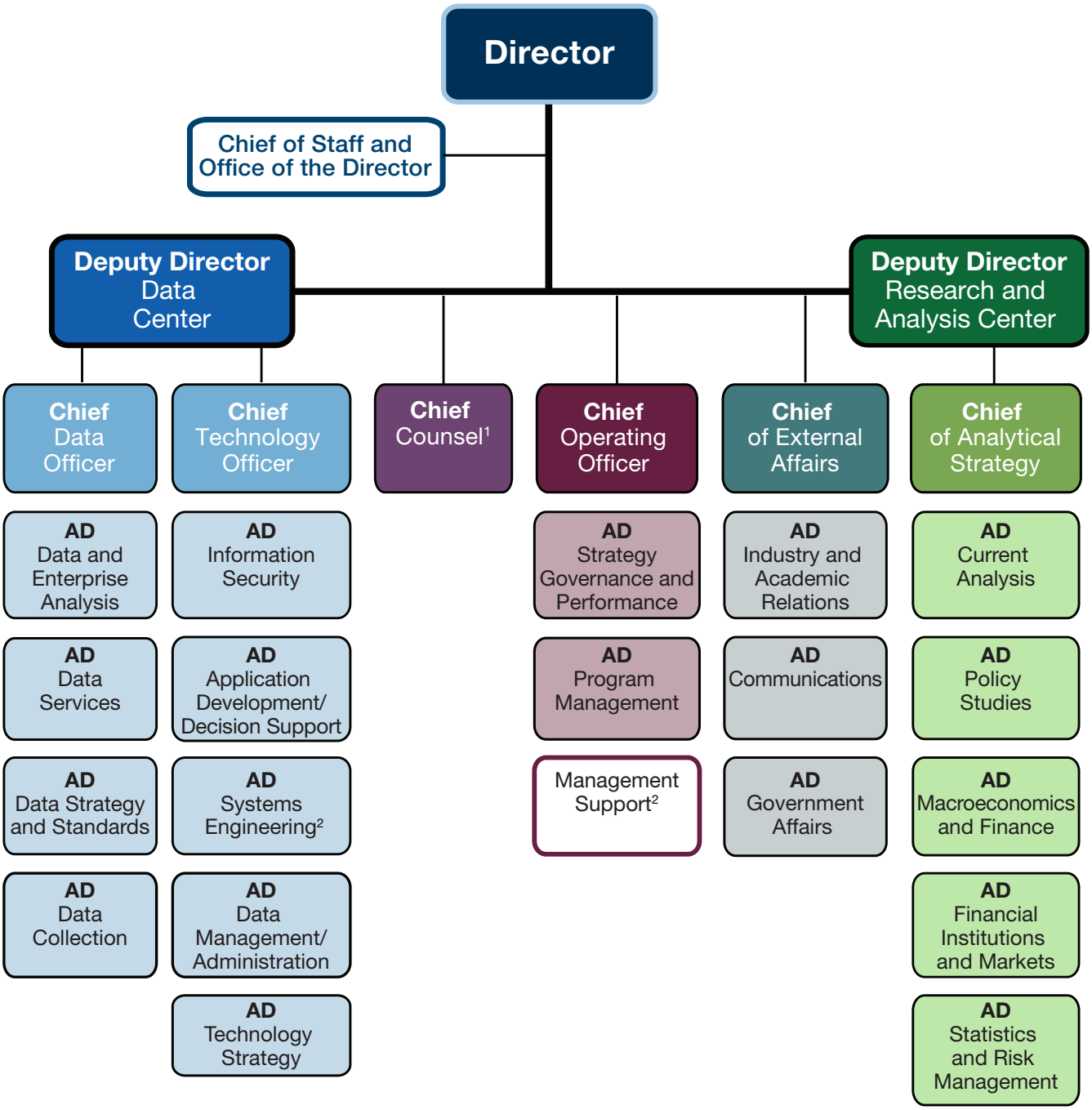
We increased our staff from 30 in FY 2011 to 120 at the end of FY 2012 and more than 180 by the end of FY 2013.

Our goal for FY 2014 is 250 employees. We are planning to reach a total of 282 employees in FY 2015, including permanent, reimbursable, and detailed staff members.

The Office's senior management team currently comprises the Director, a Deputy Director for each of the two centers (Data Center and Research and Analysis Center), and six Chiefs (Chief Data Officer, Chief Technology Officer, Chief of Analytical Strategy, Chief of External Affairs, Chief Operating Officer, and Chief Counsel). OFR Deputy Directors and Chiefs oversee 18 sections led by 17 Associate Directors.

About half of our staff will ultimately be in the Data Center, split between its data and technology groups. The Research and Analysis Center will constitute approximately 22 percent of the staff. The Office of the Director and support functions (Counsel, External Affairs, and Operations) will make up the remaining 27 percent.

Figure 70. OFR Organizational Structure



Note: AD = Associate Director

[1] Reports to the Department of Treasury Office of General Counsel.

[2] Includes services through the Department of Treasury Departmental Offices.

Source: OFR

ORGANIZATIONAL STRUCTURE AND RESPONSIBILITIES OF THE OFFICE OF FINANCIAL RESEARCH

Section 154 of the Dodd-Frank Act establishes within the Office, to carry out the programmatic responsibilities of the Office, the Data Center and the Research and Analysis Center.

The Data Center, on behalf of the Council, shall collect, validate, and maintain all data necessary to carry out the duties of the Data Center. The data assembled shall be obtained from member agencies, commercial data providers, publicly available data sources, and financial entities under certain statutory authority detailed in the law.

The Research and Analysis Center, on behalf of the Council, shall develop and maintain independent analytical capabilities and computing resources—

(A) to develop and maintain metrics and reporting systems for risks to the financial stability of the United States;

(B) to monitor, investigate, and report on changes in systemwide risk levels and patterns to the Council and Congress;

(C) to conduct, coordinate, and sponsor research to support and improve regulation of financial entities and markets;

(D) to evaluate and report on stress tests or other stability-related evaluations of financial entities overseen by the member agencies;

(E) to maintain expertise in such areas as may be necessary to support specific requests for advice and assistance from financial regulators;

(F) to investigate disruptions and failures in the financial markets, report findings, and make recommendations to the Council based on those findings;

(G) to conduct studies and provide advice on the impact of policies related to systemic risk; and

(H) to promote best practices for financial risk management.

Facilities

Most OFR employees are based in our headquarters in Washington, D.C. We also have a small office in New York City to support research and data-related interactions with the New York-based financial community, including regulators, data providers, academics, and financial market participants.

We will continue to have a small number of work arrangements with contributors outside Washington, D.C., and New York to support our research collaboration with academics.

Information Technology Infrastructure

The Office needs systems for data acquisition, management, and dissemination under strict rules for security and data sharing. In addition, we are building a robust research and analytical environment for handling large amounts of data to support complex financial models, computations, and analysis. We are also building a secure platform for collaboration and communication with Financial Stability Oversight Council member agencies and outside researchers.

During FY 2013, we expanded the short-term analytical environment (initially established in FY 2012) to meet data growth requirements and improve performance. We also put in place several basic components of the longer-term environment and completed the architectural activities, planning, and design for the remaining components.

The Office has access to more than 50 distinct sources of data related to the economy and the financial system. In addition, for the data stored within the Office, we are building a long-term analytic environment that allows incremental capacity increases when needed. Over the next year, we expect to host several hundred terabytes of data.

As an office in the Treasury Department, the Office benefits from the Treasury's secure information technology infrastructure and follows Treasury's security policies. We are expanding security controls as necessary for OFR-specific systems and data, and for sharing information among Council member agencies.

Finance

On May 21, 2012, Treasury issued a final rule for collecting assessments from bank holding companies with total consolidated assets of $50 billion or greater and an interim final rule for collecting assessments from nonbank financial companies supervised by the Federal Reserve Board. The initial assessment on July 20, 2012, was based on a fee rate of about $7,700 per $1 billion of assets held by the assessed companies.

Treasury did not replenish the Financial Research Fund until September 2013 because FY 2012 expenditures were lower than projected. Treasury collected $35 million on September 16, 2013. This assessment was based on a fee rate of about $2,021 per $1 billion of assets held by the assessed companies.

Our FY 2014 estimated budget is $86 million. Details are available in the FY 2014 budget and are provided annually in the President's Budget.

RESEARCH SEMINAR SERIES BRINGS TOGETHER EXPERTISE

The OFR Research Seminar Series is an ongoing initiative to keep Office researchers and analysts engaged and up-to-date on the latest work in the field of financial research.

Seminars are held frequently, usually one or more times per week.

These events bring some of the brightest minds in the country to the OFR's offices to discuss innovative research related to financial stability. OFR researchers and other staff members engage with the visiting experts in active discussions about the research and related topics.

OFR researchers and analysts also have the opportunity to ask for feedback on research initiatives they are working on or planning.

During 2013, the Office held more than 70 seminars through September. During 2012, the Office held more than 60 seminars.

B. OFR Outreach and Collaboration

The Dodd-Frank Wall Street Reform and Consumer Protection Act requires the Office to work closely with the Financial Stability Oversight Council, its member agencies, and a wide range of stakeholders, including industry representatives, academics, other researchers, and the public.

In addition, the Office is tasked with making data and information available to the public. To achieve these objectives, we expanded relationships and increased our outreach efforts in the past year.

OFR Outreach

The Director and employees from across the organization have participated in extending our outreach and improving communications with the public and other stakeholders.

For example, the Office realigned the Division of External Affairs to coordinate engagement with external stakeholders and partners in government. The Office named a Chief of External Affairs, added staff members, defined roles for communications and Congressional affairs, and incorporated the outreach function for industry and academia. In addition, the Office improved its website, making it more user-friendly and expanding available content. About 4,000 subscribers now receive notifications when the Office posts new Web content.

Congressional Testimony

OFR Director Richard Berner testified in March 2013 before the House Financial Services Subcommittee on Oversight and Investigations. Director Berner described the Office's major accomplishments and key priorities, as well as the steps under way to enhance the transparency and accountability of the Office.

OFR Collaboration

We are leveraging the expertise of our staff members through partnerships and collaborations in an array of initiatives to meet the mandate of fostering a network of outside researchers, academics, industry experts, and others. Our "virtual research-and-data community" also encompasses visiting scholars, fellows, and interns.

OFFICE OF FINANCIAL RESEARCH WORKING PAPERS IN 2013

Following are the working papers the OFR published in 2013, through December:

"Common Ground: The Need for a Universal Mortgage Loan Identifier," OFR Working Paper no. 12 (December 5, 2013), coauthored by Matthew McCormick and Lynn Calahan.

"Cryptography and the Economics of Supervisory Information: Balancing Transparency and Confidentiality," OFR Working Paper no. 11 (September 4, 2013), coauthored by Mark Flood, Jonathan Katz, Stephen Ong, and Adam Smith.

"Stress Tests to Promote Financial Stability: Assessing Progress and Looking to the Future," OFR Working Paper no. 10 (July 18, 2013), coauthored by Rick Bookstaber, Jill Cetina, Greg Feldberg, Mark Flood, and Paul Glasserman.

"How Likely Is Contagion in Financial Networks?" OFR Working Paper no. 9 (June 21, 2013), coauthored by Paul Glasserman and H. Peyton Young.

"The History of Cyclical Macroprudential Policy in the United States," OFR Working Paper no. 8 (May 15, 2013), coauthored by Douglas J. Elliott, Greg Feldberg, and Andreas Lehnert.

"Stress Scenario Selection by Empirical Likelihood," OFR Working Paper no. 7 (April 9, 2013), coauthored by Paul Glasserman, Chulmin Kang, and Wanmo Kang.

"Hedge Fund Contagion and Risk adjusted Returns: A Markov switching Dynamic Factor Approach," OFR Working Paper no. 6 (March 13, 2013), coauthored by Ozgur (Ozzy) Akay, Zeynep Senyuz, and Emre Yoldas.

"Systematic Scenario Selection," OFR Working Paper no. 5 (February 7, 2013), coauthored by Mark D. Flood and George G. Korenko.

"CoCos, Bail-In, and Tail Risk," OFR Working Paper no. 4 (January 23, 2013), coauthored by Nan Chen, Paul Glasserman, Behzad Nouri, and Markus Pelger.

Financial Research Advisory Committee

In 2012, the Office established the Financial Research Advisory Committee, made up of 30 distinguished professionals in economics, data management, risk management, information technology, and other fields. The members include two Nobel laureates in economics, leaders in business and nonprofit fields, and prominent researchers at major universities and think tanks.

The committee first met in December 2012 in Washington, D.C. At the second committee meeting in New York City in August 2013, OFR Director Berner cited the Office's five strategic priorities for the coming year and noted that the advisory committee's three subcommittees had been meeting since December to develop substantive recommendations to help the Office fulfill its mandate. The full committee formally adopted the recommendations during the meeting and presented them to us.

The recommendations are on our website at: www.treasury.gov/initiatives/ofr/about/Pages/Financial-Research-Advisory-Committee.aspx

Fellowship Program

The Dodd-Frank Act authorized the Office to establish a fellowship program, in consultation with the Chairperson of the Council, for outside experts from academia, industry, and elsewhere in government to spend up to two years at the OFR performing research and training employees.

The Office created the Fellowship Program in 2012 to support our staff through research and training related to financial stability, risk management, financial data management, information technology, and information security.

We began recruiting fellows in the fall of 2012 and will continue recruitment aligned with the academic calendar. In addition to our Fellowship Program, the Office uses the Treasury Departmental Offices' Fellowship program.

We have emphasized high-level interactions with academics and practitioners in our efforts to build a virtual research community. As part of this initiative, the OFR Fellowship Program is attracting expertise to

supplement the permanent workforce and keep us on the leading edge of research and data management.

Grants Program

In May 2013, the Office announced a partnership with the National Science Foundation (NSF) to promote and support novel research related to financial stability. We are collaborating with the NSF's Directorate for Computer and Information Science and Engineering to fund grants for innovative research on approaches to computing and information processing to identify and analyze risks to the financial system.

The joint OFR-NSF program is based on the NSF's Early-concept Grant for Exploratory Research (EAGER) program. The program is one way we are fulfilling our mandate to conduct, coordinate, and sponsor research to support and improve regulation of financial entities and markets.

Topics include analysis of financial networks, methods for measuring threats to financial stability, standardization of financial data, interconnections in the financial system, financial risk management techniques, data security, secure data sharing, and other subjects.

The NSF awarded the first grant in the program in September 2013 for a multidisciplinary project to examine the impact of high-speed trading activity on the financial system. This research will also yield insights into working with extremely large financial datasets in a supercomputing environment. The researchers conducting the work are based at the University of Illinois at Urbana-Champaign and the San Diego Supercomputing Center.

For more about the program, see www.treasury.gov/initiatives/ofr/research/Pages/GrantsProgram.aspx

Working Paper Series

The Office launched its Working Paper Series in January 2012 for staff researchers to collaborate with outside research experts, expanding our virtual research community and leveraging the expertise of our staff. These papers are intended to trigger a collaborative cycle of lively discussion among researchers and subsequent feedback to help fine tune our research to promote financial stability.

Through December 2013, the Office published 12 working papers — 9 papers in 2013 alone.

Participation in External Events

Office leaders and staff members participate in a wide range of events related to financial stability research, data, and analysis. During 2013, they spoke at industry and acedemic conferences, and participated in panels discussing specific aspects of data standards, financial analysis, systemic risk, and other topics.

Conferences

Each year, the Office and the Council jointly hold a conference in Washington, D.C., to bring together thought leaders from the financial regulatory community, academia, public interest groups, and the financial services industry to discuss data and technology issues, and analytical approaches for assessing, monitoring, and mitigating threats to financial stability. These conferences are also invaluable opportunities to receive broad-based input on the Office's strategic priorities.

In December 2012, the Office and the Council co-hosted the second annual conference, "Assessing Financial Intermediation: Measurement and Analysis." The event examined recent changes in financial institutions, assessed markets and activities, and explored future implications for financial stability, risk management, and policy.

The third annual conference is scheduled to be held in January 2014 in Washington, D.C. The agenda for the event and conference materials will be posted on our website.

In May 2013, the Federal Reserve Bank of Cleveland and the Office jointly sponsored "Financial Stability Analysis: Using the Tools, Finding the Data," a conference focused on the data and tools needed for measuring potential threats to financial stability.

In September 2013, the Federal Reserve Bank of New York and the OFR jointly sponsored the "Conference on Stable Funding," a set of discussions assessing vulnerabilities in short-term funding markets and exploring ways to mitigate those vulnerabilities.

All OFR speeches, Congressional testimony, press releases, and information about conferences and events are posted online at www.treasury.gov/ofr.

Glossary

2a-7 Funds	Rule 2a-7 of the Investment Company Act of 1940 sets requirements and investment rules for money market funds. It defines accounting practices that permit a fund to report a stable net asset value of $1 per share (see Money Market Fund).
Agency Mortgage-Backed Securities	A mortgage-backed security issued or guaranteed by federal agencies or government-sponsored enterprises.
Agent-Based Models (ABM)	A simulation model that tracks the actions of agents with specified rules of behavior as they interact over time.
Algorithmic Trading	A computer trading strategy that uses mathematical models to determine the best time to buy blocks of shares without significantly affecting a stock's price, or to capture gains based on calculations of share prices changes.
Alternative Trading Systems	Private trading networks, including some characterized by low transparency and restricted market participant access. "Dark Pools" in equity trading are examples.
Arbitrage	The simultaneous buying and selling of the same asset in different markets to make a profit from price differences with little or no risk.
Asset-Backed Commercial Paper (ABCP)	Short-term debt that has a fixed maturity of up to 270 days and is backed by financial assets such as trade receivables, consumer debt receivables, auto and equipment loans or leases, or asset-backed securities.
Authorized Participant	An entity, typically a broker-dealer, through which an exchange-traded fund acquires desired assets in exchange for equally valued shares of the fund.
Automatic Stabilizer	An economic instrument or policy tool that seeks to moderate economic fluctuations as a matter of course without direct intervention by policymakers.
Bank for International Settlements (BIS)	An international financial organization that serves central banks in their pursuit of monetary and financial stability, helping to foster international cooperation in those areas and acting as a bank for central banks.
Bank Holding Company (BHC)	Any company that has direct or indirect control of one or more banks and is regulated and supervised by the Federal Reserve in accordance with the Bank Holding Company Act of 1956. BHCs may also own nonbanking subsidiaries such as broker-dealers and asset managers.
Basel Committee on Banking Supervision (BCBS)	An international forum for the cooperation of bank supervisors that aims to improve banking supervision worldwide. The BCBS develops guidelines and supervisory standards, such as standards on capital adequacy, the core principles for effective banking supervision, and the Concordat on cross-border banking supervision. Following the financial crisis, the BCBS developed new global capital and liquidity standards for the banking system that are collectively referred to as Basel III.
Basis Point	A financial instrument unit of change equal to 1/100th of 1 percent.
Broker-Dealer	An entity that buys and sells securities for itself and others.
Call Report	A report of a bank's condition and income that all federally insured U.S. depository institutions must file on a quarterly basis.
Capital Requirement	A requirement that a specified fraction of a financial institution's funding come from equity rather than debt.

Captive Insurer	An entity that provides insurance for its parent company.
Carry Trade	An investment strategy involving borrowing at low interest rates to purchase assets that yield higher returns.
Central Clearing	A settlement system in which securities or derivatives of a specific type are cleared by one entity, a clearing house or central counterparty, which guarantees the trades. It is an alternative to bilateral or over-the-counter trading (see Over-the-Counter).
Clearing Bank	A commercial bank that facilitates payment and settlement of financial transactions, such as check clearing or matching trades between the sellers and buyers of securities and other financial instruments or contracts.
Closed Limit-Order Book	The record of unexecuted limit orders for a security placed by traders. Only the keeper of the book has access to the details of all the orders; depending on local rules, certain privileged participants, such as market makers or specialists, may have access to the highest-priced bid and lowest-priced offer.
Collateral	Any asset pledged by a borrower to guarantee payment of a debt.
Commercial Paper (CP)	Short-term (maturity of up to 270 days), unsecured corporate debt.
Comprehensive Capital Analysis and Review (CCAR)	An annual exercise by the Federal Reserve to ensure that institutions have robust, forward-looking capital planning processes that account for their unique risks and sufficient capital to continue operations throughout times of economic and financial stress.
Conditional Value at Risk (CoVaR)	A measure of the value at risk of the financial system conditional on distress at a single financial institution, from Adrian and Brunnermeier (2010).
Contagion	The process by which losses at one institution spread to other institutions through the financial system.
Contingent Capital Notes (CoCos)	A type of security that converts into a specified number of shares upon occurrence of a specified event. For a contingent capital note issued by a bank, conversion may be contingent on its level of Tier 1 capital falling below a given threshold.
Contingent Liability	A liability that is only incurred depending on the outcome of a future event.
Convexity Event Risk	Risk that an initial increase in long-term interest rates can be significantly amplified by many MBS investors actively hedging the duration of their MBS. Convexity events can result in rapid changes in long-term interest rates, sharp increases in interest rate volatility, and reduced liquidity in fixed income markets.
Correlation Risk	The risk that the value of two or more assets will move in tandem, increasing the volatility of a portfolio and potentially leading to large, simultaneous losses. Correlation risk is typically mitigated through hedging.
Countercyclical	The movement of a financial or macroeconomic variable in the opposite direction of the business cycle. A variable is procyclical if it tends to increase when the economy is growing and decrease when it is shrinking.
Countercyclical Capital Buffer	A policy requiring banks to build up capital buffers during favorable economic periods that can be used to absorb losses in unfavorable periods.
Counterparty Exposure	The vulnerability that a counterparty in a derivatives contract may default on its obligations.
Covenant-lite Loans	Loans that do not include typical protections for lenders, such as requirements that the borrower deliver annual reports or restrictions on loan-to-value ratios.
Credit Cycle	The rise in credit creation during the expansion phase of the business cycle, often accompanied by a relaxation of underwriting and other credit standards, and the subsequent decline in the availability of credit during economic contractions.

Credit Default Swap (CDS)	A bilateral contract protecting against the risk of default by a borrower. The buyer of CDS protection makes periodic payments to the seller and in return will receive a payoff if the borrower defaults, similar to an insurance contract. The buyer does not need to own the loan covered by the swap.
Credit Risk	The risk that a borrower may default on its obligations.
Credit Risk Transfer	A financial transaction, typically through credit default swaps, that changes who bears the risk of default or changes in the creditworthiness of a counterparty or debtor.
Credit Spread	The difference in yield between a security and an otherwise similar security of higher quality.
Cyclical Risk	Any financial or economic risk that is closely tied to the business cycle.
Cyclical Macroprudential Policy	A policy that seeks to moderate cyclical vulnerabilities, curbing excess leverage or funding risk in an upswing and easing constraints on leverage or funding in a crisis.
Data Committee	A committee within the Financial Stability Oversight Council whose mission is to "support FSOC coordination of, and consultation on, agency rulemakings on data collection, and seek to minimize duplication of data gathering operations."
Data Gap	A term which describes instances where purchased, collected, or derived data currently collected by financial regulatory agencies is insufficient to perform necessary research or mandated regulatory monitoring.
Debt-to-Income Ratio	For a borrower, the ratio of debt payments to income.
Derivative	A financial contract, such as a swap, option, or futures contract, that derives its value from the price of some other security, commodity, or other asset.
Discount Window	The Federal Reserve facility for extending credit directly to eligible depository institutions.
Distressed Insurance Premium (DIP)	An indicator of a firm's vulnerability to systemic instability. DIP uses information from firms' credit default swap spreads and equity prices to measure the implied cost of insuring a given firm against broader financial distress.
Duration	The sensitivity of the prices of bonds and other fixed-income securities to changes in the level of interest rates.
Eurozone	An economic region comprised of all European Union countries that use the euro as their national currency.
Exchange-Traded Fund (ETF)	An investment fund whose shares are traded on an exchange. ETFs offer continuous pricing, unlike mutual funds which offer only end-of-day pricing. ETFs are often designed to track an index or a portfolio of assets.
Fair Value Models	Models for determining the value of an asset based on the price at which the asset could be bought or sold between two willing parties.
Federal Financial Institutions Examination Council (FFIEC)	An interagency body that prescribes uniform principles, standards, and report forms for the federal examination of financial institutions. The FFIEC makes recommendations to promote uniformity in the supervision of financial institutions. Members include the Federal Reserve, the FDIC, the NCUA, the OCC, the CFPB, and a representative of state financial supervisors.
Federal Funds Rate	The interest rate at which depository institutions trade balances held in their reserve accounts at the Federal Reserve, usually overnight. The Federal Open Market Committee establishes the target rate for trading in the federal funds market and the Federal Reserve Bank of New York implements it.
Feedback	A pattern of behavior in which an outcome in one sector or area of the economy is potentially magnified or reduced beyond its original scope due to the impact of the outcome on another area of the economy.

Financial Intermediation	Any financial service in which a third party or intermediary matches lenders and investors with entrepreneurs and other borrowers in need of capital. Often investors and borrowers do not have precisely matching needs, and the intermediary's capital is put at risk to transform the credit risk and maturity of the liabilities to meet the needs of investors.
Financial Research Advisory Committee	A committee providing advice and recommendations to the OFR as it carries out its duties and authorities under the Dodd-Frank Act.
Financial Stability	The condition in which the financial system is sufficiently functioning to provide its basic tasks for the economy even under stress.
Financial Stability Board (FSB)	An international coordinating body that monitors developments in the international financial system on behalf of the G-20 nations. The FSB was established by the G-20 in 2009 and is the successor to the earlier Financial Stability Forum.
Financial Stability Oversight Council	Council established by the Dodd-Frank Act with the responsibility to identify potential risks to the financial stability of the United States, promote market discipline, and respond to emerging threats to financial stability. The Council has ten voting members: the Secretary of the Treasury, who chairs the Council, Chairman of the Federal Reserve, Comptroller of the Currency, Director of the Consumer Financial Protection Bureau, Chairperson of the U.S. Securities and Exchange Commission, Chairperson of the Federal Deposit Insurance Corporation, Chairperson of the Commodity Futures Trading Commission, Director of the Federal Housing Finance Agency, Chairman of the National Credit Union Administration Board, and an independent member with insurance expertise appointed by the President. There are also five non-voting members: the Director of the Office of Financial Research (part of the Treasury Department and established by the Dodd-Frank Act), the Director of the Federal Insurance Office (also part of the Treasury Department), a state insurance commissioner, a state banking supervisor, and a state securities commissioner.
Fire Sale	The disorderly liquidation of assets to meet margin requirements or other urgent cash needs. Such a sudden sell-off drives down prices, potentially below their intrinsic value, when the quantities to be sold are large relative to the typical volume of transactions.
Fiscal Risk	Risk stemming from deviations in fiscal policy from expectations.
Form FR Y-14A	A set of semiannual balance sheet projections based on a range of potential macroeconomic scenarios that are submitted by bank holding companies with $50 billion or more in consolidated assets. The Federal Reserve uses the data to assess capital adequacy as part of its Comprehensive Capital Analysis and Review program, and discloses summary results of stress testing.
Form FR Y-14Q	A form that collects detailed data on bank holding companies' various asset classes, capital components, and income on a quarterly basis, which the Federal Reserve uses to support supervisory stress testing models and monitoring.
Form FR Y-15	An annual report of systemic risk data submitted by bank holding companies with $50 billion or more in consolidated assets to the Federal Reserve. Banks may request that their information be kept confidential.
Form FR Y-9C	A quarterly financial statement submitted by bank holding companies with $500 million or more in consolidated assets. The form is the Federal Reserve's primary tool to monitor financial conditions between on-site inspections.
Form N-MFP	A monthly disclosure of portfolio holdings submitted by money market funds to the SEC, which makes the information publicly available. SEC Rule 30b1-7 establishes the technical and legal details of N-MFP filings.
Form PF (Private Funds)	A periodic report of portfolio holdings, leverage, and risk management submitted by hedge funds, private equity funds, and related entities. The reports are filed with the SEC and CFTC, which keep the information confidential. The Dodd-Frank Act mandated the reporting to help the Financial Stability Oversight Council monitor risks. Depending on fund size, reporting is annual or quarterly.

Form X-17A-5 ("FOCUS reports")	A quarterly or monthly financial condition report submitted by broker-dealers to the SEC.
Funding Liquidity	The availability of credit to finance the purchase of financial assets.
Funding Run	A situation in which a financial institution faces heavy redemptions and is forced to liquidate positions. A funding run can involve feedback effects, such as asset fire sales.
Futures	Standardized, exchange-traded contracts to buy or sell an underlying asset at a specified date and price.
General Collateral Finance (GCF)	An interdealer repo market in which the Fixed Income Clearing Corporation plays the role of intraday central counterparty. Trades are netted at the end of each day and settled at the triparty clearing banks (see Triparty Repo).
Government-Sponsored Enterprise (GSE)	A privately owned financial institution that has a federal charter authorized by law and a mission to promote the flow of credit to the housing market, student loans, or other specific sectors.
Gross Domestic Product (GDP)	The broadest measure of aggregate economic activity, measuring the total value of all final goods and services produced within a country's borders during a specific period.
Haircut	The discount at which an asset can be pledged as collateral. For example, a million dollar bond with a 5 percent haircut would collateralize a $950,000 loan.
Hedge Fund	A pooled investment vehicle that is available to accredited investors and can charge a performance fee on unrealized gains, borrow more than one half of its net asset value, and sell assets short and trade complex derivative instruments that cannot be traded by mutual funds.
Hidden Markov Chain	A mathematical model for the behavior of a system that is not fully observable. For financial markets, this defines a form of latent structure with a fixed set of possible economic "states" at any given time. The probability of switching states at a particular time depends only on the current state and not, for example, on historical trends.
High-Frequency Trading	A trading strategy that uses technology to execute market orders in fractions of seconds.
Home Mortgage Disclosure Act (HMDA)	A law requiring lending institutions to report mortgage loan data.
Impaired Trading Liquidity	The inability to trade in large size without having a significant impact on market price.
Implied Volatility	When pricing an option, the volatility required as an input to the option pricing model to yield the current market price.
Interest Rate Swap	A swap in which the parties swap interest rate cash flows, typically between a fixed rate and a floating rate (see Swap).
Institutional Cash Pools	Large, short-term cash balances of nonfinancial corporations and institutional investors, such as asset managers, securities lenders, and pension funds.
International Association of Insurance Supervisors (IAIS)	An international organization of insurance regulators and supervisors that aims to promote effective and globally consistent supervision of the insurance industry and contribute to financial stability.
International Monetary Fund (IMF)	An organization created at the end of World War II to stabilize exchange rates and support international payment systems. The IMF provides credit to developing nations and those in economic distress, typically conditional on economic and financial reforms.
International Organization for Standardization (ISO)	The world's largest developer of voluntary international standards in products, services, and practices.

International Swaps and Derivatives Association (ISDA)	A trade association of over-the-counter derivatives participants. The ISDA Master Agreement, used by many derivatives dealers and counterparties, standardized derivative terms to simplify netting and reduce legal risks.
Legal Entity Identifier (LEI)	A unique 20-digit alphanumeric code assigned to each legal entity within a company that participates in global financial markets.
Leverage	The use of borrowed money to finance investments or conduct financial activities.
Leveraged Loans	Loans extended to a borrower who already has significant amounts of debt or whose debt is not rated investment-grade by credit rating agencies.
Liquidity	See Market Liquidity and Funding Liquidity.
Liquidity Coverage Ratio (LCR)	A Basel III standard to ensure that a bank maintains adequate unencumbered, high-quality liquid assets to meet its anticipated liquidity needs for a 30-day horizon under a liquidity stress scenario specified by supervisors.
Liquidity Intermediation	The use of short-term, liquid deposits to make long-term, illiquid loans.
Loan Origination	The point in the loan process in which the borrower applies for a loan and the lender approves or declines the loan.
Loan-to-Value (LTV) Ratio	The ratio of the amount of a loan to the value of an asset, typically expressed as a percentage. This is a key metric when considering the financing of a mortgage.
London Interbank Offered Rate (LIBOR)	The interest rate at which banks can borrow unsecured funds from other banks in London wholesale money markets, as measured by daily surveys of the British Bankers' Association. The published rate is a trimmed average of the rates obtained in the survey. Many contracts are tied to the level of LIBOR, making it an important global benchmark.
Macroeconomic Risk	Risk from changes in the economy or macroeconomic policy.
Macroprudential Supervision	Supervision to promote the stability of the financial system as a whole (see Microprudential Supervision).
Margin Call	A requirement by a broker that a borrower increase the collateral pledged against a loan in response to changes in the collateral's value.
Margin Requirement	Rules governing the necessary collateral for a derivative, loan, or related security required to cover, in whole or in part, the credit risk one party poses to another.
Market Depth	The ability of a market to absorb excess demand to buy or sell a security without affecting the price quoted for subsequent trades. A market with a lot of depth will have low price impact from trading.
Market Liquidity	The ability of a market to absorb large and frequent transactions with limited price impact and low transaction costs.
Market Participant Symbol	A unique character-combination that represents an entity listed on an exchange, such as a stock's ticker symbol.
Market Risk	The risk that an asset's value will change due to unanticipated movements in market prices.
Maturity Risk	The risk that a bond's value will decrease before it matures. The probability of price fluctuation increases over longer time horizons, so interest rates are typically increasing in maturity.
Mark to Market	The process of revaluing a portfolio or security to reflect current or recent market prices.
Maturity Transformation	The funding of long-term assets with short-term liabilities. This creates a balance sheet mismatch that can pose risks when short-term funding markets are constrained.
Metadata	Data that provide information about the structure, format, or organization of other data.

Microprudential Supervision	Supervision of the activities of a bank, financial firm, or other components of a financial system (see Macroprudential Supervision).
Money Market Fund (MMF)	A fund that typically invests in government securities, certificates of deposit, commercial paper, or other highly liquid and low-risk securities. Some MMFs are governed by the SEC's Rule 2a-7.
Mortgage Real Estate Investment Trust (mREIT)	Investment vehicle that borrows short-term funds in repo markets and invests in real estate and real-estate securities.
Nonlinearity	The characteristic of an economic relationship among two or more variables that is not a simple (linear) proportion. For example, a compound growth rate is a nonlinear function of time.
Net Asset Value (NAV)	The price per share of a mutual fund or exchange-traded fund based on the value of the fund's shares at the close of the previous day.
Operational Risk	Risks occurring during the normal operation of a business, including, for example, failed internal processes.
Option	A financial contract granting the holder the right, but not the obligation, to engage in a future transaction on an underlying security or real asset. Examples include an equity call option, which provides the right but not the obligation to buy a block of shares at a fixed price for a fixed period, and an equity put option, which similarly grants the right to sell a block of shares.
Overnight Indexed Swap (OIS)	An interest rate swap used by banks to hedge against fluctuations in official interest rates set by central banks. In an OIS, an agreed index of an overnight floating rate, such as the Federal Funds Rate, is exchanged for a fixed rate for a set period (see Interest Rate Swap).
Over-the-Counter (OTC)	Trading that does not involve an organized exchange. In over-the-counter markets, participants trade directly with each other, typically through voice or computer communication.
Payment-In-Kind (PIK) Bonds	A bond that compensates the holder with other bonds rather than cash.
Price Impact Measure	The change in the market price of a security caused by a one-directional order flow (buy or sell) of a given size (see Market Depth).
Prime Broker	Brokerage offering a range of services to hedge funds, including securities lending, financing, trade execution, and cash management.
Procyclical	See Countercyclical.
Provisioning	The recording of a liability by a bank or other financial institution to cover expected losses on loans.
Refinancing Risk	The risk that a borrower will face liquidity problems if it is unable to rollover its existing debt.
Regulatory Arbitrage	The practice of taking advantage of differences between regulatory regimes to avoid their costs or constraints.
Repo Run	A situation in which repo investors lose confidence in the market due to concerns about counterparties, collateral, or both, and respond by pulling back their funding or demanding larger haircuts.
Repurchase Agreement (Repo)	A transaction in which one party sells a security to another party and agrees to repurchase it at a certain date in the future at an agreed price. Banks often do this on an overnight basis as a form of liquidity that is essentially a collateralized loan.
Reverse Repurchase Agreement	A term for a repo from the perspective of the counterparty that is lending the cash (see Repurchase Agreement).

Risk Management	The business and regulatory process of identifying and measuring risks and then responding to them. Categories of risk include operations, credit, market, control, liquidity, legal, model, and regulatory.
Risk Premium	The difference between the expected return of an asset and that of a risk-free asset. It is the investor's premium for bearing the risks of holding that asset.
Risk Transformation	A form of financial intermediation in which an intermediary raises funds from risk-averse investors and then uses those funds to provide capital to borrowers for risky ventures. Risk is retained by the intermediary and its capital serves as a buffer against losses for its investors.
Risk-Weighted Assets	Banks are required to assign a risk weighting, or a degree of credit risk, to residential mortgages, commercial real estate, derivative contracts, cash, and other assets to help supervisors calculate a minimum capital requirement. For example, a Treasury bond unconditionally guaranteed by the U.S. government has a zero risk weighting.
Run Risk	The risk that investors lose confidence in an institution — due to concerns about counterparties, collateral, solvency, or related issues — and respond by pulling back their funding.
Scenario Analysis	An analysis of performance under a range of possible market situations and different interest rates. An example might include analyzing a bank's capital ratio by simulating a range of adverse shocks to the value of its assets.
Secure Multiparty Computation	A body of computational tools to support information security by performing calculations jointly on data from multiple sources without ever sharing the various source datasets.
Securities Lending/ Borrowing	The temporary transfer of securities from one party to another for a specified fee and term, in exchange for collateral in the form of cash or securities.
Securitization	A financial transaction in which assets such as mortgage loans are pooled and securities representing interests in the pool are issued.
Shadow Banking	Credit intermediation done outside of the insured depository system, involving leverage, maturity transformation, and the creation of money-like liabilities.
Shared National Credit Program	An interagency review of large syndicated bank loans in the United States conducted by the bank regulators.
Short-Term Wholesale Funding	Funding instruments that are typically issued to institutional investors to raise large amounts of funding for short periods. Examples include large checkable and time deposits, commercial paper, and repurchase agreements.
Sovereign Debt Crisis	A financial crisis created by the potential or actual default of government debt.
Statistical Data Privacy	A body of computational tools for assessing with known precision whether releases of statistical summaries are likely to reveal private data about individuals comprised by the summary.
Stress Test	A modeling exercise where asset prices are shocked a pre-specified amount, sometimes along with other financial and economic variables, to observe the effect on financial institutions or markets.
Structural Macroprudential Policy (or Through-the-Cycle)	A policy that seeks to address potential structural vulnerabilities of the financial sector (see Cyclical Macroprudential Policy).
Structural Risk	Aspects of the design of the financial system that make it vulnerable to a shock. Structural risks could include excessive leverage or liquidity, crowded trades, large credit concentrations, poor governance, overreliance on one or a small number of essential service providers, or data and analytical gaps.
Swap	An exchange of cash flows agreed by two parties with defined terms and over a fixed period.

Swap Execution Facility	A term defined in the Dodd-Frank Act as a trading platform which market participants use to execute and trade swaps by accepting bids and offers made by other participants.
Syndicated Loan	A loan, usually provided to a single borrower, by a group of lenders.
Systemic Expected Shortfall (SES)	A systemic risk indicator that estimates the extent to which the market value equity of a financial firm would be depleted by a decline in equity prices.
Term Premium	The excess yield an investor must receive in order to purchase a longer maturity bond over a shorter maturity bond of the same issuer.
Tier 1 Capital Ratio and Tier 1 Common Capital Ratio	Two measures of banking capital adequacy defined in the Basel international banking accords in which capital is compared to total risk-weighted assets. Tier 1 capital includes common stock, preferred stock, and retained earnings. Tier 1 common capital is more narrowly defined and excludes preferred stock.
Treasury-Eurodollar (TED) Spread	The spread between the three-month U.S. Treasury rate and the three-month LIBOR rate.
Triparty Repo	A repurchase agreement in which a third party agent, such as a clearing bank, acts as an intermediary for the exchange of cash and collateral between the two counterparties. In addition to providing operational services to participants, the triparty agents in the U.S. triparty repo market extend large amounts of intraday credit to facilitate the daily settlement of triparty repos.
Underwriting Standards	Terms, conditions, and criteria used to determine the extension of credit in the form of a loan or bond.
Value at Risk (VaR)	A tool measuring the risk of portfolio losses. The VaR projects the probability and maximum expected loss for a specific time period. For example, the VaR over 10 days and with 99 percent certainty measures the most one would expect to lose over a 10-day period, 99 percent of the time.

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Endnotes

CHAPTER 2

[1] For instance, in their monitoring framework, Adrian, Covitz, and Liang (2013) evaluate vulnerabilities affecting large complex financial institutions, shadow banks, asset markets, and nonfinancial institutions. The International Monetary Fund's vulnerability exercise is based on an assessment of risks to fiscal, financial, external, and real sectors (in the case of emerging markets), although it also includes elements of contagion and asset valuations in assessing risks to advanced economies.

[2] See, for instance, Acharya and others (2010), Adrian, Covitz, and Liang (2013), Aspachs and others (2006), Blancher and others (2013), Dattels and others (2010), FSOC (2011, 2012a, 2013), Haldane, Hall, and Pezzini (2007), OFR (2012), and Sarlin and Peltonen (2011).

[3] Granted, some vulnerabilities may be both cyclical and structural. For instance, diminished trading liquidity may be driven by structural shifts in the market microstructure as well as by cyclical supply/demand forces.

[4] A forthcoming working paper will provide further details on the selection criteria, methodology, and performance.

[5] Adrian and Shin (2010), Begalle and others (2013), Brunnermeier and Pedersen (2009), Copeland, Martin, and Walker (2011), and Gorton and Metrick (2012).

[6] Since the financial crisis, a larger share of collateral backing triparty repos has shifted from riskier private sector assets to government-related securities. Securities dealers have also diversified funding sources and lengthened the maturity of their repo books, and as a result in aggregate now finance only 9 percent of their liabilities with repo, down from more than 40 percent prior to the crisis. The market has also become less concentrated, with the top three dealers accounting for about 30 percent of average daily volume, down from 50 percent before the crisis, which reduces the difficulty for the financial system of absorbing a potential counterparty default. Although a substantial amount of repos is still financed overnight, the maturity of repos has lengthened.

[7] Much of the mortgage REIT repo funding is concentrated in 30-day tenors, which is relatively short-term compared to the duration of their assets.

[8] Based on data from Bloomberg L.P. and the Federal Reserve.

[9] Mortgage REITs hedge some of their interest rate risk with derivatives, such as swaps and options, but these hedges may be insufficient to protect their portfolios from large losses if interest rates rise. In addition, they may lose access to funding if their creditors suspect they are insufficiently hedged and facing large losses.

[10] The Federal Reserve has proposed a draft rule that would require foreign banks with a significant U.S. presence to consolidate most of their U.S. operations into an intermediate holding company in an effort to reduce potential arbitrage of enhanced U.S. prudential capital and liquidity requirements (see Board of Governors, 2012c). However, the draft rule would not require consolidation of foreign banking offices' state supervised branches and agencies, which could result in shifting risks across subsidiaries of bank holding companies.

[11] This assumes a recovery rate of 60 percent of cov-lite loans and 70 percent on other leveraged loans and the same default rate to cover the additional expected loss associated with a cov-lite loan in a normal credit cycle. See Richmond (2013).

[12] Duration estimates are derived from the Barclays Capital Aggregate Bond Index, which is a market capitalization-weighted index of Treasury securities, agency bonds, mortgage-backed bonds, corporate bonds, and a small amount of foreign bonds traded in the United States. Asset managers, index mangers, and others often seek to manage their portfolios against the Barclays index.

[13] Our dependent variable is the term premium estimated by Kim and Wright (2005). Macroeconomic factors include the unemployment gap (the difference between the seasonally-adjusted unemployment rate and the natural rate of unemployment), core consumer price inflation, and inflation uncertainty. Financial variables include a polynomial function of the MOVE index of option-implied interest rate volatility, the VIX index of option-implied equity volatility, the supply of Treasury securities held by the Federal Reserve's System Open Market Account portfolio as a share of GDP, and the supply of publicly held marketable Treasury securities, excluding Federal Reserve holdings, as a share of GDP.

[14] Asset purchases affect the term premium in several ways. Large-scale asset purchases decrease the supply of publicly traded Treasury securities, suppressing yields (Gagnon and others, 2010). In a low-rate environment,

investors that reach for yield need less compensation for taking duration risk, and an increase in private buying of longer-term assets further suppresses the term premium. Other factors complicate this relationship. For instance, the central bank's decision to increase or decrease asset purchases is endogenous to other factors known to affect the term premium, such as macroeconomic conditions and market volatility. As a result, the ultimate drivers of the term premium are more difficult to understand and to predict as monetary policy accommodation is removed.

[15] Funding runs, described in Brunnermeier and Pedersen (2009), occur when asset managers of leveraged funds are forced to sell assets, leading to sharp and sudden drops in asset prices, and in turn, further rounds of forced sales. Because assets are used as collateral for increased leverage, the risk-bearing capacity of the financial system can be severely diminished. Geanakoplos (2009) and Fostel and Geanakoplos (2008) show how leverage cycles can cause contagion. Adrian and Shin (2010) provide a theoretical analysis of the link between leverage and volatility.

[16] Equity volatility is used as a proxy for broad-scale risk.

[17] Market commentary and various trading platform data sources suggest that lean inventories and tight non-government repo financing have at least been partly responsible for the migration of broker-dealers toward larger, more frequently-traded issues.

[18] The May-June 2013 sell-off in bond markets provided an informative test of how ETF market participants react to market stress. During the episode, fixed-income ETFs were particularly popular for investors, as reflected in higher volumes in these ETFs relative to the underlying assets. Many ETFs, particularly high-yield corporate bond ETFs, began trading at significant and volatile premiums and discounts to their net asset value (NAV) and in some cases authorized participants temporarily ceased transmitting redemption orders to various ETFs or opted to redeem shares only in-kind (rather than make available a cash redemption option). While most market participants were not concerned by these events, questions remain going forward as to how market participants in the ETF ecosystem will react in future periods of market stress, especially as dealer inventories of fixed-income securities decline and ETFs continue to expand.

[19] IMF (2013d) shows that external factors (such as lower global risk and stimulative U.S. monetary policy) explain nearly all of the compression in emerging market bond spreads.

[20] Global asset prices are increasingly being driven by a single factor reflecting overall risks rather than multiple, idiosyncractic factors.

[21] After the downgrade of the U.S. sovereign credit rating by S&P in 2011, many institutional investors adjusted their mandates to avoid automatic forced sales of Treasuries in the event of an additional downgrade. Moreover, based on historical downgrades of highly-rated sovereign credits, there generally has not been much sustained impact on yields in the run-up to, or following, a credit rating downgrade. The impact has been more pronounced and sustained when a downgrade is accompanied by a broader economic or financial crisis and following multinotch downgrades (IMF, 2011).

[22] There is no cross-default provision for Treasury securities on Fedwire, the settlement funds transfer system run by the Federal Reserve, so only Treasury securities with a missed or delayed payment would be considered ineligible collateral. Other Treasury securities would remain unimpaired and accepted as collateral. However, repo rates, haircuts, and counterparty limits could still be affected on unimpaired Treasury securities.

[23] The International Swaps and Derivatives Association permits a three-day grace period on missing a payment before being considered in default. In theory, a short-lived technical default might not necessarily trigger CDS contracts.

CHAPTER 3

[1] A study by Fillat and Montoriol-Garriga (2010) finds that had U.S. banks set aside larger general provisions when the economy was strong, akin to Spanish banks, they could have better absorbed loan losses during the U.S. financial crisis and reduced by half the amount of Troubled Asset Relief Program funds required. However, these higher provisions would have been depleted by 2009 for the U.S. banking system in aggregate, highlighting the idea that a fixed capital buffer requirement is still needed to mitigate unexpected credit shocks.

[2] Change in capital ratio implemented over eight years. Reported numbers are unweighted median values across models from Table 1 in Macroeconomic Assessment Group (2010) and are changes relative to baseline after 35 quarters.

[3] From Table 2, average of changes in loan rate per 100 basis points change in capital ratio.

[4] From Table 10a.

[5] Average over the United States, the euro area, and Japan, using data from 2004-06. The United States number is 20.5 basis points.

[6] The recent proposal by the Financial Stability Board to institute haircut floors for repos is a step in the direction of enhancing the nonbank macroprudential toolkit (FSB, 2013b and 2013c). However, these restrictions would apply only to repo transactions not centrally cleared, in which nonbanks (entities not subject to capital and liquidity regulation) receive financing from banks or broker-dealers (entities subject to such regulation) against collateral other than gov-

ernment securities. This situation leaves open the possibility of a buildup of risk in nonbank-to-nonbank repo transactions and also does not address the fact that, in some non-U.S. markets, no haircut is applied to repo transactions backed by government securities, even though these securities experience price volatility and may also have credit risk. It is relevant to monitor the quantity of nonbank-to-nonbank repo as well as whether the lack of a haircut floor for non-U.S. government debt increases reliance of financial institutions on this collateral. As discussed in Chapter 5, better data related to the U.S. repo market are needed to assess these and other potential risks.

7 Opportunities for risk weight optimization in the United States are somewhat limited by the Collins amendment in the Dodd-Frank Act, which does not allow large banks to use risk weights generated by internal models below those set by regulators for smaller institutions. However, because the Collins amendment does not apply overseas, foreign banks' risk weight optimization could still undercut U.S. efforts to activate the countercyclical capital buffer requirement by failing to slow foreign credit provision to the United States.

CHAPTER 4

1 The working papers are available on the Working Paper Series page under Research on the OFR website at www.treasury.gov/OFR.

2 The code can be found on the Working Paper Series page under Research on the OFR website at www.treasury.gov/OFR.

3 The Financial Stability Board defines shadow banking as any "credit intermediation involving entities and activities (fully or partially) outside the regular banking system" (see FSB, 2013b).

4 This represents an upper estimate, since broker-dealers in bank holding companies have the ability to move some assets into their banks and obtain discount window financing.

5 The analysis covers categories SIC 0 through SIC 8. The category for SIC 9 is too small and miscellaneous to produce meaningful results. Liquidity measurement for the corporate bond markets is often complicated by the fact that individual bonds typically trade infrequently. This measurement challenge has become more significant since the crisis (see IMF, 2012). In this context, it helps to aggregate the individual bonds into broader indexes.

CHAPTER 5

1 These datasets are generally collected following Paperwork Reduction Act requirements, and the fact that they exist is publicly known.

2 More than 4,700 individual insurance legal entities file quarterly and annual public financial statements with the National Association of Insurance Commissioners. Each electronic filing may contain over 235,000 data elements.

3 The NAIC Accreditation Program seeks to establish and maintain standards to promote sound insurance company financial solvency regulation.

4 With the exception of risk retention groups formed under captive laws, which are addressed in NAIC accreditation standards.

5 See FRASER, a website maintained by the Federal Reserve Bank of St. Louis, at http://fraser.stlouisfed.org/publication/?pid=39

6 The eurozone currently comprises Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, the Netherlands, Portugal, Slovakia, Slovenia, and Spain. However, money market funds have exposure only to issuers in Austria, Belgium, France, Germany, Ireland, Italy, Luxembourg, the Netherlands, and Spain. Luxembourg is excluded from the analysis due to the lack of credit default swap data on its sovereign debt.

7 The assets of feeder funds, parallel funds, and dependent parallel managed accounts are included in determining whether a reporting fund exceeds the $500 million threshold.

8 The threshold is that the two numbers differ by more than 25 percent.

9 The ratio of Level 3 assets to the sum of Level 1, Level 2, Level 3, and cost-based assets. These values are reported as all zero for many funds and those funds are discarded from the analysis.

10 We deleted about 60 funds with reported net asset value less than $5 million.

11 Only four funds report leverage greater than 50. These funds were discarded from the analysis.

12 The leverage reported for each category is a weighted average of leverage across the funds in a given category, in which the weights are gross assets. Similarly, the proportion of hard-to-value assets is a weighted average using the same weights. The results were similar when net assets were used as weights.

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