OFR

OFFICE OF FINANCIAL RESEARCH

2014 Annual Report

LETTER FROM THE DIRECTOR

I am pleased to present the Office of Financial Research 2014 Annual Report to Congress. This report — our third — analyzes potential threats to U.S. financial stability, documents our significant progress in meeting the mission of the Office, and reports on key research findings.

Over the past year, the U.S. financial system has continued to recover and strengthen. Compared with the period just before the financial crisis, threats to financial stability are moderate. But that relatively benign backdrop is no cause for complacency.

Rather, there is good reason to watch financial developments closely. Since our 2013 report, several financial stability risks have increased. The three most important are excessive risk-taking in some markets, vulnerabilities associated with declining market liquidity, and the migration of financial activities toward opaque and less resilient corners of the financial system.

The Financial Stability Oversight Council identified similar issues in its annual report six months ago and recommended steps to address them. Our report, as in 2013, builds on and complements the Council's comprehensive perspective and policy recommendations with a more in-depth look at specific issues and an evaluation of policy options.

Last year, we introduced our benchmark tool for assessing and monitoring threats — the OFR Financial Stability Monitor, which enables us uniquely to look across the financial system and spot threats wherever they arise. The further development of this monitor presented here is just one way we fulfill our mission to develop and maintain tools and metrics to assess and monitor vulnerabilities in the financial system.

Our ability to identify and assess vulnerabilities and the quality of our judgments do not hinge on tools alone. They also depend on the quality of our raw materials — that is, the data and information we employ. What makes the OFR unique is our mission to improve the quality and scope of financial data. Global data standards are essential for data quality, so efforts to improve data quality require the engagement and cooperation of financial regulators and market participants worldwide.

For example, the Office has led the global Legal Entity Identifier (LEI) initiative from the start. This signature project is now self-sustaining, yet realizing the full benefits of the LEI system requires ubiquitous adoption. Consequently, I continue to call for regulators around the world to require the use of the LEI — and other available standards — in regulatory reporting.

In a second data-quality project, we are helping the Commodity Futures Trading Commission to improve the quality of derivatives data reported to swap data repositories. Those data are essential for assessing exposures and interconnections across the financial system.

Collaboration on efforts to fill data gaps is also necessary. We have just launched a landmark pilot project with the Federal Reserve to collect previously unavailable data for bilateral repurchase agreements, or repos. This project marks the first time the Office will collect data

directly from financial companies. This collection and subsequent analysis of this key segment of short-term, wholesale funding markets will inform our future data collection initiatives.

Four years have passed since the signing of Dodd-Frank, and a great deal has been accomplished. But the challenges of providing data and analysis for use by financial stability policymakers, and of evaluating financial stability policies and tools, remain consequential. Moreover, financial innovation and migration of financial activity to different markets, institutions, and jurisdictions will always tax our capacity to measure and analyze financial activity.

World-class thinking is required to meet these challenges. For our part, the OFR needs the independence, the flexibility, and the resources to attract and retain the core, superior talent required to achieve our mission. At the same time, our approach to our work is collaborative by necessity. The breadth and scope of our mission exceed our stand-alone capacity, regardless of our talent and resources. That is why we view the OFR as part of a virtual research-and-data community that extends the analytical capability of the Office, expands our capacity to meet urgent needs, and complements the work of others in this community.

The vision that we all share is of a transparent, efficient, and stable financial system. Our work so far has given us a strong sense of what success looks like. That perspective has informed a soon-to-be-published strategic plan that articulates our mission and goals for the next five years, and a roadmap to achieve them. First, we plan to be an essential source of data and analysis for monitoring threats to financial stability. Second, we will promote the identification and adoption of standards that improve the quality and utility of financial data. Third, our leading edge research will improve financial stability monitoring and the scope and quality of financial data, and inform policy and risk management.

I am deeply grateful for the opportunity to lead this extraordinary organization and our talented team of dedicated professionals for a fourth year. Our goals are ambitious but fulfilling our mission requires aiming high. I am more confident than ever that we are building a valuable institution that will help assure a stronger and safer financial system in the future.

Richard Berner
Director, Office of Financial Research

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EXECUTIVE SUMMARY 1

This third annual report of the Office of Financial Research (OFR) assesses threats to U.S. financial stability, outlines OFR research that supports the assessment, and describes the OFR's progress in meeting our mission. The report also evaluates policy initiatives for promoting financial stability and describes our work to improve the quality and scope of financial data and analysis.

The OFR, financial regulators, and other policy institutions have made significant progress since our last annual report in assessing the buildup of vulnerabilities in the financial system, improving the quality and scope of financial data, and developing and implementing new policy tools that — although largely untested — are designed to make the financial system stronger and more transparent.

However, several threats to financial stability have risen over the past year. This report highlights three specific risks. First, we see material evidence of excessive risk-taking during the extended period of low interest rates and low volatility. Second, markets have become more brittle because liquidity may be less available in a downturn and the risk of asset fire sales and runs in short-term wholesale funding markets remains unresolved. Third, we are concerned that financial activity is migrating toward areas of the financial system where threats are more difficult to assess because information is not available, and that activity may be consequential. Gaps in analysis, data, and policy also persist, despite progress in narrowing them. If left unaddressed, these threats could adversely affect financial stability.

This report fulfills the requirement in the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 for the OFR to report annually to Congress. As required, the report includes: (1) an analysis of any threats to the financial stability of the United States, (2) the status of our efforts in meeting the mission of the Office, and (3) key findings from our research and analysis of the financial system.

This annual report describes our:

- Financial Stability Monitor and other tools to help policymakers and market participants understand and assess vulnerabilities and potential threats to financial stability;
- analysis of the macroprudential policy toolkit regulators are developing, including key areas of progress and remaining issues, such as market liquidity risks, risks of runs and asset fire sales, and the need to address cyclical market excesses;
- work to make data standards in general and the Legal Entity Identifier in particular widespread in regulatory reporting and market practice, and OFR collaboration with the Commodity Futures Trading Commission (CFTC) to promote data standards across derivatives markets; and
- efforts to address data gaps, such as the OFR's new collaboration with the Federal Reserve to gather data about repurchase agreement (repo) markets.

Analyzing Threats to Financial Stability

Chapter 2 details where risks have increased over the past year. The focal point of this analysis is our Financial Stability Monitor, introduced last year, but refined, broadened, and deepened for this report. The monitor displays the buildup of vulnerabilities across five broad categories of risk — macroeconomic, market, credit, funding and liquidity, and contagion — based on a set of models, surveys, financial data, and other indicators.

The monitor shows that although overall risks to financial stability are not particularly elevated compared to the pre-crisis period, some have clearly intensified over the past year. One particular concern is market risk, which is the vulnerability of investor portfolios to large losses because of unanticipated adverse movements in interest rates, exchange rates, and other asset prices. The monitor also shows elevated risks among nonfinancial corporations in the United States because of relaxed lending standards, lower credit quality, higher debt levels in relation to total assets, and thinner cushions to counteract shocks. Market liquidity risks have also increased, in part reflecting structural changes in the way liquidity is provided.

Recent volatility in financial markets focused attention on some of the vulnerabilities that have been growing over the past several years. Although accommodative monetary policy has helped to foster economic recovery and promote bank balance-sheet repair, the prolonged period of low interest rates has also suppressed volatility and encouraged greater risk-taking by market participants.

We also remain concerned about structural vulnerabilities related to short-term wholesale funding markets because incentives still exist for fire sales of assets during periods of stress. Short-term funding markets are instrumental in providing liquidity to keep the global financial system operating.

Potential spillovers from an inevitable reversal in the stance of monetary policy are an additional cause of concern. The impending change in policy poses risks for market participants who have bet on sustained low volatility or low interest rates. The buildup of excesses is not unique to the United States. Emerging markets, for instance, show some parallels. Tighter global links mean that future shocks will be more quickly transmitted, likely resulting in broader disruptions.

Evaluating Macroprudential Policy Tools

Although the OFR is not a policymaking entity, the Dodd-Frank Act directed us to provide analysis and advice about policies designed to curb risks to the financial system.

In this country and overseas, regulators have made notable progress developing policies designed to make the financial system less vulnerable to shocks and less likely to be the source of shocks. For example, U.S. banking regulators have overhauled the requirements regarding the capital that banks must hold as a buffer to shocks, and they are beginning to introduce requirements on liquidity. Under the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 (Dodd-Frank Act), they also now require the largest banks to undergo supervisory stress tests and to submit resolution plans, or "living wills," to help restore market discipline. The Financial Stability Oversight Council (Council) has begun to designate nonbank financial companies for enhanced prudential standards and supervision by the Federal Reserve under another Dodd-Frank Act mandate.

In Chapter 3 of this report, we explore the benefits and challenges of the new set of policies, most of which focus on the largest banks or nonbank financial companies. We also discuss risks in mortgage securitization markets and the steps that regulators have taken, or could take, to address them, focusing on the final risk retention or "skin in the game" rule released by regulators in October.

Most reforms so far have been aimed at structural vulnerabilities. We observe in Chapter 3 that tools are also needed to address cyclical excesses. The one new cyclical tool introduced in the United States is the countercyclical capital buffer. As agreed under the international Basel III accord, regulators can require banks to hold an additional buffer of capital during boom times as a cushion against potential future losses. We note that U.S. regulators have not said how the buffer will be used or what will trigger its use. In addition, the buffer is a blunt tool that may not be suitable for addressing excesses in specific credit markets.

The leveraged lending market provides a test case of the current approach to cyclical excesses. The response to these issues has been led by bank regulators, who regulate the largest institutions that originate leveraged loans, often for sale to asset managers through various instruments. Despite stronger supervisory guidance and other actions, excesses in this market show little evidence of easing.

Research on Financial Stability

In Chapter 4, we highlight three multiyear research projects at the OFR. The first uses agent-based models to simulate the spread of contagion across multiple channels for risk transmission in financial markets during crises. These models hold great promise for understanding the dynamics of fire sales and other chains of complex events. The models attempt to capture the behaviors and interactions of diverse market participants by considering the roles each agent plays in stress events as they unfold. The second project describes the OFR's exploration of visualization techniques that go beyond familiar line charts and bar charts to help analysts monitor financial stability. Effective and innovative visualizations reveal key patterns and connections in complex financial data. The OFR is also developing interactive visualizations for displaying these insights online.

The third section of Chapter 4 describes ongoing OFR research on credit default swap markets. Research is focused on the role of information flows on credit default swap activity and pricing and how transaction sizes affect prices and liquidity under different market conditions. In addition, the chapter discusses implications for financial stability posed by central counterparty clearing of credit default swaps.

Advancing Data Standards

In Chapter 5 of the report, we describe the OFR's work to promote and develop financial data standards, which are essential to make data suitable for financial stability analysis and for financial companies' internal risk management.

The global Legal Entity Identifier (LEI) project is the most advanced of these standards, and it took major strides forward in 2014 with the completion of the governing structure for the LEI system. The LEI is like a bar code for identifying entities that engage in financial market transactions. It is a linchpin for making connections in the massive volumes of financial data that course through the international economy every day. To date, about 300,000 LEIs have been issued to entities around the world and 19 utilities have been approved to issue LEIs for use in regulatory reporting. Regulations requiring the LEI are being issued at an accelerating pace across the world. The OFR's Chief Counsel chairs the international committee overseeing the system.

As momentum builds and the LEI system grows, the benefits are growing as well, including efficiencies for financial companies in internal reporting and in collecting, cleaning, and aggregating data. We also expect to reduce companies' reporting burdens by generating efficiencies in reporting data to regulators.

In 2014, the OFR began work to help the CFTC and other regulators improve data quality in swap data repositories. This is a critical initiative for market participants and regulators to make sense of the vast amounts of new market data that these repositories are beginning to collect.

The OFR also created plans in 2014 to prepare and publish reference databases for financial entities and companies and financial instruments, as required in Dodd-Frank. The LEI system will provide all needed inputs to create and maintain a financial entity database. As an outgrowth of projects such as the work with the CFTC, the OFR has also begun to develop formats and standards for reporting financial transaction and position data and for identifying financial instrument types. In addition, the OFR will develop a prototype of the financial instrument reference database.

Data sharing is critical to our mission. The Office continues to work with Council member organizations to develop protocols and procedures for securely sharing data for monitoring and analysis.

Addressing Data Gaps

In Chapter 6, we discuss our progress in filling gaps in the data available for monitoring and analyzing financial stability. In October, we announced a pilot project with the Federal Reserve to gather data about the market for bilateral repos. This project focuses on a critical gap in the data needed for financial stability analysis. A repo is essentially a collateralized loan, when one party sells a security to another party with an agreement to repurchase it later at an agreed price. Repos are an important source of short-term funding for the financial industry. The U.S. repo market provides more than $3 trillion in funding every day. The bilateral repo market, which constitutes half of the total market, is not only opaque, but also vulnerable to runs and fire sales.

Our ability to evaluate financial developments has benefited significantly as regulators introduced new data collections and expanded old ones in recent years. For example, the Securities and Exchange Commission's (SEC's) new Form PF has provided unprecedented insights about hedge funds and other private funds. Chapter 6 explains our analysis of hedge fund leverage using information from that form.

Outreach, Collaboration, and Infrastructure

Chapter 7 describes the OFR's progress in building its organization as a valued source of high-quality data and expert research and in collaborating with member agencies of the Council, outside researchers, and regulators overseas. This collaboration is central to the mission of the OFR.

In the 2014 fiscal year, we organized workshops and conferences in collaboration with the Council and its member agencies. This year, our Financial Research Advisory Committee met twice, and presented more than a dozen recommendations that span our work in research, risk management, and data standards. We awarded three grants to outside experts to promote financial stability research under a joint program with the National Science Foundation. OFR senior managers and research staff members participated in dozens of public events, both for general and technical audiences, increasing awareness of our activities and promoting further collaborations with outside organizations.

Our forthcoming strategic plan for FY 2015-19 describes our vision, mission, goals, and objectives, and discusses specific ways we will carry out that mission. The plan is a blueprint to guide our activities, set our priorities, and inform the public about our mission and how we work to achieve it. The plan also contains metrics required by law to evaluate our performance and hold us accountable to oversight and the public.

Information technology is critical to carry out our mission. In 2014, we completed installation of a world-class, analytic environment for collecting, storing, aggregating, and maintaining large volumes of data. We also installed computing tools to support complex financial models, cutting edge visualization, and analysis. The Office uses a wide range of security tools to assure protection of confidential, nonpublic information and has created a proprietary recovery site to assure business continuity.

We continue to hire highly qualified employees. In the past three years the staff has increased from 30 to nearly 225 employees. As detailed in our forthcoming 2014 Human Capital Report to Congress, we plan a steady-state total workforce of approximately 300.

Agenda Ahead

In Chapter 8, we describe our plans for 2015 and beyond. Our research priorities include:

- broadening our market monitoring framework, including the publication of a Financial Markets Monitor, a version of which is currently presented only to the Council;
- developing a suite of additional monitors and dashboards, focused on money market funds, hedge funds, and credit default swap markets;
- publishing working papers that describe in greater detail the methodology behind our Financial Stability Monitor and Financial Stress Index, as well as a series of short papers on significant threats to financial stability;
- expanding our analysis of stress tests and other macroprudential policy tools; and
- publishing research on financial stability, risk management, and related topics, including working papers on agent-based models, visualization techniques, and credit default swap markets, as described in Chapter 4.

Our data priorities include:

- advocating for the global implementation of the LEI in regulation and market practice;
- promoting data standards in derivatives markets, in collaboration with the CFTC;
- leading or contributing to the development and implementation of new standards, such as universal loan identifiers in the mortgage market;
- collecting data on the repo market, in collaboration with the Federal Reserve;
- filling the data gaps discussed in Chapter 6, particularly to help us understand risks in asset management activities and short-term wholesale funding markets; and
- creating a prototype financial instrument reference database to promote market transparency.

Our institutional priorities continue to focus on building our expert workforce and our technological capabilities, including a leading-edge intranet for the OFR staff and deployment of the new OFR public website.

In 2015, we will continue to collaborate with the Council and its member agencies and with our network of outside researchers, industry experts, and others. We will also continue to engage with our stakeholders in Congress and expand our grants program with the National Science Foundation.

ANALYZING THREATS TO FINANCIAL STABILITY

2

Financial markets came under pressure in September and October, exposing some of the vulnerabilities and risk-taking that have been promoted by several years of low interest rates and low volatility. In this chapter, we highlight concerns about: (1) excessive risk-taking and positioning, with a focus on interest rate risks, credit risks, and volatility risks; (2) market structure and liquidity issues, with a focus on the fragmentation of market liquidity and the persistent risks of asset fire sales and runs; and (3) the migration of activities due to financial innovation and regulatory arbitrage.

2.1 Analytic and Monitoring Framework

Seeking higher returns, market participants have taken significant duration, credit, and liquidity risk during six years of low interest rates, low volatility, and ample funding liquidity. Our analysis focuses on the risk that an unanticipated interest rate or volatility shock could reveal those vulnerabilities.

Since our last annual report, market excesses and consequent threats to financial stability have been increasingly evident across a number of dimensions. For example, throughout most of 2014, low volatility and compressed risk premia persisted across asset classes, while nonfinancial corporate credit fundamentals deteriorated. While an accommodative monetary policy helped support the economic recovery and promoted balance-sheet repair by lowering borrowing costs, it also created incentives for risk-taking, with potential consequences for financial stability.

Since our last annual report, market excesses and consequent threats to financial stability have been increasingly evident across a number of dimensions.

The decline in risky asset prices and increase in volatility that occurred in September and October 2014 exposed some of those excesses. That some markets proved to be surprisingly brittle under this modest stress strongly suggests that both cyclical and structural vulnerabilities have increased over the past year. Whether they turn out to be serious vulnerabilities will only be revealed in time by larger market shocks. In this chapter, we describe the framework and indicators we use to track and analyze vulnerabilities.

Market Developments and Financial Stability Monitoring. Section 2.2 describes our monitoring activities, focusing on our Financial Stability Monitor, which tracks and quantifies five categories of risk based on a host of underlying indicators, and our Financial Stress Index, which tracks risks on a real-time basis.

Potential Threats to Financial Stability. In Section 2.3, we highlight the key cyclical and structural vulnerabilities that concern us, based on the results of our Financial Stability Monitor, market intelligence

gathered from a range of sources, and other surveillance tools. Financial stability risks have risen since our last report, centered in three areas:

- **Excessive risk-taking,** including: (1) interest rate risks and operational challenges posed by a normalization in monetary policy; (2) credit risks related to excessive risk-taking and a weakening in nonfinancial corporate credit fundamentals; (3) volatility risks, characterized by reaching-for-yield and herding behavior following a long period of low volatility; and (4) emerging market risks, as capital outflows may reveal underlying fundamental weaknesses.
- **Market structure and liquidity issues,** including: (1) market liquidity risks, caused by fragmentation and structural changes in various market segments; (2) run risks and asset fire sale risks in wholesale funding markets; and (3) market infrastructure vulnerabilities in equity markets, stemming from complexity and lack of transparency.
- **Financial innovation and migration of activities** from more tightly to less tightly regulated parts of the financial system, such as: (1) captive reinsurance companies, (2) mortgage servicing rights, and (3) single family rental securitization.

2.2 Market Developments and Financial Stability Monitoring

This section describes market developments over the past year and our monitoring activities, including an update of the Financial Stability Monitor, which we introduced in our 2013 annual report.

Review of 2014 Market Developments

Following a prolonged period of calm, investors' concerns about extended valuations and global economic growth triggered a broad-based reassessment of risk in September and October 2014. Global risky assets sold off, volatility spiked, and global sovereign bond yields fell amid a flight to safety. Measures of tail risk — the risk of extremely rare events — also increased, as demonstrated by demand for protection against adverse future moves in market prices. The dislocation was large and unexpected, but short-lived. Expectations for continued monetary policy accommodation helped asset prices stabilize and partially recover. But investor sentiment remains fragile.

The episode revealed a number of underlying vulnerabilities. First, during a protracted period of low interest rates and the Federal Reserve's quantitative easing, investors may have taken low volatility for granted and underestimated the potential for a reversal. While quantitative easing policies are intended to encourage investors to buy risky assets, there is also a risk that the perceived reversal of such policies will lead investors to turn the other way, triggering market instability.

Similarly, investors may have become too sanguine about the availability of market liquidity — the ability to transact in size without having a significant impact on price — during both good times and bad. While structural changes in the provision of market liquidity are not fully understood, financial stability analyses in recent years, including the OFR's previous annual reports, have noted the potential fragility of market liquidity during a market shock, due in part to the reduced willingness or capacity of broker-dealers to provide liquidity (see OFR, 2013a; IMF, 2014c; and **Market Liquidity Risks** in **Section 2.3**). The recent market dislocation showed those concerns to be valid, as market liquidity quickly vanished in traditionally liquid markets such as U.S. Treasuries, cash, and futures markets, leading to less market depth and further sharp price declines. (Reduced market depth increases the transaction cost of executing a trade in reasonable size.)

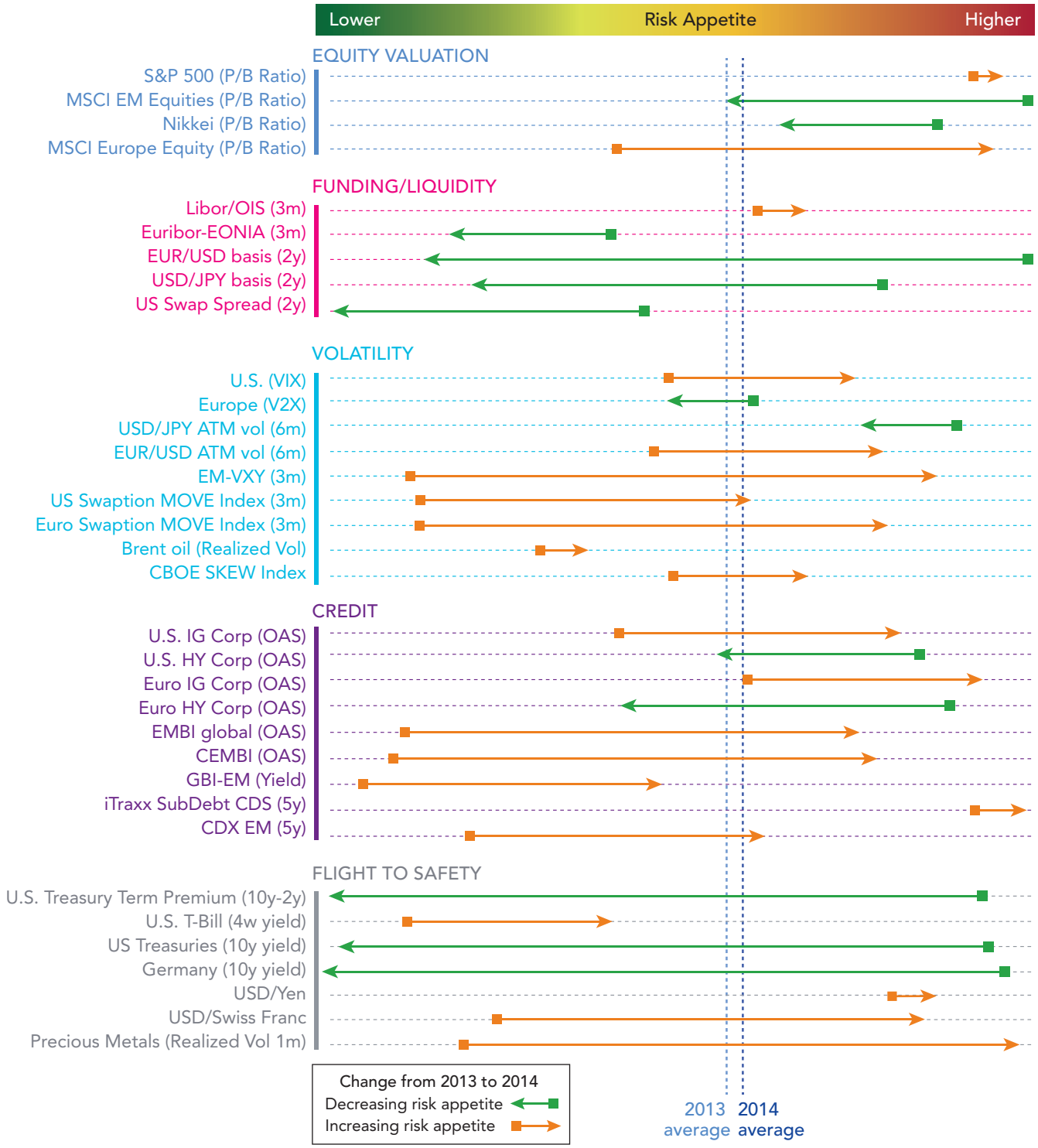
The liquidity strains in the U.S. Treasury market spread quickly to other markets, affecting related asset classes such as interest rate futures, swaps, and options to differing degrees. A liquidation of speculative short positions in interest rate markets also contributed to the instability. Anecdotally, some of the price movements appeared continuous, suggesting that a high volume of transactions was executed by algorithmic trading systems.

Although the dislocation that peaked in mid-October was fleeting, we believe there is a risk of a repeat occurrence, given the increased prevalence of algorithmic trading, a shift in risk preferences by broker-dealers, and the persistent incentives for risk-taking. The potential for a rapid and severe adjustment in prices followed by a reversal in derivatives markets or fixed-income markets — which are large, interconnected, and widely used for hedging and risk management — raises a host of financial stability concerns.

Despite the market gyrations, overall demand for risky assets has not abated (see **Figure 2-1**). Investors continue

Figure 2-1. Risk Tolerance Financial Market Heat Map

Overall risk appetite has firmed since our last annual report

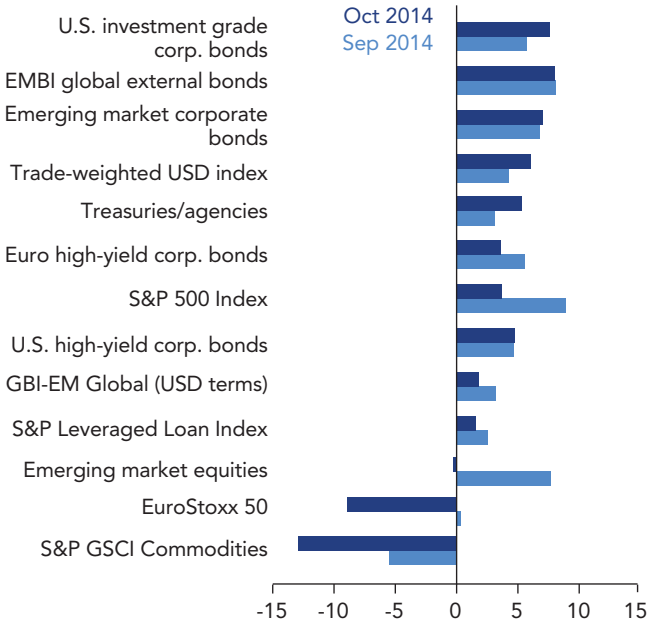


Note: Each indicator is scaled to a percentile range rank and compared to the levels prevailing over the past three years. The dotted vertical lines represent the average across all five asset classes for 2013 and 2014. The direction of the arrow displays the change in the risk appetite between the two years. P/B = Price-to-Book ratio (a ratio used to compare a stock's market value to its book value); EM = emerging market; LIBOR = London Interbank Offered Rate; OIS = Overnight Index Swap; EONIA = Euro Overnight Index Average (1-day interbank interest rate for the euro zone); V2X = European equivalent of VIX; ATM =at-the-money (for options, where the strike price is the same as the current spot price of the underlying security); vol = volatility; VXY = measure of volatility in a basket of currencies; MOVE = Merrill Option Volatility Estimate Index; IG = investment grade; HY = high-yield; EMBI = J.P. Morgan's Emerging Markets Bond Index; CEMBI = J.P. Morgan's Corporate Emerging Market Bond Index; GBI-EM = J.P. Morgan's Government Bond Index-Emerging Markets (an emerging market benchmark index that tracks local currency bonds); CDX EM = Markit's index of credit default swaps covering emerging market companies.

Sources: Bloomberg L.P., OFR analysis

Figure 2-2. Total Year-to-Date Returns (percent)

Most risky assets show positive returns this year, despite market stress in late September and October



Note: Data are year-to-date through September 15, 2014, just before a period of market stress began, and through October 17, 2014, when the stress event had largely subsided.

Sources: Bank of America Merrill Lynch, Bloomberg L.P., JPMorgan Chase & Co., OFR analysis

Although the dislocation that peaked in mid-October was fleeting, we believe there is a risk of a repeat occurrence, given the increased prevalence of algorithmic trading, a shift in risk preferences by broker-dealers, and the persistent incentives for risk-taking.

to be rewarded for taking credit, duration, and liquidity risk. Even after taking into account the broad-based market dislocation that occurred in September and October, higher risk assets such as eurozone peripheral bonds, emerging market sovereign and corporate debt, and U.S. corporate bonds remain among the better performing assets this year (see **Figure 2-2**).

Overall global financial and monetary conditions remain broadly accommodative, reflecting the outlook for slow economic growth and low inflation (see **Figure 2-3**). While the Federal Reserve and Bank of England have spelled out the circumstances that would entail future changes in their policy stances, currently they remain committed to accommodative policies. The Bank of Japan and the European Central Bank have taken additional measures to ease policy further.

Accommodative global monetary policy, coupled with the Federal Reserve's purchases of large amounts of low-risk assets and changes in risk sentiment, helped to compress volatility and risk premiums (the returns in excess of the return earned on a risk-free investment).

These conditions encouraged investors to increase their holdings of long-dated securities and products with riskier credit attributes in a search for higher returns. Over the past five years, investors moved out of money market instruments and into riskier assets such as leveraged loans, high-yield corporate credit, eurozone peripheral bonds, and emerging market equities. Investors moved into global equities more slowly (see **Figure 2-4**). For instance, cumulative flows from U.S.-domiciled mutual funds into bonds have increased by nearly $1 trillion since the end of 2008, while the flow into equities has been a mere trickle. As a result, some investors (particularly those with unhedged positions and duration mismatches) grew more heavily exposed to an abrupt correction in the fixed-income markets compared to the pre-crisis period.

During the recent bout of volatility, investors partly unwound their positions in eurozone peripheral credits, U.S. equities, and high-yield and leveraged loans. But the liquidation was not enough to offset the extended long positions that investors had built up over the past few years. On the contrary, the fleeting nature of the episode ultimately had the effect of reinforcing demand for duration, credit, and liquidity risk, and led many investors to reestablish such positions.

Unlike prior to the financial crisis, investors have not significantly increased balance-sheet leverage to boost returns. That's partly because of constraints on banks from increases in their capital requirements. Overall, the aggregate amount of nonderivatives-based leverage in the financial system has remained stable and is below peak levels. Total outstanding repurchase agreements (repos) and the issuance of financial products with embedded leverage are below pre-crisis levels. However, we lack detailed information on derivatives-based leverage; it is an area that suffers from data opacity and warrants further analysis.

There are a few worrying exceptions to this low-leverage trend. While financial institutions have reduced the amount of debt on their balance sheets compared to their assets, debt accumulation has increased among nonfinancial companies and the government. Managers of structured investment products such as collateralized loan obligations are also increasing their use of leverage, and total margin debt (debt used to purchase securities) has risen. These trends require close monitoring.

Financial Stability Monitoring Activities

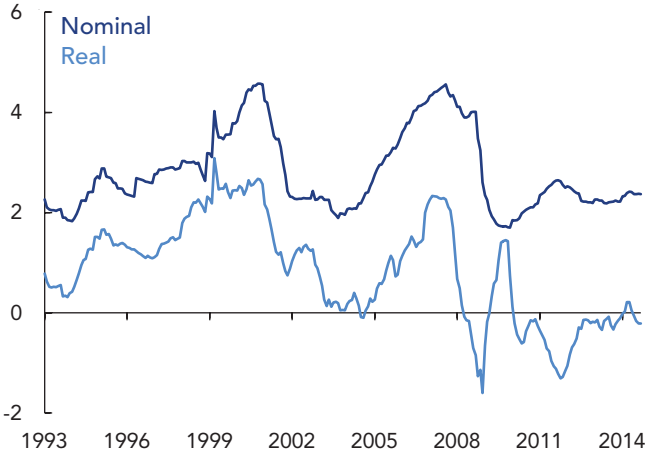
The OFR continues to build and refine our financial stability monitoring and analytical toolkit to include a spectrum of monitors, models, metrics, and visualization tools. We will continue to gather market intelligence and acquire data to quantify and analyze vulnerabilities and risks.

The OFR's Financial Stability Monitor provides a high-level summary of the buildup and overall level of vulnerabilities in the financial system as of September 30, 2014 compared to October 31, 2013 (see **Figure 2-5**). Several financial stability risks have risen since our last report, notably those that measure market and liquidity risks. While overall threats are not particularly elevated compared to the peak of the 2007-09 financial crisis, a number of risks are close to those prevailing in late 2005 or early 2006. Highlights include:

- **Macroeconomic risks remain little changed.** The U.S. macroeconomic outlook has improved amid stronger sentiment and stable quarterly growth. Market perceptions of tail risks have diminished, as reflected by a decline in global market-implied sovereign credit risk. Geopolitical tensions in emerging markets and uncertainty about growth in the eurozone have had limited spillover effects here (see **Emerging Markets** in **Section 2.3**). However, the risk of slow growth and low inflation — which some have called

Figure 2-3. Global Monetary Policy Rates (percent)

Amid a weak economic outlook, global monetary policy remains broadly accommodative

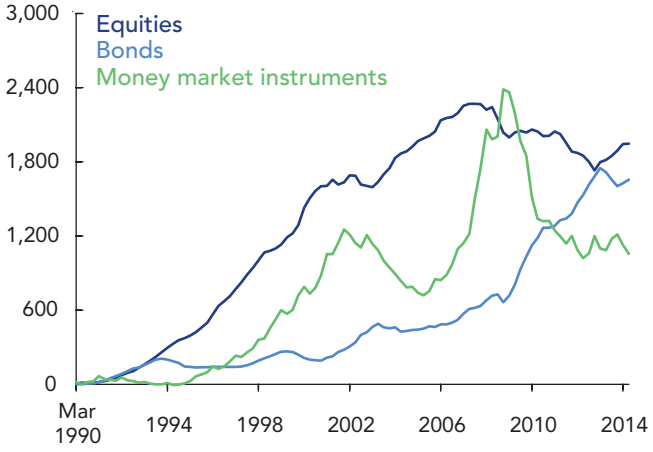


Note: Rates are weighted by gross domestic product and include Australia, Belgium, Brazil, Canada, China, France, Germany, India, Italy, Japan, Mexico, the Netherlands, Norway, Poland, Russia, South Korea, Sweden, Switzerland, Turkey, the United Kingdom, and the United States.

Sources: Bloomberg L.P., OFR analysis

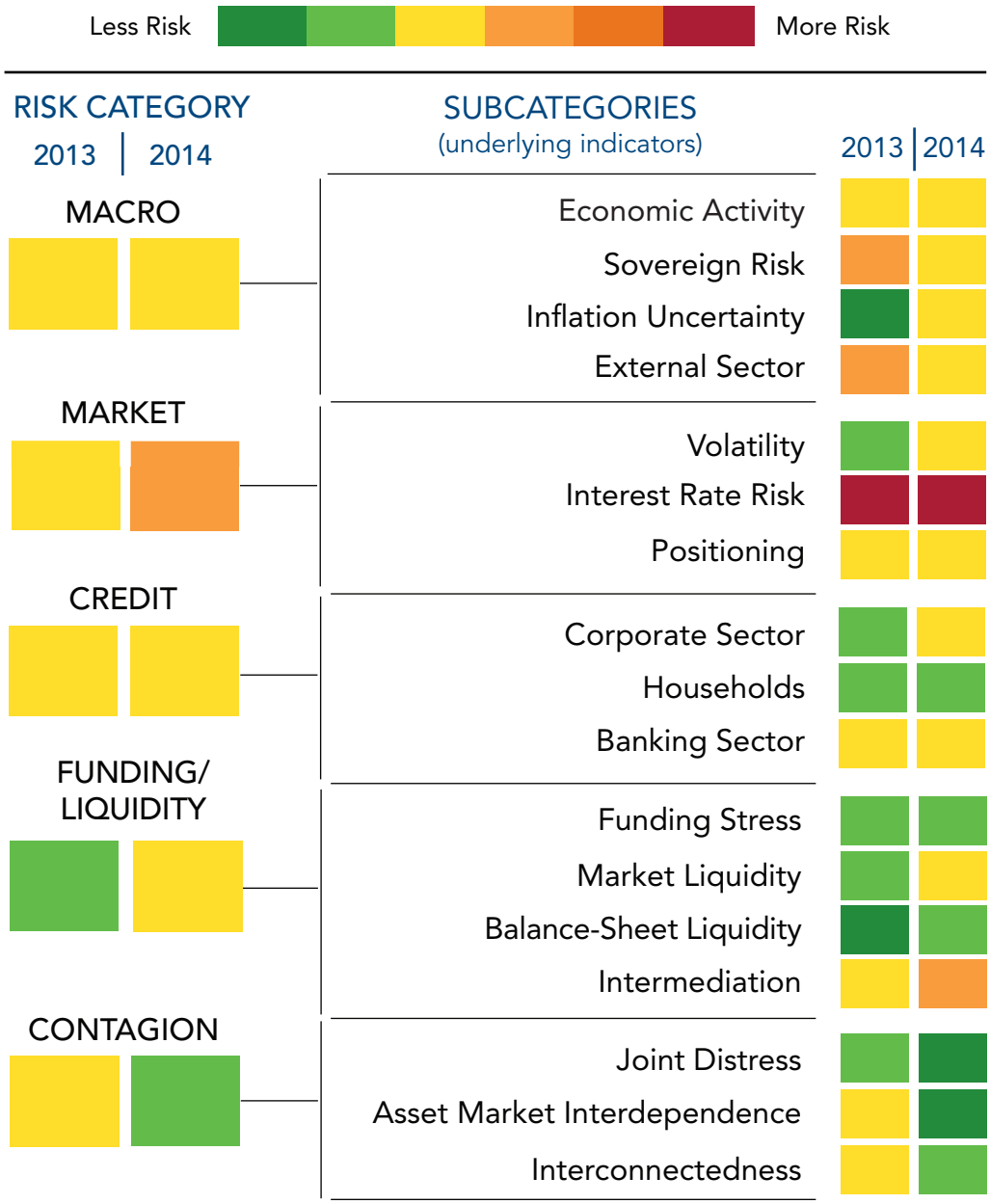
Figure 2-4. Cumulative Mutual Fund Flows to Bonds, Equities, and Money Market Instruments ($ billions)

Quantitative easing encouraged investors to shift out of cash into riskier assets



Sources: Haver Analytics, OFR analysis

Figure 2-5. OFR Financial Stability Monitor



Notes: Green signifies low financial stability risks, while red signifies elevated risks. The figure represents a series of underlying indicators based on maximum levels prevailing from January 1, 1990 (if available) to the present. Each risk category is constructed as a weighted average across the prevailing risk levels, with weights assigned based on the back-test performance of each of the indicators in the underlying categories. Positioning is determined by the weighted average z-scores of the underlying indicators since our last annual report. Data are as of September 30, 2014 and October 31, 2013. Some risk subcategories were revised to include indicators recently added to the Financial Stability Monitor. The OFR will issue a working paper in 2015 detailing the components that make up the monitor.

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

Several financial stability risks have risen since our last report, notably those that measure market and liquidity risks.

Figure 2-6. Financial Stability Monitor Risk Classification and Examples of Indicators

Risk	Definition	Indicators
Macro-economic	Evaluates risks that have the potential to affect financial stability through various macro channels such as growth, external balances, fiscal vulnerabilities, and confidence channels.	Financial conditions, output gap, sovereign debt levels and financing costs, foreign exchange reserves, current account balances, consumer and business confidence, inflation volatility, and inflation expectations
Market	Assesses the risk of destabilizing losses across key asset classes and investment strategies as a result of adverse movements in asset prices.	Duration, positioning, risk premiums valuations, and volatility
Credit	Measures the propensity of a counterparty to meet its financial obligations, and includes market-implied and balance-sheet measures of risk.	Corporate credit spreads, balance-sheet leverage, lending conditions, delinquencies, asset quality of households, corporates, banks, and nonbank financial institutions
Funding/ liquidity	Captures market liquidity, balance-sheet liquidity ratios, stress in funding markets, and the potential for vulnerabilities that arise from excessive leverage.	Broker-dealer inventories, turnover, volume, cash balances, dependence on wholesale funding, changes in short-term investor assets under management and tenors, foreign exchange basis swaps, short-term funding rates/spreads
Contagion	Measures the vulnerability of the financial system to sudden shocks that may spread as a result of interconnectedness.	Contingent claims analysis, conditional value at risk, systemic expected shortfall, distressed insurance premium, network analysis, cross-border exposures, sovereign-bank exposures, correlation risk

Source: OFR analysis

"secular stagnation" — leaves some economies and financial systems vulnerable to shocks.

- **Market risk has increased across a number of measures.** Duration risk (the sensitivity of bond investments to a change in interest rates) remains elevated, and could potentially expose investment portfolios to sizeable losses in the event of an unanticipated rise in interest rates (see **Credit Risks** and **Interest Rate Risks** in **Section 2.3**). There is evidence of valuation misalignments and crowded positioning in some market segments, posing the risk of a disorderly withdrawal if market participants exit similar positions simultaneously. These buildups have occurred amid historically low volatility, which increases the potential for excessive risk-taking and high leverage and could worsen the consequences if volatility suddenly spikes (see **Volatility Risks** in **Section 2.3**).
- **Credit risk measures are mixed — improving in the household and banking sectors, but continuing to deteriorate at the margin in the corporate sector.** Overall bank fundamentals in the United States are strong, with much of the improvement attributed to enhanced capital and liquidity buffers to comply with new regulations. Delinquencies, default rates, and debt overhangs have continued to abate since the financial crisis; indeed, delinquencies and charge-offs at commercial banks for nonmortgage consumer and commercial loans are near record lows. However, overseas banks, particularly in the eurozone, show unresolved structural weaknesses and balance-sheet repair is incomplete (see IMF, 2014c). Our concerns focus on the buildup of risks in U.S. nonfinancial corporates. Although delinquencies in this sector remain low, we expect that the credit cycle, when it turns, will be exacerbated by the combination of increased balance-sheet leverage, reduced compensation for risk, lower credit quality, weaker covenants, and easing lending standards (see **Credit Risks** in **Section 2.3**).
- **Measures of funding appear stable, but market liquidity is a concern.** Monetary policy is still accommodative and wholesale funding markets show reduced concentration risk, maturity risk, and intraday credit risk, while collateral quality has improved. However, these are precisely the circumstances that have in the past fostered excessive leverage, maturity transformation, and liquidity transformation. And funding markets can shift rapidly in the event of an

unanticipated market disturbance, especially when it is accompanied by leverage or a liquidity mismatch (see **Run Risks and Asset Fire Sale Risks** in **Section 2.3**). Corporate balance-sheet liquidity remains strong, measured by cash balances, although somewhat diminished since our last annual report. We remain concerned that traditional liquidity providers are less able than they were before the crisis to intermediate and provide liquidity in the event of a market disruption (see **Market Liquidity Risks** in **Section 2.3**). Furthermore, six years of abundant funding liquidity may have masked the depth of the deterioration in trading liquidity.

- **Measures of contagion risk have moderated.** Market-based measures of joint distress of major U.S. financial institutions are at post-crisis lows. (However, it is worth noting that market-implied contagion measures tend to show weak forward-looking properties. Such measures are more effective at identifying peaks in the midst of a crisis.) Direct measures of interconnectedness, such as financial institutions' holdings of sovereign debt and foreign claims of U.S. banks, have also declined over the past year. Conservative balance sheets have made banks more resilient to financial shocks. Measures of cross-asset correlation are at modest levels.

CONSTRUCTION OF THE MONITOR

The OFR's Financial Stability Monitor does not predict when or how future systemic shocks could materialize. It would be difficult, if not impossible, to pinpoint the probability, magnitude, or timing of shocks that might trigger a systemic financial event. The monitor instead attempts to isolate and analyze vulnerabilities in the financial system that could be exposed by shocks, such as incentives to take excessive risks.

The Financial Stability Monitor considers five categories of risk: macroeconomic, market, credit, funding and liquidity, and contagion. These categories closely align with the tasks of a well-functioning financial system — credit allocation, maturity transformation, risk transfer, liquidity intermediation, and a smoothly operating system for payments (see **Figure 2-6**).

In selecting the monitor's underlying indicators, we focused on ones with high frequency and history over multiple business cycles and periods of financial distress. Most start in 1990 and have a daily or monthly frequency.

The Financial Stability Monitor cuts across different geographies, sectors, and measurement methods (see **Figure 2-7A**). We concentrate primarily on risks directly related to U.S. financial stability, but we also take into account spillovers or shocks to and from other major economies and large, complex financial institutions. The monitor includes indicators for sectors such as government, households, corporations, banks, and nonbank financial services firms. The monitor uses model-based indicators, as well as measures based on balance sheets, surveys, and markets.

The Financial Stability Monitor is constructed with five risk categories (see **Figure 2-7B**). Each category is evaluated using a series of underlying indicators based on maximum and minimum daily levels prevailing from January 1, 1990 (if available) to the present. Each indicator is weighted according to its performance in a series of tests. Indicators are then combined into subcategories, such as interconnectedness or joint distress. Several subcategories make up each risk category, which is constructed as a weighted average of the prevailing risk levels for each indicator. Results are summarized on a heat map, in which green indicates that risks to stability are low and red indicates they are elevated.

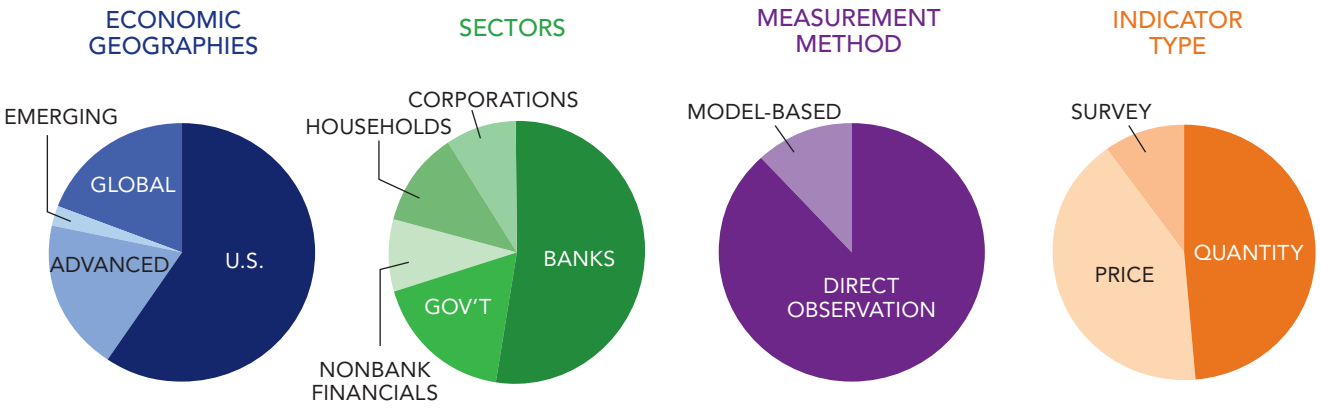
The Financial Stability Monitor aims to identify underlying vulnerabilities that may predispose a system to a crisis. We have a good sense of preconditions that lead to crises: for example, excessive leverage, excessive risk-taking, a rapid rise in capital flows, and reduced policy buffers. Indicators were partly selected based on the experience with historical episodes of stress. However, every crisis has been unique, both in terms of the triggers and the propagation. Had we designed the monitor prior to the 2007-09 global financial crisis, we would likely have underestimated the role of funding markets in transmitting stress or underestimated the importance of macrofinancial linkages. (Given the benefit of hindsight, the monitor shows a pronounced buildup of risk during the runup to the crisis.) The lesson is that we will need to adjust our framework as new, more forward-looking metrics are developed, as our understanding about the transmission of risk evolves, and as the system is tested during future periods of stress. The Financial Stability Monitor is a dynamic framework that we will adjust as conditions evolve.

The monitor's main limitations include:

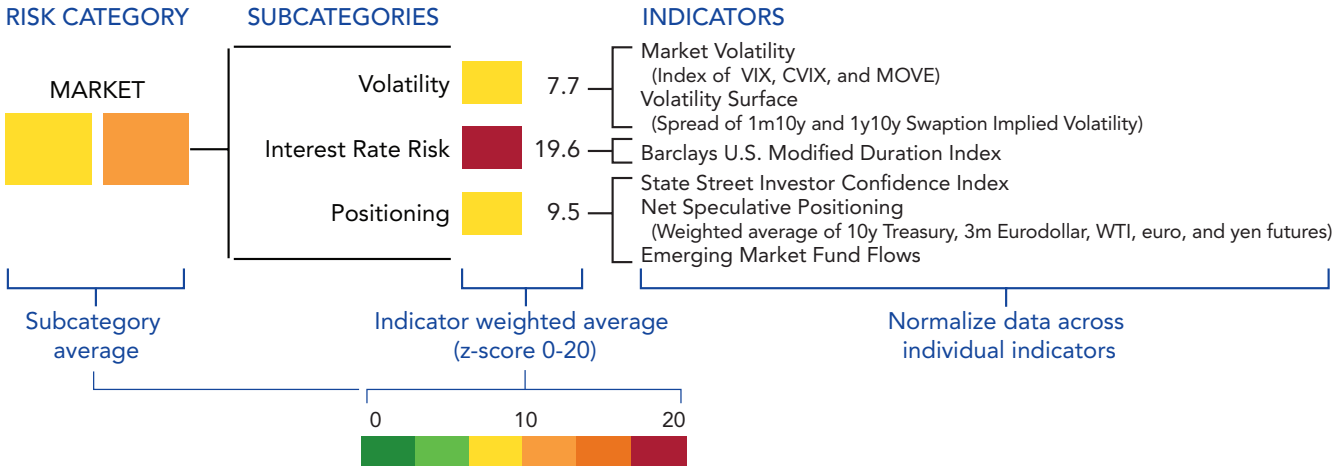
- It may miss some vulnerabilities, especially those that are hard to quantify. For instance, containing operational risk, and cyberattacks in particular, is important to assure infrastructure resilience. But it would be a

Figure 2-7. Composition (A) and Construction (B) of the Financial Stability Monitor

A. The Financial Stability Monitor cuts across different geographies, sectors, and measurement methods.



B. An illustration of how the Financial Stability Monitor is constructed.



Source: OFR analysis

challenge to develop metrics to monitor cyber-related vulnerabilities, assess their systemic impacts, and identify gaps in oversight.

- A number of the indicators in the monitor are near-coincidental. More work is needed to make it more forward-looking. The difficulty in providing early warnings or reliable turning points may not allow policymakers time to take action to avoid a crisis or substantially dampen its effects.
- The Financial Stability Monitor does not take into account systemwide feedback effects, changes in historical relationships, or different phases in the business, credit, and monetary policy cycles.
- Because the Financial Stability Monitor is calculated relative to historical norms, it does not account for unprecedented events, although post-crisis forensic analysis may still be informative.

We are seeking ways to make the monitor more forward-looking — not to try to predict shocks with precision, but to signal that trouble might be on the horizon. We are also working to increasingly take into account the complexity and interconnectedness of institutions and markets, as well as the channels that can transmit or amplify shocks.

Since the OFR introduced the Financial Stability Monitor one year ago, we have substantially refined our framework. First, we expanded the monitor's breadth and depth, and acquired data to populate the underlying metrics. Second, we conducted performance tests on the underlying indicators to gauge each one's reliability. We identified indicators that can provide early warnings, identify critical thresholds, and

Back-testing the Financial Stability Monitor

The Financial Stability Monitor was designed based on historical experiences that inform our understanding of the preconditions that lead to crises. To assess the quality of the underlying indicators in the monitor, we tested each indicator for its ability to capture extreme events such as market peaks and troughs, identify turning points, and give early warning signals of stress at a reasonable horizon during prior crises (see Arsov and others, 2013; Dattels and others, 2010).

We looked at selected historical crisis episodes to assess how the range of indicators performed. If a particular indicator performed poorly on all three tests, we removed it from the monitor. Indicators that performed well on the tests were weighted more heavily.

The tests are summarized as follows:

EARLY WARNING SIGNAL

The early warning signal tested an indicator's ability to signal stress far enough in advance to give policymakers time to implement contingency measures. We tested each underlying indicator against a proxy for systemic risk, the Financial Stress Index published by the Federal Reserve Bank of Cleveland (FRB Cleveland).

We applied a Granger causality test, a statistical technique that tests if one time series precedes (or "Granger-causes") another. We used F-tests to test whether lagged information on a variable in the monitor provided statistically significant information about the FRB Cleveland stress index. If it did not, we gave it a low score on its early warning characteristics. A final early warning score was computed by taking a simple average of the measure's performance on the Granger causality and lag-length regression tests.

EXTREME EVENT SIGNAL

The extreme event tested an indicator's ability to forecast extreme stress events such as market peaks and troughs with reasonable accuracy. We used a statistical technique known as logistic regression to test lags of each indicator against periods of high financial stress. We defined a period of high stress occurring when the FRB Cleveland stress index exceeded its 75th percentile on a historical basis. The extreme event score was computed by taking a simple average of the measure's performance based on statistical significance and model fit.

TURNING POINT SIGNAL

The turning point tested an indicator's ability to capture the timing of critical turning points during a stress event. We examined how each indicator performed ahead of sharp and sustained equity market selloffs during recent crises, such as the January 1991 savings and loan crisis, the July 1997 Asian financial crisis, the August 2000 bursting of the U.S. Internet bubble, and the July 2007 global credit crisis. To reach our turning point conclusions, we asked four questions:

1. Did the indicator fall outside the threshold (defined as plus or minus one standard deviation from the mean) six months ahead of the stress event, providing an early warning signal?
2. Did the indicator fall outside the threshold during or within six months after the stress event, capturing its severity?
3. Did the indicator signal a stress event that never materialized over the next 12 months? If so, we classified it as a false positive error.
4. Did the indicator fail to signal a stress event before or during a stress event that actually materialized? If so, we classified it as a false negative error.

Identifying measures that provide consistent early warning signals is a challenge for policymakers. Our initial findings showed few indicators performed well in identifying early warning signals. However, a large number performed better in the extreme event study. A mix of market- and institution-based indicators across all five risk categories included in the Financial Stability Monitor showed some ability to identify and capture stress events. Measurements that estimate the impact of broader financial distress on a specific bank's market value or insurance premium performed well in all the tests, and so did measures of volatility, corporate credit pricing, and asset return correlation.

The turning point exercise produced mixed results in testing for errors. While more than 90 percent of the measures were able to capture the stress events, many signaled false positives. A policymaker might worry less about false positives and prefer to err on the side of caution rather than overlooking a stress event entirely. In any case, follow-up analysis and judgment will be needed prior to taking any action.

The indicators we selected seem to successfully capture mounting risks ahead of selected crisis events and to help us evaluate their depth. But it is only one tool in our toolkit. We continue to identify and develop forward-looking indicators that may help improve our ability to monitor vulnerabilities.

accurately mark the severity of a crisis (see **Back-testing the Financial Stability Monitor**). Third, we shifted from an equal-weighting scheme to one that gives more weight to indicators that generate a higher-quality signal.

OTHER MONITORING ACTIVITIES

The Financial Stability Monitor is just one tool policymakers can use to monitor the health of the financial system. It is a starting point to highlight potential weak links that require further investigation. It should be accompanied by rigorous and robust quantitative assessments, such as stress tests and macroprudential surveillance.

The OFR is building a suite of monitoring tools to assess risks to the financial system (see **Building Tools for Financial Stability Monitoring**). Some will appear as analytical tools or as working papers, including one that describes our Financial Stability Monitor in greater detail. We will also publish research briefs about some of the current threats in this chapter.

Macroprudential surveillance, a complement to this toolkit, contains five critical elements:

1. Robust technology and granular data to monitor price fluctuations, transactions, and investor positioning across assets.
2. Real-time market intelligence-gathering from a broad range of sources.
3. Flexibility to update surveillance techniques as financial instruments and markets evolve.
4. Collaboration and routine information-sharing with regulators in the United States and internationally.
5. Ability to communicate concerns promptly to authorities when action may be needed.

Central banks, regulators, and supervisors collect large amounts of data and intelligence about financial institutions and markets (see Watkins, 2008). Authorities have made significant progress since the financial crisis, with greater access to detailed financial data, enhanced monitoring efforts, and expanded sources of information through interagency briefings, surveys, and interactions with industry and market participants.

But more is needed. There is no integrated platform to analyze large amounts of data across asset classes, nor are there sufficiently detailed data to detect real-time vulnerabilities in major asset markets or key participants. Surveillance efforts

Building Tools for Financial Stability Monitoring

The tools we are developing to assess risks to the financial system include:

MONITORING PRODUCTS

Financial Markets Monitor for the public that summarizes major developments and emerging trends in global capital markets. A version is currently distributed or presented roughly twice a month to the Council and its Systemic Risk Committee.

Interactive money market fund monitor that examines holdings of individual funds and the industry as a whole on the basis of credit, interest rate, and liquidity risk.

Credit default swap monitor that provides analytics on various financial stability metrics in the credit default swap (CDS) market, such as market concentration and interconnectivity.

Liquidity library to monitor market liquidity conditions on a broad, high-frequency basis.

Hedge fund monitor based on regulatory and commercial data to provide insights into this traditionally opaque alternative asset class.

MONITORING-RELATED PAPERS

Methodology paper on the Financial Stability Monitor.

Reference guide on U.S. repurchase agreement (repo) and securities lending markets. The guide will examine how dealers and their clients use these markets, building on the Office's ongoing research on the sources and uses of short-term funding, and will identify potential vulnerabilities and data gaps.

Short, nontechnical papers analyzing potential emerging threats to financial stability in our new OFR Briefs series (see **Section 4.5**).

are overly dependent on potentially unobjective market participants to provide intelligence and data.

The Securities and Exchange Commission's (SEC's) Market Information Data Analytics System and the Financial Industry Regulatory Authority's Order Audit Trail System and planned Consolidated Audit Trail are steps in the right direction (see **Section 6.3**). But they were not designed to support the analysis of financial stability and they cover only public markets. Large gaps in coverage remain and the process for collecting critical data and developing sophisticated technology can be slow.

Monitoring tools need to be improved. For instance, natural language processing tools could be more widely used to identify and monitor emerging trends and themes (see Leskovec and others, 2009), to develop more timely and accurate metrics for monitoring and forecasting macroeconomic variables (see Choi and Varian, 2009; Antenucci and others, 2014), and to understand the impact of disparate information sources on markets such as how markets interpret negative and positive economic news (see Sinha, 2010).

While monitoring tools provide insight into the buildup of vulnerabilities, they reveal little about the amplification and propagation of shocks. For those insights, we need other forensic analytical tools. For example, we can apply agent-based models to financial markets to run dynamic simulations and observe how an individual agent's behavior can transform a crisis by withdrawing funding or selling assets (see **Section 4.2**). Unlike existing monitoring tools, dynamic agent-based simulations can help explain complex situations in which the relationships among variables do not necessarily follow historical patterns.

Although accommodative policy supports a robust economic recovery, there are increasing signs that the Federal Reserve's low interest rate policy may be encouraging excessive risk-taking in some asset classes, increasing the potential for adverse market outcomes.

2.3 Potential Threats to Financial Stability

Although overall financial stability risks are not particularly elevated, some vulnerabilities have intensified. In this section, we take a closer look at the risks that either signal further deterioration or suggest caution is warranted. We highlight cyclical vulnerabilities, many of which are interrelated. For example, low interest rates combined with low market volatility may have reinforced excessive risk-taking related to credit and liquidity. A reversal in these conditions could interact with underlying vulnerabilities to pose a threat to financial stability. We also highlight structural vulnerabilities in market liquidity, run risk in short-term wholesale funding markets, market infrastructure, and risk migration.

Cyclical Risks

INTEREST RATE RISKS

The risk associated with keeping long-term rates low for a protracted period and the challenge of managing a smooth exit from extraordinary monetary policy remains a recurring theme. Although accommodative policy supports a robust economic recovery, there are increasing signs that the Federal Reserve's low interest rate policy may be encouraging excessive risk-taking in some asset classes, increasing the potential for adverse market outcomes. These signs include an increase in corporate credit risk (for example, low long-term borrowing costs have encouraged nonfinancial corporates to increase leverage to peak levels prevailing in 2005-07); carry trades and other trading strategies that are contingent on volatility remaining low; and a shift into higher-yielding but less liquid assets.

There is a tradeoff between mitigating excessive risk-taking and promoting the mandated macroeconomic objectives of the Federal Reserve. While the purpose of quantitative easing is to encourage risk-taking in an effort to spur economic growth, there may be a point at which it could also increase the vulnerability of the financial system to a future shock. This illustrates the often-necessary complementarity between monetary policy, which addresses risks in the real economy, and macroprudential policy, which addresses potential financial stability concerns using a separate set of tools. In recent years, while monetary policy deliberately sought to stimulate economic risk-taking by boosting risky asset values, macroprudential policy narrowly targeted

financial risk-taking in order to mitigate potential vulnerabilities (see **Chapter 3**).

Despite the recent market dislocation, market pricing and investment positions continue to suggest market participants expect interest rates to remain low, followed by a gradual rise when the Federal Reserve begins to tighten monetary policy. This expectation is reflected, for instance, in: (1) low near-term market-implied interest rates and low nominal growth expectations relative to the forecasts of the Federal Open Market Committee (FOMC); (2) depressed medium-term interest rate and inflation expectations relative to prior monetary policy cycles, as implied by yields on five-year U.S. Treasury notes five years ahead (see **Figure 2-8**); and (3) elevated duration in bond portfolios.

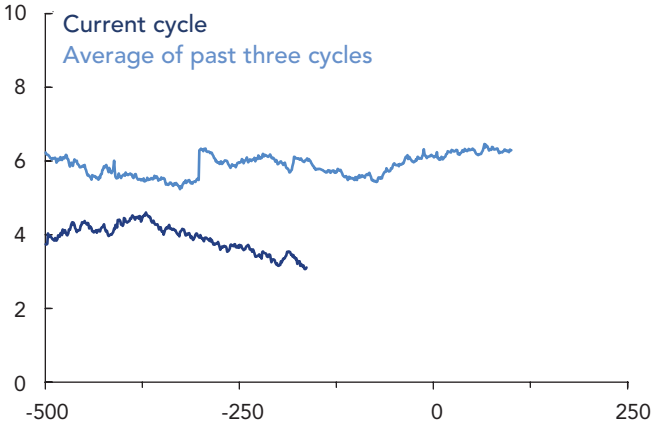
There are a few important potential risks associated with the policy normalization process. First, there is the risk that the adjustment occurs more quickly than some market participants expect — this could have adverse results, for example, investors could experience large portfolio losses on longer-dated assets, and bank depositors could shift large amounts from banks to alternative, higher-yielding investments. Second, there is the risk that financial markets may overreact to a change in policy, causing destabilizing volatility and conditions to tighten more quickly than policymakers would otherwise like, both domestically and abroad.

When we published our 2013 annual report, the duration of a typical U.S. fixed-income portfolio was high, suggesting that investors were not particularly concerned about an imminent rise in long-term interest rates. (Duration measures the vulnerability of a portfolio of assets to a rise in interest rates.) Portfolio duration is even higher today. An immediate 100 basis point shock to interest rates would result in an estimated $212 billion (unhedged) loss to U.S. bond mutual funds, or 5.6 percent on average across funds — well above estimated losses at this point in previous monetary policy cycles (see **Figure 2-9**). Losses from a given change in interest rates would be larger than in the past.

Outsized losses may be difficult for some market participants to absorb in the event of an unanticipated increase in long-term rates. Of course, the impact of such losses depends on the distribution, time frame, hedging activity, and other conditions. For instance, losses that are concentrated in entities with large unhedged positions or with mismatches between assets and liabilities would likely be more difficult to absorb.

Figure 2-8. Five-Year/Five-Year Forward Rates During Federal Reserve Tightening Cycles (percent)

Long-term interest rate and inflation expectations are low compared to historical tightening episodes

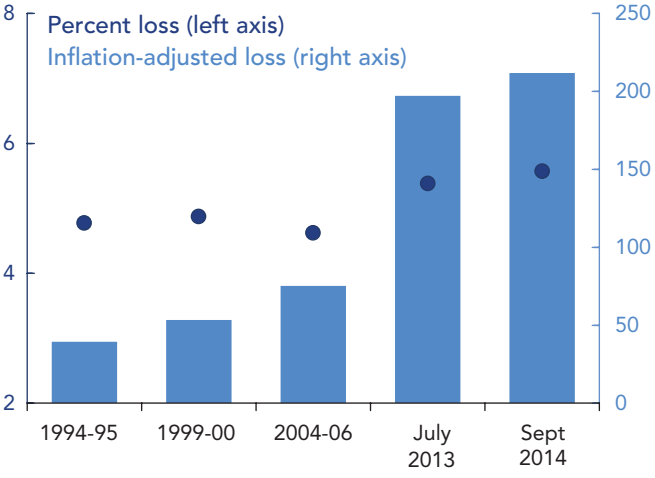


Note: Data are based on prior periods U.S. monetary policy tightening starting in February 1994, July 1999, and July 2004. Hypothetical interest rate tightening in the current cycle is assumed to begin in June 2015, as implied by interest rate futures markets. The horizontal axis represents the number of trading days before and after the first interest rate hike (which occurs at time t=0).

Sources: Bloomberg L.P., OFR analysis

Figure 2-9. Estimated Loss to U.S. Bond Funds Following a 100 Basis Point Shock to Interest Rates ($ billions and percent)

Extended duration increases vulnerability to interest rate shocks

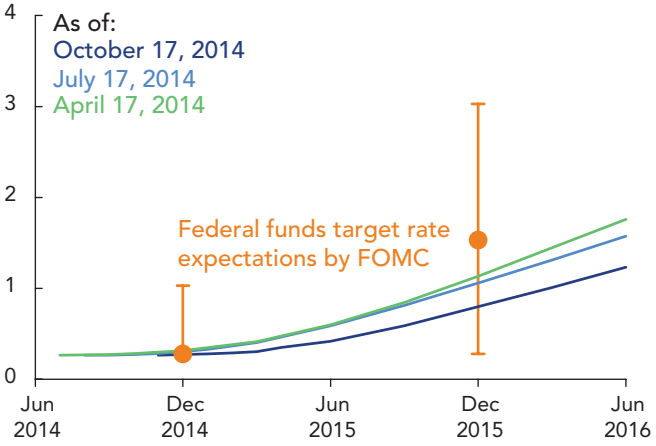


Note: Data are based on prior periods of U.S. monetary policy tightening starting in February 1994, July 1999, and July 2004. For the 1994-95 cycle, bond convexity is set to zero, because convexity data for that period are unavailable. The Barclays Capital U.S. Aggregate Float Adjusted Index which excludes the Federal Reserve's holdings of MBS and Treasuries, was used as a proxy for duration of an average fixed-income portfolio. Modified duration stood at 5.6 years during the month of September 2014, a long-term peak.

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

Figure 2-10. Three-Month Eurodollar Futures (percent)

Market-implied interest rate expectations are more dovish than Federal Open Market Committee (FOMC) projections



Note: Expectations are based on the Federal Reserve's September 17, 2014 FOMC meeting. The federal funds target rate is the policy rate determined by the FOMC. Whiskers represent the range of FOMC projections and dots represent median FOMC projections.

Sources: Bloomberg L.P., Board of Governors, OFR analysis

Interest rate risk extends beyond nonfinancial bond portfolios. On the liability side, a reversal of banking system deposits is a potential risk once interest rates rise. U.S. banks have seen dramatic growth in their non-interest-bearing deposits relative to total banking system liabilities. There is a non-negligible risk that these deposits could shift to alternative, higher-yielding investments as rates rise. The lack of historical data on deposit behavior at near-zero rates, coupled with structural changes post-crisis, make it difficult to quantify potential deposit outflows if rates were to normalize. Additional institutional deposit outflows may also occur as a result of a reallocation by eligible participants to the Federal Reserve's Overnight Fixed-Rate Reverse Repurchase Agreement Operational Exercise.

More broadly, the Federal Reserve's monetary policy trajectory could have spillover effects on global interest rates, currencies, and capital flows, tightening domestic or global financial conditions more quickly than expected. Historically, tightening in U.S. monetary policy has been accompanied by a rise in interest rate volatility, as markets adjust to the shift in stance. (There are, of course, exceptions: in 2004, for instance, long-term rates and volatility rose only marginally in reaction to monetary policy tightening.)

During the past year, global monetary policies became less synchronized. Central banks in the United States and the United Kingdom took the first steps toward slowing the pace of policy accommodation, while central banks in Japan and the eurozone have further eased policy. Even if central banks can control short-term rates through forward guidance, there is a risk that normalization of the U.S. term premium could exert upward pressure on long-term rates in other countries. The sharp but short-lived selloff in emerging markets during the so-called Taper Tantrum in mid-2013 illustrates this risk.

The process of departing from a policy of low interest rates may also pose operational and market challenges. The FOMC's current strategy for normalizing monetary policy, when economic conditions permit, contains the following elements: (1) raise the target range for the federal funds rate and (2) reduce the Federal Reserve's securities holdings, primarily by ceasing to reinvest repayments of principal on securities held in its long-term securities portfolio.

To implement this strategy, the Federal Reserve has said it will use the interest rate it pays on excess reserve balances as the primary tool to guide the federal funds rate into the target range, while relying on other tools, like the reverse

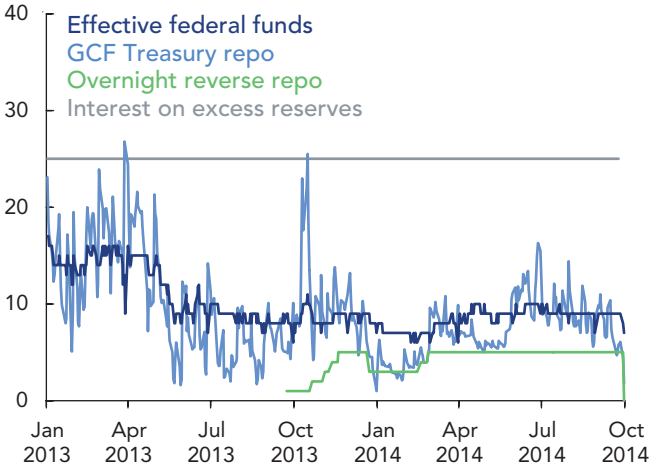
repo and the term deposit facilities, to augment the process, if needed. This strategy is contingent on the evolution of economic and financial developments.

The more immediate challenges associated with the mechanics of the exit strategy include the lack of experience with new monetary policy tools, the difficulty of managing short-term interest rates in the normalization process, and reliance on a larger set of counterparties, all against the backdrop of ongoing regulatory reforms. Specifically, those challenges include:

- **Communication challenges.** Enhancing its communications strategy has been a long-term priority for the Federal Reserve. There has been considerable improvement in transparency (see Yellen, 2012; Jeremy Stein, 2014). However, the Federal Reserve has never implemented such a complex exit strategy. There is noticeable skepticism among investors, as indicated by a gap between market-implied expectations of the future path of interest rates and the FOMC's projections (see **Figure 2-10**). Uncertainty could result if market participants misinterpret the plans or if the Federal Reserve's actions are perceived as incomplete or still evolving in response to changes in financial or economic conditions.
- **Inability to guide short-term rates.** In September 2013, the Federal Reserve authorized overnight reverse repo auctions to help control the federal funds rate. The reverse repo facility appears able to support the floor for overnight interest rates at the level paid by the facility. However, demand for the facility increases at the end of each quarter, at which time short-term market interest rates decline below the facility rate (see **Figure 2-11**). This dynamic suggests a potential challenge for the Federal Reserve to maintain the target for the effective fed funds rate. To mitigate the risk of significant shifts in short-term rates, the Federal Reserve plans to vary the rate offered on its overnight facility, adjust the facility cap, and provide term reverse repo operations.
- **Disintermediation and run risk.** Because the Federal Reserve may need to drain a large amount of its reserves to control the federal funds rate, the central bank expanded its list of authorized counterparties for the reverse repo facility beyond primary dealers. The Federal Reserve is now the largest counterparty in the triparty repo market,

Figure 2-11. Federal Reserve Policy Rates and Short-term Market Interest Rates (basis points)

The exit strategy may pose challenges guiding short-term market rates

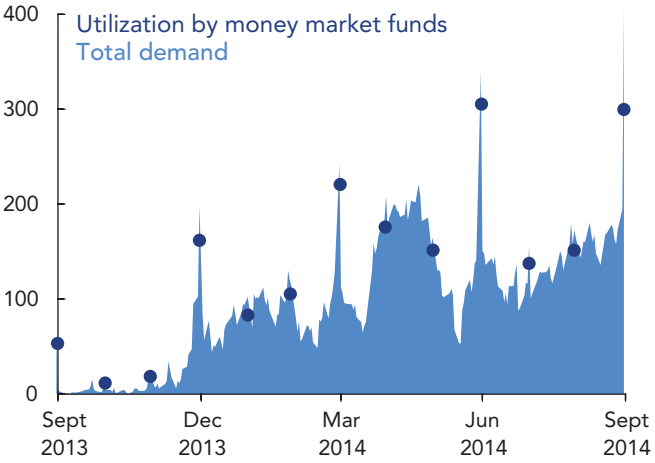


Notes: The overnight reverse repo facility began on September 23, 2013.

Sources: Bloomberg L.P., Board of Governors, Depository Trust & Clearing Corp., Federal Reserve Bank of New York

Figure 2-12. Federal Reserve Reverse Repo Facility Demand and Utilization ($ billions)

Utilization spikes at the end of each quarter reflect increased demand from money market funds



Note: Money market fund utilization data are available on a monthly basis.

Sources: Federal Reserve Bank of New York, SEC Form N-MFP, OFR analysis

and its role is likely to remain substantial, subject to a cap. As new nonbank counterparties rely on the reverse repo facility as an overnight cash investment, the Federal Reserve may potentially supplant other funding intermediaries, the consequences of which are difficult to fully project (see **Figure 2-12**). This risk of disintermediation should be mostly contained by limiting the size of the facility and by phasing it out when it is no longer required for monetary policy normalization purposes.

CREDIT RISKS

Vulnerabilities to credit-related risks highlighted in our annual report last year persist; if anything, they have increased.

The traditional credit cycle goes through four phases:

- **Repair** (balance-sheet cleansing),
- **Recovery** (restructuring),
- **Expansion** (increasing leverage, weakening lending conditions, diminishing cash buffers), followed by
- **Downturn** (rising defaults, falling asset prices, increasing funding pressure).

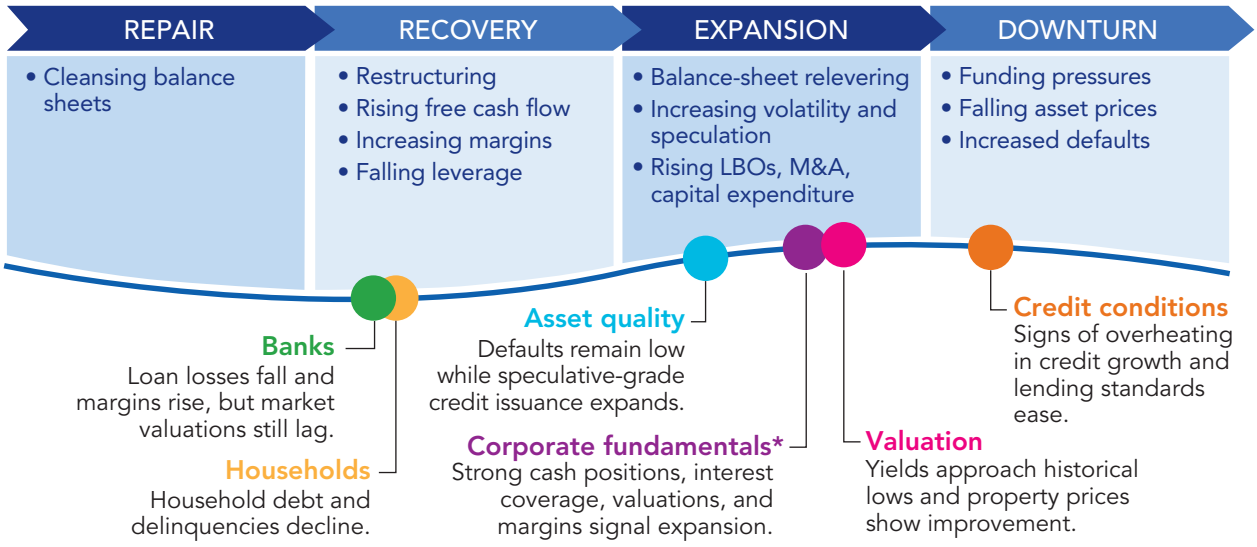
Figure 2-13 illustrates where we are in the credit cycle. Most nonfinancial corporate credit market indicators show the United States is currently somewhere between the expansion and downturn phases, while the household and banking sectors are still recovering from the financial crisis. Nonfinancial corporate balance-sheet leverage is still rising, underwriting standards continue to weaken, and an increasing share of corporate credit risk is being distributed through market-based financing vehicles that are exposed to redemption and refinancing risk. Credit spreads remain tight and risk premiums low, even after the repricing that occurred in September and October 2014.

Earlier in the cycle, corporations issued long-term debt to replace short-term debt and to finance capital expenditures, but the share of proceeds allocated to these activities has diminished. Proceeds are instead being used in ways that increase leverage such as through stock buybacks, dividend increases, mergers and acquisitions, and leveraged buyouts, rather than to support business growth.

Low interest rates and looser bank lending standards have encouraged a rapid expansion in corporate credit. These conditions have enabled corporations to reduce debt servicing costs and lock in a low cost of funding. But easy

Figure 2-13. Where Are We in the Credit Cycle?

Late-cycle behavior is becoming increasingly pronounced



Note: Metric includes credit growth, lending conditions, leverage, interest coverage, capital expenditures, EBITDA margins, bond yields, housing prices, default rates, non-performing loans, price-to-book ratio, gross debt, foreclosures, and delinquencies. The current value of each credit metric was compared to the range of values in each phase for the last credit cycle ending around 2007-08 and placed accordingly. EBITDA is an indicator of a company's operating performance and refers to earnings before interest, tax, depreciation, and amortization.

* Corporate fundamentals data are through Q1 2014.

Sources: Bloomberg L.P., Haver Analytics, Morgan Stanley, OFR analysis

credit conditions have also allowed companies to lever up, perhaps taking on more debt than they can service. The ratio of debt to earnings before interest, taxes, depreciation, and amortization for the most highly leveraged loans rose to 7.7 in October 2014, up from a low of 5.5 in 2009, and is approaching the peak registered in 2007. Even an average rate of default could lead to outsized losses once interest rates normalize, given the expansion in corporate debt.

The quality of new debt issued by companies has also been weaker than in previous cycles. High-yield debt accounts for 24 percent of total corporate debt issued since 2008, compared with 14 percent during past cycles, and low-rated credits dominated new issuance volumes over the past year. Companies have also taken advantage of looser bank lending standards. Two-thirds of loans to companies during this cycle have been covenant-lite (lacking strict legal covenants), compared with 33 percent during previous cycles (see **Figure 2-14**). In addition, there has been a trend of eroding debt cushions for covenant-lite loans and a significant increase in bank debt-only structures. These attributes are likely to lead to lower recovery rates on defaulted credit instruments once the credit cycle turns.

The combined issuance of collateralized loan obligations — securities backed by pools of corporate loans — and leveraged loans, which are higher-risk bank loans often sold to institutional investors, has exceeded the peak levels of the last credit cycle. Bank regulators are clearly aware of the buildup in credit risk and have responded with guidance and exhortations to banks (see **Section 3.5**).

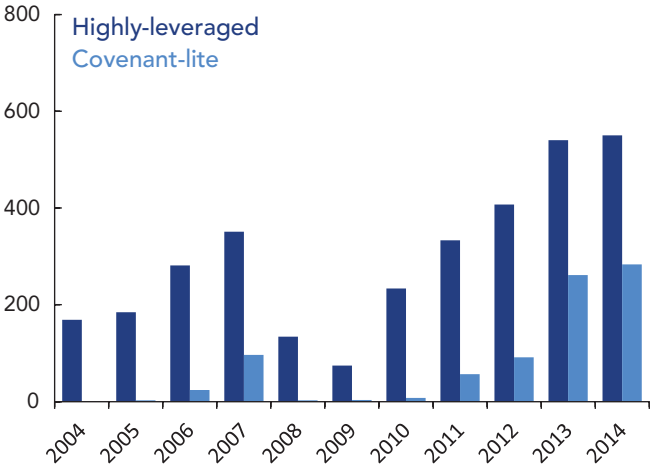
Leveraged loans are often viewed as a hedge for investors against a rise in interest rates because they tend to carry floating rates. However, interest rate risk may be higher than perceived, because recent deals have been sold with high interest rate floors. Were the Federal Reserve to tighten monetary policy, causing market rates to rise, the value of those floors would decline initially and prices on leveraged loans would fall.

For now, still-strong retained earnings and better liability management help companies mitigate potential refinancing risk. But as the cycle turns from expansion to downturn, the buildup of past excesses will eventually lead to future defaults and losses.

Some investors remain undeterred by the deterioration in corporate credit fundamentals and rising debt levels. Although corporate credit spreads are not excessively tight

Figure 2-14. New Issue Covenant-Lite and Highly-Leveraged Loan Volumes ($ billions)

New issuance reflects weak covenant structures and higher deal leverage

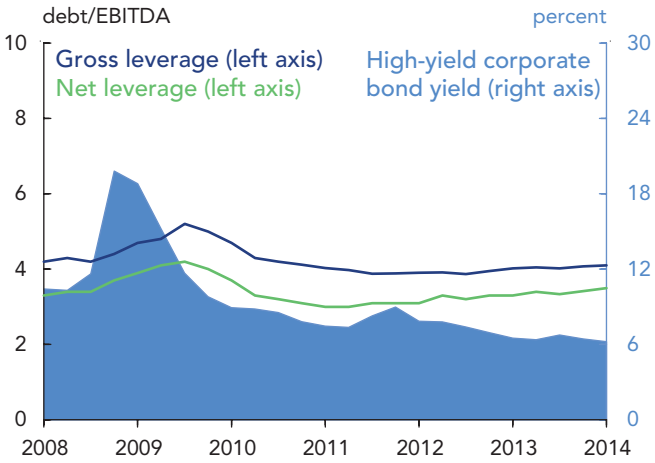


Note: 2014 data are based on annualized data through September 30, 2014. Highly-leveraged loans are defined as loans with a spread of London Interbank Offered Rate (LIBOR) + 225 basis points or more.

Sources: Standard & Poor's, OFR analysis

Figure 2-15. High-Yield Corporate Leverage and Bond Yield

Rise in leverage has not translated into a higher cost of credit

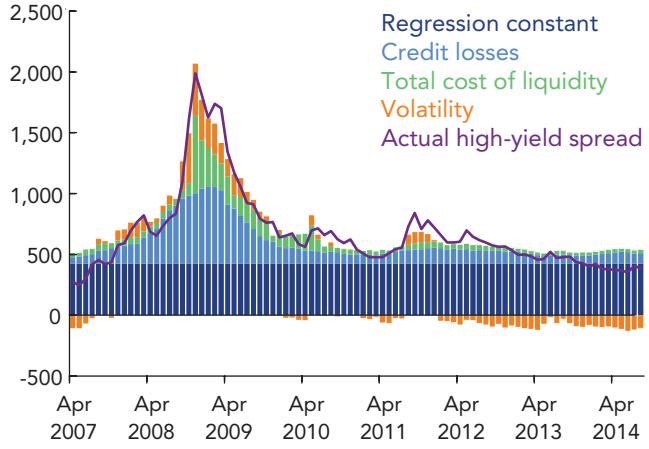


Note: EBITDA is an indicator of a company's operating performance and refers to earnings before interest, tax, depreciation, and amortization. Gross leverage is the ratio of total debt to EBITDA. Net leverage is the ratio of net debt to EBITDA, where net debt is total debt less cash and short-term investments.

Sources: Haver Analytics, JPMorgan Chase & Co., OFR analysis

Figure 2-16. Fair Value of U.S. High-Yield Bond Spread (basis points)

Depressed volatility and liquidity risk premia contribute to underpricing in high-yield bonds

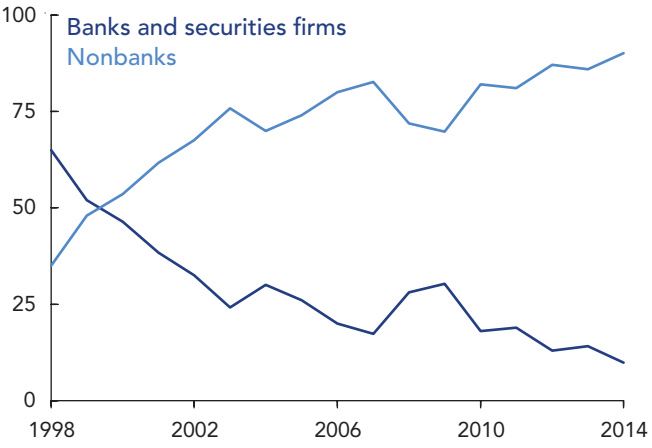


Note: Credit losses are defined as the expected loss from default (using Moody's actual and forecast high-yield default rates and assuming a constant 30 percent recovery rate). Volatility is based on an average of the normalized VIX and MOVE indices. The cost of liquidity incorporates two components: cost of trading (defined as high-yield bond turnover multiplied by bid-ask spreads), and the opportunity cost of cash (defined as mutual fund liquidity).

Sources: Bloomberg L.P., Haver Analytics, Moody's Analytics, OFR analysis

Figure 2-17. Primary Market for Highly Leveraged Loans: Banks versus Nonbanks (percent)

Credit risk is increasingly being distributed via nonbanks



Note: Nonbanks include institutional investors, insurance companies, and finance companies. Data for 2014 are through June 30, 2014. Highly-leveraged loans are defined as loans with a spread of LIBOR + 225 basis points or more.

Source: Standard & Poor's

relative to the historical trend, yields on leveraged loans and high-yield bonds, and spreads per unit of leverage, are at historic lows. Current low rates indicate investors are not being compensated for the incremental increase in corporate leverage (see **Figure 2-15**). Mispricing is also evident from the fair value estimates we calculated based on a set of fundamental determinants of high-yield bonds. High-yield bond spreads are roughly 50 basis points rich based on our estimates (see **Figure 2-16**). Credit, liquidity, and volatility risk have contributed to the mispricing, and all three risks tend to rise simultaneously during periods of stress.

Product innovation has also increased in corporate credit markets, a hallmark of late-stage credit cycles. Recent issues have provided broader, cheaper access to credit such as exchange-traded, high-yield, and leveraged loan funds; total return swaps on leveraged loans; and synthetic collateralized debt obligations. This development contrasts with limited innovation elsewhere in the financial system.

Nonbank lenders have increased their credit exposure significantly since the financial crisis (see **Figure 2-17**) and engage in riskier deals than banks because of low interest rates (see Aramonte, Jung, and Stebunovs, 2014). The composition of investors in the corporate bond market has also changed since 2007. Insurance companies and pension funds collectively own about one quarter of outstanding corporate bonds, but mutual funds and exchange-traded funds (ETFs) are rapidly catching up. Investments in corporate bonds by mutual funds and ETFs have increased by 500 percent to $622 billion since the end of 2008, with almost half allocated to high-yield bonds. Short-duration funds, which invest in leveraged loans, have shown the most significant growth. Assets under management have increased ten-fold over the last five years, driven by a search for yield and a hedge against an eventual rise in interest rates. In sum, much of the recent growth in credit risk-taking is concentrated in nonbank entities that are not directly regulated by banking supervisors.

VOLATILITY RISKS

In our last annual report, we discussed the volatility paradox — the increased potential for excessive leverage or risk-taking during periods of low volatility. Expectations of low volatility and continued benign conditions paradoxically incentivize market participants to extend risk positions, sowing the seeds of financial stress and high volatility when excesses unwind. This section analyzes broad developments in volatility markets, documenting where volatility has

Carry Trades Rise When Volatility Is Low

Investors' expectations of low volatility have increased the popularity of carry trades.

In its broadest sense, a carry trade is a trade that takes advantage of the difference between the income stream earned on a financial contract or asset and the cost of funding to hold the asset. Carry trades are most predominant in currency, fixed-income, volatility, and derivatives markets.

In a simple currency carry trade, an investor borrows a currency with low interest rates to finance the purchase of a higher-yielding currency. The trade generates an income stream, or carry, while the investor holds the asset. The final returns on the investment depend on the difference in interest rates and the movements of the exchange rate between the two currencies. A depreciation of the higher-yielding currency can offset the returns from the interest rate differentials.

Carry trades have implications for financial stability (see FSOC, 2014). A crowded carry trade position — when many investors use similar trading strategies — may contribute to excessive volatility during a market selloff as investors liquidate positions at the same time. The inherent leverage can amplify losses that stem from higher funding costs and reduced returns on long positions.

Market conditions that support the activity and performance of carry trades are relatively easy to track. Carry trade performance is gauged by the returns on portfolios with long positions in high-yielding assets and short positions in low-yielding assets. This measure shows that while returns were positive for the first eight months of 2014, they have declined from those registered between 2004 and 2007 (see **Figure 2-18**). The rally in the U.S. dollar has wiped out most of the year-to-date returns for dollar-funded carry trades, and there is some evidence that fewer leveraged investors have been involved in currency carry trades.

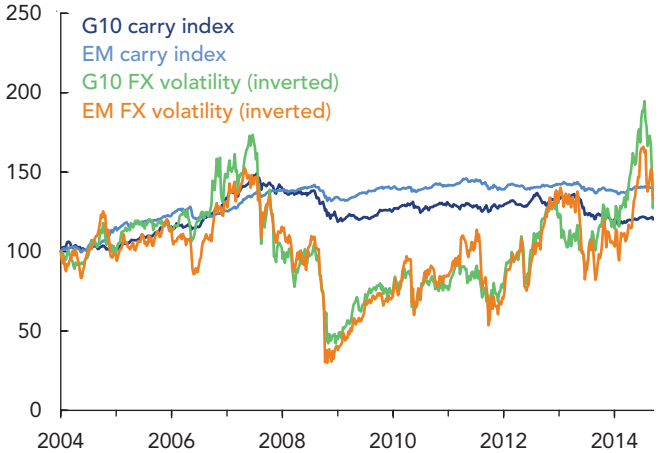
The CFTC reports the positioning of speculative traders in foreign exchange futures contracts on the Chicago Mercantile Exchange. While a useful guide the data do not differentiate carry trades from other trades, and forward markets are not captured. The flow of funds across borders is another potential proxy for activity. However, gross portfolio debt inflows do not show a particularly strong link with the carry-to-risk ratio over a long period.

Another important metric is the likelihood of carry trades to unwind. For instance, the Barclays Capital Carry Unwind Risk Index measures the probability of a decline in carry trades based on volatility, swap spreads, speculative positioning, and an estimated price of risk (see **Figure 2-19**). That index showed an increase in the probability of a broad selloff as volatility temporarily rose in October.

To monitor carry trade activity, we need better data. The Depository Trust & Clearing Corporation (DTCC) has been collecting data on derivatives positions and could expand the granularity of such data to identify investors who simultaneously hold short positions in low-yielding currencies and long positions in high-yielding currencies. Similarly, the CFTC could provide more disaggregated classification data to include a similar identifier.

Figure 2-18. Foreign Exchange Carry Returns and Implied Volatility (Index January 2, 2004 = 100)

Low volatility has supported carry trade returns



Note: The G10 carry index is the Barclays Intelligent Carry Index. The EM carry index is the Citi Foreign Exchange Emerging Markets Carry Beta Index. G10 FX volatility (inverted) is the Deutsche Bank Currency Volatility Index. EM FX volatility (inverted) is the J.P. Morgan Emerging Market Volatility Index.

Figure 2-19. Risk of Carry Unwind Leads Carry Index

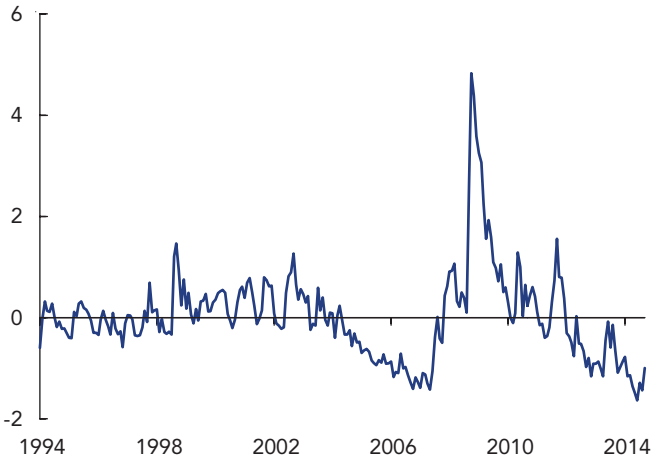
The risk of a reversal in carry trades increase with a rise in volatility

Note: A decrease in the Barclays Carry Unwind Risk Index represents a decrease in the risk of carry unwinds. A decrease in the inverted Goldman Sachs Carry Index indicates the index is increasing in value.

Sources (both charts): Bloomberg L.P., OFR analysis

Figure 2-20. Implied Volatility Indexes (normalized to Z-scores)

Implied volatility is unusually low across all major assets…

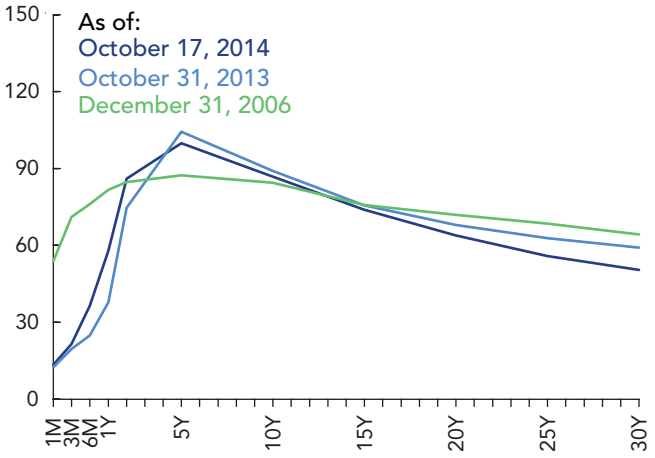


Note: Simple average of the standardized Chicago Board Options Exchange Equity Market Volatility Index (VIX)®, the three-month Deutsche Bank Currency Volatility Index (CVIX), and the Merrill Option Volatility Estimate Index (MOVE) based on data since January 1991.

Sources: Bloomberg L.P., OFR analysis

Figure 2-21. One-Year Swap Rate Volatility Term Structure (basis points)

…although steeper curves reflect uncertainty in the longer run



Note: The x-axis indicates option expiry dates.

Source: Bloomberg L.P.

Option-implied volatility has rarely been so low over this length of time across such a wide range of assets.

declined and the factors keeping it low. This type of analysis is essential to complement market-based measures that tend to reflect low risk when volatility is low.

Option-implied volatility has been unusually low across most major asset markets during the post-financial crisis period, with brief interruptions in mid-2013 when the Federal Reserve indicated it might reduce asset purchases sooner than investors expected and in October 2014 as investors reassessed their expectations for global growth (see **Figure 2-20**). Similarly, a measure of the attractiveness of selling volatility — the difference between implied and trailing one-month realized volatility — is also at low levels. Since September 2014, there has been some evidence that risk sentiment is beginning to shift. The slope of the volatility curve has steepened somewhat, reflecting increased concern about a rise in volatility in the intermediate term (see **Figure 2-21**), and demand for downside protection has increased in some markets, notably foreign exchange and equities.

Option-implied volatility has rarely been so low over this length of time across such a wide range of assets. Low volatility creates moral hazard by reducing investors' perception of risk. A sustained period of low volatility can lead investors to an increased use of carry trades and willingness to use leverage inexpensively through options to amplify returns (see **Carry Trades Rise When Volatility is Low**). This in turn sows the seeds for a market reversal, as market participants become too levered and reduce their buffers against adverse shocks.

Several factors have contributed to the decline in volatility:

- **Less uncertainty about future monetary policy.** The dispersion of risk-neutral option-implied expectations has narrowed for the federal funds rate, the interest rate set by the Federal Reserve for a bank to lend overnight funds to another bank. That suggests convergence across investors on the central bank's monetary policy plans. To be clear: there is reduced uncertainty amongst market participants on the timing and pace of interest rate hikes, but still high uncertainty on the mechanism of exiting from unconventional policies.
- **Less uncertainty about the economic outlook.** Lower volatility in asset prices is linked to lower volatility in forecasts about inflation and economic growth.
- **Reduced signs of financial stress.** Periods of significant financial stress can generate market volatility.

The OFR Financial Stress Index

Our Financial Stress Index (FSI) is a real-time snapshot of global risk appetite. When it is low or declining, it signals risk appetite is high or increasing. Its purpose is to distill information embedded in daily market pricing into a measurement of global financial stress, which can be further decomposed into various dimensions of stress.

While the Financial Stability Monitor signals the buildup of vulnerabilities across different dimensions of risk, the OFR's FSI shows the overall risk appetite of market participants. The markets included in the FSI are based on their responsiveness to factors associated with financial stress. They include equities, high-yield debt, emerging market assets, volatility, and other traditional risk assets (see **Figure 2-1** in **Section 2.2**).

The index uses a statistical technique called principal component analysis, which identifies the unique factors or components that influence the total variation across the sample. The FSI uses a rolling window on the set of inputs in order to take into account changes in market conditions.

To construct the index on a given date, we first use a subset of the data from the previous 500 trading days. Each of the series in this subset is standardized to have zero mean and variance equal to one. A principal components analysis is run on these standardized series and the first principal component is extracted. This first principal component, which by construction reflects the extent that the variables move together, is interpreted to reflect the degree of financial stress. The value of the FSI on the given date is then the projection of the actual data on the date along the first principal component.

A higher value of the index reflects greater financial stress and lower risk tolerance among investors. In contrast to financial stress indexes published by the Federal Reserve banks of Cleveland, Kansas City, and St. Louis, our FSI uses a statistical technique that allows the relationships among its risk factors to change over time. (We use a rolling principal component window rather than a static window, which allows us to capture relationships dynamically.) In addition, while other financial stress indexes focus on signals derived from U.S. capital markets, our FSI has a more global scope. This is intended to reflect the potential for contagion to transmit risk across national borders.

Figure 2-22 shows our FSI's performance over the past decade, including the contributions of five key risk factors.

Figure 2-22. OFR Financial Stress Index

The recent rise in stress reflects broad sources of instability

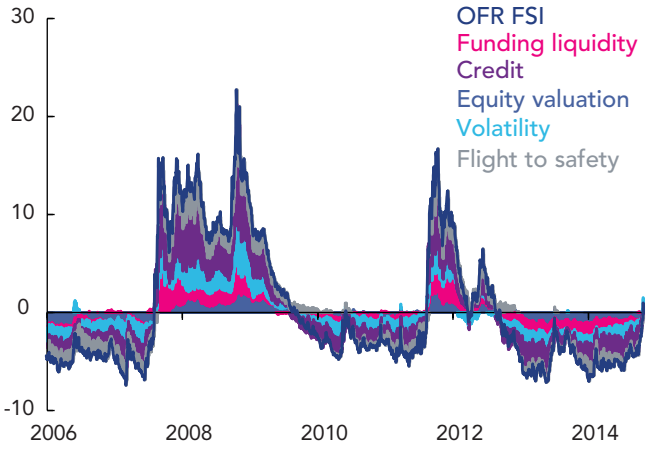
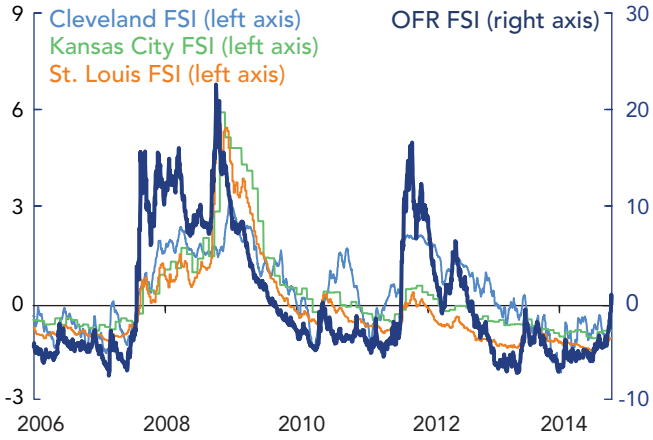


Figure 2-23. Comparison of the OFR and Federal Reserve Banks' Financial Stress Indexes



Sources (both): Bloomberg L.P., Federal Reserve banks of Cleveland, Kansas City, and St. Louis, Haver Analytics, JPMorgan Chase & Co., OFR analysis

Since January 2013, the index suggests that until recently, financial stress remained subdued, due primarily to low stress in short-term funding markets, credit markets, and volatility. While further investigation is needed, our initial findings suggest that the innovative construction and the broader reach appear to improve the responsiveness of the FSI relative to other indices. Note, for instance, that the index signaled increased stress — rising more steeply and sooner than other FSIs — prior to the beginning of the financial crisis in 2007, and again, during the more recent dislocation in September and October 2014 (see **Figure 2-23**).

Figure 2-24. Explanatory Variables

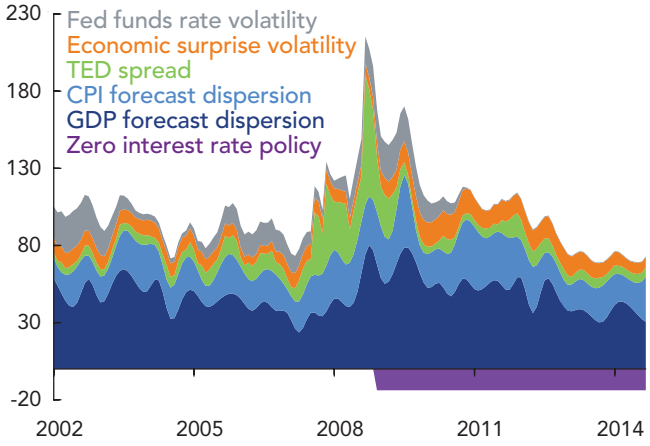
Area of Focus	Variables
Unconventional Monetary Policy	Zero-lower bound dummy
Dispersion of Market Expectations	CPI forecasts GDP forecasts Volatility of federal funds rate Volatility of U.S. Economic Surprise Index
Lack of Financial Stress	TED Spread
Reduced Mortgage-Related Hedging Activity	Size of Federal Reserve balance sheet Size of Fannie Mae and Freddie Mac retained portfolios

Note: The TED spread is the difference between the three-month U.S. Treasury bill interest rate and the London Interbank Offered Rate.

Sources: Bloomberg L.P., Federal Reserve Bank of Philadelphia, Haver Analytics, OFR analysis

Figure 2-25. Contributors to Interest Rate Volatility (basis points)

Macroeconomic and monetary policy clarity have lowered interest rate volatility



Sources: Bloomberg L.P., Federal Reserve Bank of Philadelphia, OFR analysis

Such stress occurred during the global financial crisis in 2007-09 and during the eurozone crisis in 2010-12. Since then, financial stress has receded (see **The OFR Financial Stress Index**).

- **Supply and demand in volatility markets have changed.** Greater willingness to sell volatility has also suppressed its price, driven by two developments. First, asset managers, high-yield funds, and leveraged loan funds have increased their short volatility positions, indicating they expect volatility to remain at a low level, at least in the near term. Second, a contraction in the balance sheets of the government-sponsored enterprises, Fannie Mae and Freddie Mac, led to reduced demand to hedge negative convexity risk and reduced demand for interest rate volatility protection.

We assessed the relative weight of these factors in explaining the current low levels of implied interest rate volatility (see **Figure 2-24**).

We found both structural and cyclical factors help to explain a reasonable amount of the overall level of implied volatility in interest rates. Contrary to expectations, there was no evidence that reduced demand to hedge mortgage-related securities has contributed to changes in volatility. The results confirm that greater clarity about the macroeconomic and monetary policy outlooks, in particular, was an important driver of implied volatility (see **Figure 2-25**). Any significant change in these factors (assuming coefficients remain stable) could lead to a reversal in the current low volatility environment.

EMERGING MARKETS

Low interest rates, stronger growth prospects, and greater risk appetite have attracted large capital flows into emerging market assets and enabled borrowers in emerging market economies to increase leverage. This section examines the growing investment in emerging markets and attempts to assess the importance of domestic and external factors as drivers of local currency emerging market bonds.

The same vulnerabilities highlighted in last year's annual report remain, including the risk of a reversal in capital inflows, the buildup of corporate debt, and the potential for a policy misstep as a result of diminished policy buffers. Despite the rise in idiosyncratic risks over the last year — such as Argentina's currency devaluation and default, the crisis in Ukraine (see **Russian and Eastern European Developments**), tensions in the Middle East, and concerns about an economic slowdown in China — spillovers to

Since the OFR's last annual report, tensions in Ukraine and Russia have increased, exposing regional financial markets to potential risks.

In late 2013, the Ukrainian government came under pressure from Russia not to sign a historic European Union (EU) deal. Russian militants began to take control of the Crimean peninsula and in mid-March 2014, Crimean voters passed a referendum to join Russia. After the referendum, the United States and the EU imposed sanctions against Russian individuals and companies, including travel bans, asset freezes, and restricted access to capital markets. Russia responded with retaliatory travel and trade sanctions. Violence continues in parts of eastern Ukraine.

Price declines have been limited to assets with significant exposure to Russia and Ukraine. Russian equities, bonds, and currencies sold off significantly after the United States and EU imposed several rounds of sanctions. The ruble is 20 percent weaker against the U.S. dollar, and external sovereign bond spreads are 135 basis points wider (see **Figures 2-26** and **2-27**). Spillovers have been limited in other regional asset classes.

TRANSMISSION CHANNELS

Escalation of the crisis could spread to financial markets in the United States and Europe through several channels. The first is through total foreign claims on Russia: external debt totals roughly $700 billion, of which foreign bank claims represented roughly $209 billion as of the first quarter of 2014. Some European banks are heavily exposed. The direct exposure of U.S. banks is a manageable $27 billion (or 0.8 percent of bank claims), but if other claims such as derivatives, guarantees, and trade credit are included, the combined exposure amounts to 3.4 percent. U.S. banks have tried to mitigate these risks by reducing their exposure to Russia.

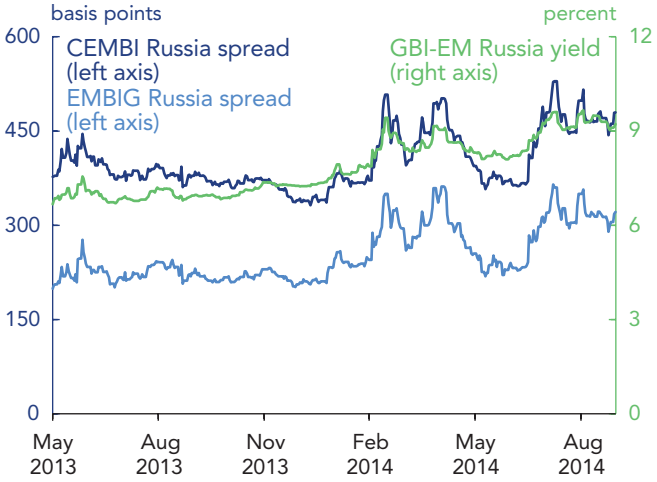
Another direct linkage comes from financial investments. Roughly half of Russia's foreign portfolio assets are held by offshore centers, including holdings by investment funds. The dominance of these funds increases the vulnerability to outflows. Russia registered $85 billion of private capital outflows by nonresidents during the first nine months of 2014, an increase in the pace of outflows.

Stress could also be transmitted through energy trade and other macroeconomic channels. Russia accounts for 8 percent of global crude oil imports and the EU imports 25 to 30 percent of its crude oil and gas from Russia. A decline in overall domestic demand in Russia and Ukraine could also affect trade among major exporters, especially for nations in central Europe and the former Soviet Union.

An escalation in political tensions could lead to more aggressive sanctions and potentially more counter actions by Russia. Foreign financial institutions could be affected if Russia seized foreign assets or if the creditworthiness of Russian assets declined.

Figure 2-26. Performance of Russian Sovereign and Corporate Bonds

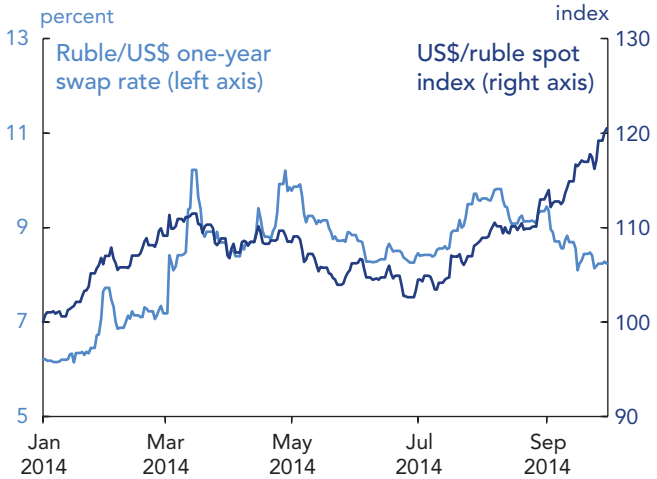
Russian assets under significant pressure as geopolitical risks rise



Note: CEMBI is the Corporate Emerging Market Bond Index denominated in U.S. dollars. EMBIG is the Emerging Market Bond Index Global denominated in hard currency. GBI-EM is Government Bond Index-Emerging Markets denominated in local currencies. All three are JPMorgan Chase & Co. indexes.

Sources: Bloomberg L.P., JPMorgan Chase & Co., OFR analysis

Figure 2-27. Performance of Russian Ruble and Cross-Currency Basis Swap

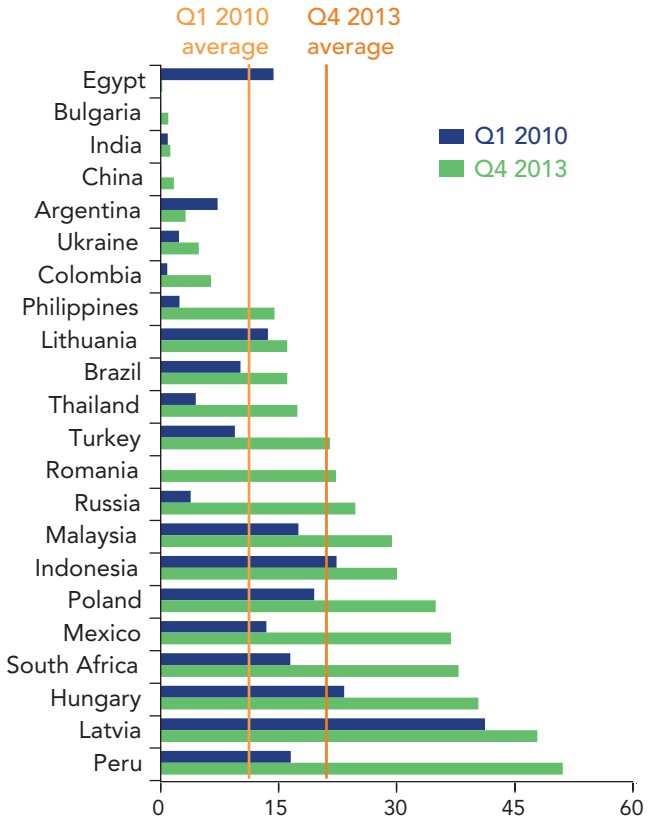


Note: An increase in the spot rate is associated with a depreciation of the ruble. Index: January 2, 2014 = 100.

Sources: Bloomberg L.P., OFR analysis

Figure 2-28. Foreign Ownership of Emerging Market Local Currency Government Bonds (percent of outstanding)

Foreign participation in emerging markets has increased as capital markets have deepened



Sources: International Monetary Fund, OFR analysis

broader emerging market assets have been limited. Even the risk-reduction that occurred in September and October 2014 in response to global growth concerns had limited sustained impact on emerging market assets. Emerging market bonds are still one of the best performing assets this year.

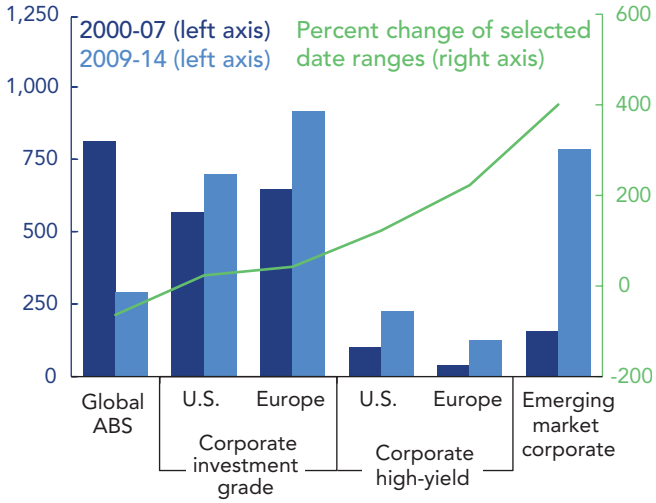
Cross-border investment flows into emerging market assets have been above their long-term trend in recent years. Emerging markets have registered $177 billion in short-term equity and debt capital inflows this year, bringing their influx since 2010 to $1.3 trillion. Yield-sensitive debt flows account for most of the increase. Foreign holdings as a share of total outstanding debt are also substantially higher relative to the immediate post-crisis period across most emerging markets, driven both by a deepening in local capital markets as well as by a search for higher-yielding assets (see **Figure 2-28**). While foreign participation lowers borrowing costs and provides access to a larger, more diverse investor base, research shows that cross-border capital flows are more volatile, particularly when they include retail investors. The continued development of a local investor base could mitigate the effects of foreign capital outflows in future crises.

Nonfinancial corporations, which took advantage of low interest rates and strong demand to increase leverage, are especially vulnerable to the curtailing of foreign investment (see **Figure 2-30**). Corporate debt in emerging markets has expanded more rapidly than nearly all other credit asset classes since the crisis (see **Figure 2-29**). There are a number of countries and sectors with high and rising debt levels, which may complicate the adjustment when financial conditions eventually tighten. A sharper-than-expected slowdown could lead to increased default rates as revenues slow relative to debt service requirements. Indeed, profitability has already decreased in a number of countries where leverage is elevated amid slower growth, in turn eroding debt servicing capacity (see IMF, 2014b). An increasing amount of debt of nonfinancial corporations is also denominated in foreign currency. This may increase sensitivity to debt servicing risks and rising losses in the event of depreciation in local currencies if corporations do not have natural or financial hedges.

Given the sensitivity of emerging market assets to U.S. interest rates during the selloff that occurred in mid-2013, we assessed the relative importance of domestic fundamentals and global factors in driving the yields of emerging market local currency bonds (see Ebeke and Lu, 2014; Miyajima, Mohanty, and Chan, 2012). We regressed nine

Figure 2-29. Average Annual Gross Debt Issuance ($ billions, percent)

Emerging market corporate debt has expanded at a fast pace

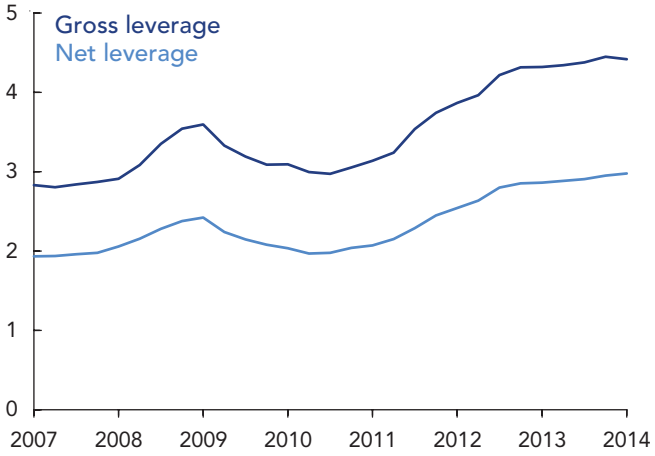


Note: Data include private placements and publicly-issued bonds. 2014 data are through August 2014 and annualized.

Sources: Dealogic, OFR analysis

Figure 2-30. Median Corporate Leverage in Emerging Markets (GDP-weighted, ratio)

Emerging market corporate leverage is at elevated levels

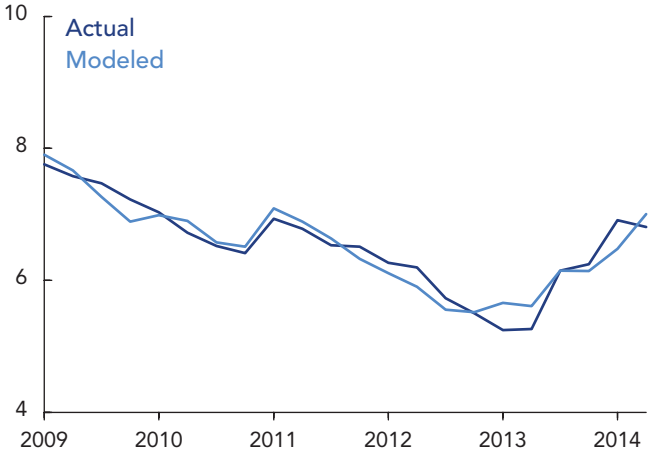


Note: Gross leverage is the ratio of total debt to EBITDA and net leverage is the ratio of net debt to EBITDA, where net debt is equal to total debt less cash and short-term investments. Corporate leverage is averaged from the trailing four quarters and is based on firms in countries including: Brazil, China, India, Indonesia, Poland, Russia, South Africa, South Korea, and Turkey. EBITDA is an indicator of a company's operating performance and refers to earnings before interest, tax, depreciation, and amortization.

Sources: Bloomberg L.P., Morgan Stanley, OFR analysis

Figure 2-31. Fair Value for Emerging Market Local Currency Government Bonds (percent)

Bond yields are no longer depressed relative to fundamentals, but are sensitive to changes in external factors

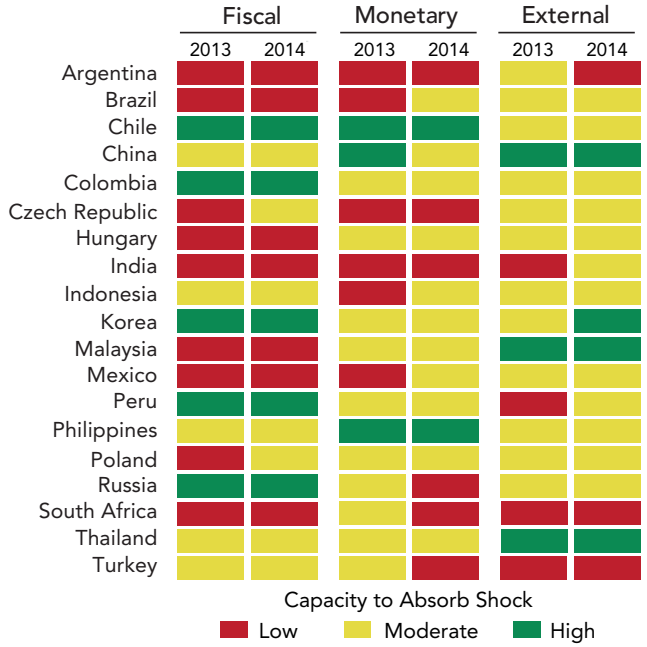


Note: Domestic factors are proxied by the headline inflation rate, domestic policy rate, GDP growth rate, ratio of current account balance to GDP, ratio of fiscal balance to GDP, and ratio of external debt to GDP. External factors are proxied by the U.S. 10-year Treasury yield, foreign ownership of domestic bonds, and the Chicago Board Options Exchange Market Volatility Index, or VIX®.

Sources: Bank of Mexico, Bloomberg L.P., Central Bank of the Republic of Turkey, Central Reserve Bank of Peru, Haver Analytics, Hungarian National Bank, International Monetary Fund, OFR analysis

Figure 2-32. Policy Buffers in Emerging Markets

Diminished policy buffers reduce the ability to cushion an external shock



Note: Color-coding is determined as follows:
Fiscal Buffer: Green if gross financing needs are less than 5% of gross domestic product (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.
Monetary Buffer: 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 noninflation 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%. Yellow otherwise. Countries operating under currency board regimes are coded as red.
External Buffer: Green if current account balance is greater than 6% of GDP and foreign exchange reserves are greater than 6% of GDP; or if current account balance is less negative than -5% of GDP and foreign exchange reserves are greater than 40% of GDP. Red if current account balance is more negative than -5% of GDP or foreign exchange reserves are smaller than 6% of GDP. Yellow otherwise.

Sources: Bloomberg L.P., Haver Analytics, International Monetary Fund, OFR analysis

domestic and global factors against the level of yields on 16 emerging market bonds, using quarterly data from the first quarter of 2009 through the second quarter of 2014. The analysis leads to the following conclusions:

- **Local currency valuations in emerging markets appear appropriately priced**. Despite earlier outsized inflows and demand for higher yielding assets, the selloffs in mid-2013 and again in 2014 appears to have curtailed some of the excesses in emerging market debt pricing (see **Figure 2-31**).
- **However, yields appear vulnerable to future changes in global factors.** A one standard deviation increase in U.S. long-term yields is associated with an increase of roughly 60 basis points in emerging market local yields, while a one standard deviation increase in the VIX® is associated with a 25 basis point increase in yields. Meanwhile, domestic fundamentals, such as local policy rates and external debt, have been weaker drivers of emerging market bond yields over the past few years.

Although valuations of bonds in emerging markets do not currently appear high, greater sensitivity to global forces, the rapid growth in short-term capital flows across borders, and a weakening in corporate balance sheets increase vulnerability to external shocks. An abrupt flight of investment would be especially challenging for countries where policy buffers — or the capability to cushion a shock — are weak or have diminished such as in Argentina, Russia, South Africa, and Turkey (see **Figure 2-32**).

Structural Vulnerabilities

MARKET LIQUIDITY RISKS

Various developments since the crisis have led to changes in market liquidity, such as changes in broker-dealer risk preferences, changes in the investor base, financial product innovation, and regulatory changes. This section discusses how changes in the provision of liquidity could disrupt market conditions and impair financial stability. We also discuss potential liquidity-related risks with mutual funds and exchange-traded funds (ETFs) that invest in illiquid assets (see **Bank Loan Funds and Liquidity Mismatches**).

Market liquidity is essential for markets to operate efficiently. Whereas funding liquidity relates to conditions that affect the liabilities of institutions (that is, the availability of wholesale funding), market liquidity applies to the trading activity that takes place in capital markets. The two are

Bank Loan Funds and Liquidity Mismatches

Bank loans, which are mostly floating-rate products, have attracted investor interest as a hedge for rising interest rates and for yield enhancement. However, investments in mutual funds and ETFs that invest in bank loans carry risks from a mismatch of liquidity as a result of different settlement practices and liquidity between fund shares and the underlying bank loan assets.

ETF shares are traded on an exchange throughout the day at market-determined prices, unlike mutual funds, whose shares can only be traded at the fund's net asset value that is calculated at the end of each business day. ETFs were initially created to provide retail investors with intraday liquidity in actively-traded asset classes. Market-makers facilitate trading and profit from a small margin they earn between the purchase and sale price of ETF shares.

ETFs have been marketed to a broad range of investors as a way to diversify exposure into less liquid asset classes, including high-yield corporate bonds and emerging market assets. In October 2014, assets under management of U.S. ETFs and exchange-traded products stood at a record high of nearly $1.9 trillion.

Demand for instruments to hedge interest rate risk has led to growth in floating-rate bank loan ETFs. At present, the outstanding size of bank loan ETFs is relatively small at around $8 billion, while bank loan mutual funds are larger with more than $70 billion in assets.

The following scenario illustrates underappreciated liquidity risks in bank loan ETFs. It shows how a mismatch in liquidity may fuel a self-reinforcing cycle of price declines in ETF shares and underlying assets. While the same liquidity mismatch is also present in mutual funds investing in bank loans, ETFs could be more vulnerable because of investors' expectations of intraday liquidity.

- Bank loan prices drop modestly due to an isolated credit event, change in market expectations, or other development. The decline leads some investors to exit the market by selling their ETF shares in the secondary market.
- Investors in bank loan ETFs attempt to limit losses by selling shares. Because an ETF is explicitly marketed as a product with better liquidity than the underlying assets or a similar mutual fund portfolio, ETFs attract investors who are more likely to trade in response to a large intraday price movement.
- ETF market-makers now hold substantial inventories of ETF shares. To limit the selling pressure, market-makers cut the price at which they are willing to buy ETF shares in the secondary market. This accelerates the price decline for ETF investors.
- ETF market-makers (through authorized participants) turn to ETF portfolios to redeem shares purchased in the secondary market, although the majority of ETF share trading occurs in the secondary market and does not affect ETF portfolio liquidity (see ICI, 2014).
- However, liquidity risk management practices may vary. If the ETF portfolio does not have sufficient liquid assets to meet redemptions, its manager may attempt to raise cash by selling portfolio assets — bank loans — in the secondary market. Because the settlement period for bank loans is longer than for ETF shares, the ETF portfolio is unable to meet requests for cash redemptions. ETF shares are normally settled within three to seven days, while the settlement time of bank loans is generally longer than seven days (see Moody's, 2014). Mutual funds investing in bank loans are also susceptible to the settlement mismatch.
- As available liquidity in bank loan funds evaporates and selling pressure from investors builds, ETF market-makers may refrain from buying additional ETF shares altogether if they reach their balance-sheet capacity.

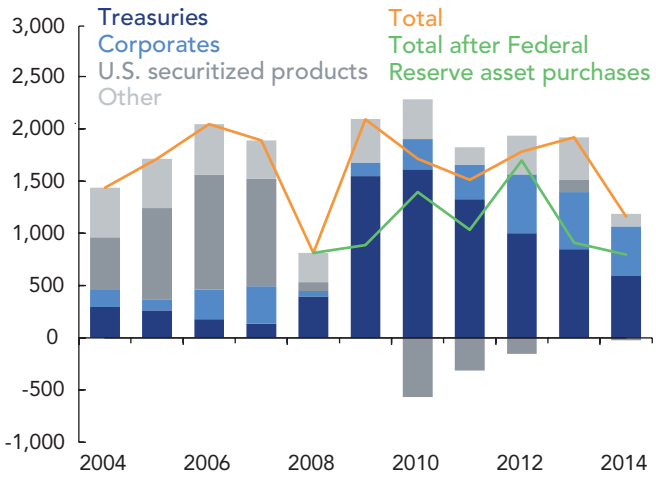
This illustrative scenario shows how demand for liquidity from ETF investors ultimately translates into demand for liquidity in the ETF's underlying assets, affecting other types of funds with similar investments.

Not all ETFs are vulnerable to a self-reinforcing cycle of liquidity-induced price declines. For example, ETFs tracking equities — which represent the bulk of the ETF universe — do not exhibit the same price opacity and potential settlement delays as bank loan ETFs. But investors may not appreciate the liquidity differences of the underlying markets for bank loan ETFs and equity ETFs.

At present, mutual funds and ETFs that invest in illiquid assets such as bank loans represent a small part of total mutual fund and ETF assets. However, the continued search for yield and demand for secondary market liquidity could spur growth. Under normal market conditions, these investment alternatives work as intended. But funds that reference assets with weak market liquidity may give investors a false sense of security about liquidity during stressful episodes.

Figure 2-33. Net Issuance of Fixed-Income Securities ($ billions)

Lack of available collateral may have contributed to changes in trading liquidity

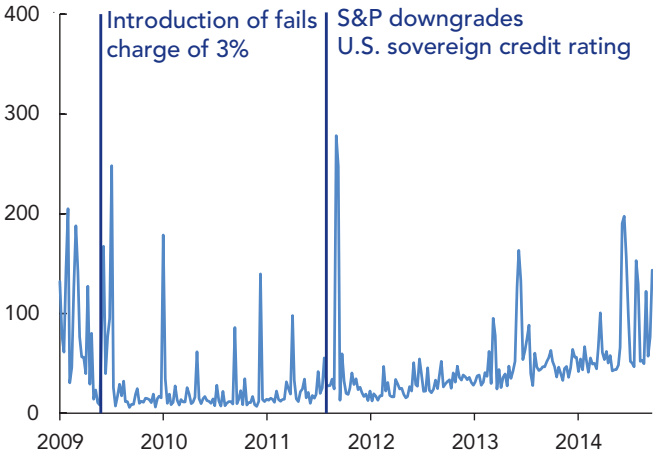


Note: Other includes agency debt, municipal bonds, emerging market sovereign bonds, and corporates. 2014 data are estimated annual figures.

Sources: Haver Analytics, JPMorgan Chase & Co., OFR analysis

Figure 2-34. Primary Dealer Settlement Fails to Deliver U.S. Treasury Securities ($ billions)

U.S. Treasury securities show a structural increase in trades that failed to settle as scheduled



Sources: Bloomberg L.P., Federal Reserve Bank of New York, OFR analysis

related because the ease with which an asset is traded is contingent on the ease with which funding can be obtained. Financial crises often include sharp reductions in liquidity and downward cascades in prices, as large losses force asset sales and risk aversion increases the hoarding of cash.

Several developments since the financial crisis have altered the amount of liquidity available in the financial system and the ways investors redeem holdings to get cash. Regulations requiring banks to hold more capital and more restrictive constraints on leverage have increased the cost of securities financing activities and reduced incentives to maintain them. Changes in the investor base, securities markets, financial products, and risk appetite have also contributed importantly to the decline in liquidity. Some changes are cyclical, such as a decline in available collateral (see **Figure 2-33**) from slow-to-recover securitization markets and the removal of a sizable portion of Treasury securities, agency mortgage-backed securities (MBS), and agency debt from the market as a result of the Federal Reserve's asset purchase program. Other changes are structural, such as regulatory changes that introduce longer-term balance-sheet constraints and an evident reduction in broker-dealer willingness to put capital at risk (see Adrian and others, 2013).

Traditional indicators do not show excessive concern about market liquidity. But signs are emerging that market liquidity has become more fragmented in a few markets since the crisis. These signs include the following, to varying degrees:

- Large broker-dealer inventories have shrunk, inventories have grown more concentrated in high-quality liquid assets, and dealer willingness to buffer periods of intense selling pressure has been more limited;
- Trading volumes have declined despite increased inflows (for instance, in emerging market sovereign bonds and U.S. corporate bonds), leading to depressed turnover in secondary markets;
- Trading activity is concentrated in the primary new issue market or in a small number of credits in U.S. and emerging market corporate bonds, suggesting reduced market depth;
- The size of an average trade has declined in both high-yield and investment grade corporate bond markets;
- Spreads for newly issued bonds have widened relative to older benchmark bonds for the same maturity in some asset classes; and

- Even traditionally liquid assets are failing to settle as scheduled as broker-dealer inventories and securities lending portfolios have diminished (see **Figure 2-34**).

The fragile nature of liquidity was especially evident during the selloff in fixed-income markets in mid-2013 and during the market dislocations in September and October of 2014. Neither development was widespread or severe enough to lead to outsized price declines and forced deleveraging.

To some extent, factors such as changes in the investor base and low volatility have helped prevent mild liquidity shortages from becoming more severe and sparking selloffs. The cycle is self-reinforcing. An increase in traditional buy-and-hold investors results in less turnover, which suppresses volatility. Low volatility enhances returns and reinforces trading strategies such as carry trades that assume volatility will remain low. Positive returns attract more investment to higher risk assets that are less liquid, which perpetuates the cycle.

Many market participants acknowledge the risk that market liquidity may decline once interest rates begin to rise. However, investors have no obvious hedge to manage liquidity shocks, aside from holding more cash or cash equivalents or securing committed liquidity facilities. Since the crisis, investors have not been subject to a true test of the market's resilience to provide liquidity, particularly in newer niche markets.

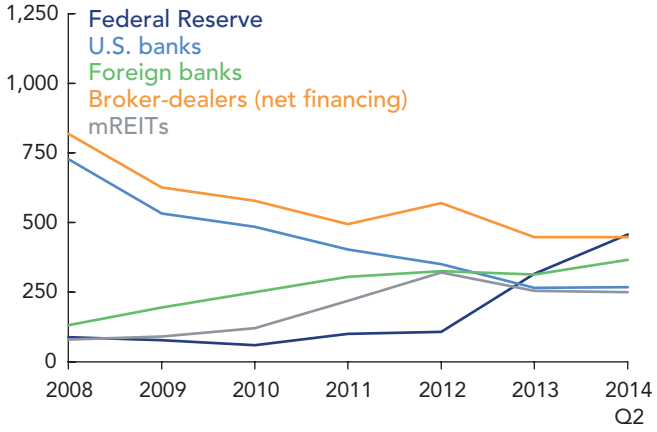
Tracking market liquidity is a further challenge because asset markets are numerous and diverse. The OFR is developing a set of measures to monitor liquidity across core markets. Our measures are organized into broad categories based on the aspect of liquidity they address: depth, breadth, resilience, quality, and immediacy (see **Figure 2-36**). This exercise will help develop a knowledge base on the use of the various measurement methodologies. Monitoring liquidity on an asset basis and across different dimensions may also provide insights into how liquidity shocks are transmitted across markets.

RUN RISKS AND ASSET FIRE SALE RISKS

Short-term funding markets are critical to market functioning as an efficient source of financing, but may create systemic vulnerabilities. We remain concerned about risks related to short-term wholesale funding markets, given that incentives still exist for runs and asset fire sales during periods of stress.

Figure 2-35. Funding in the Fed Funds and Repo Markets ($ billions)

The largest borrowers in short-term wholesale funding markets



Sources: Board of Governors, OFR analysis

The repo market, the largest short-term funding market, has undergone substantial change in recent years. However, it still remains susceptible to asset fire sales and runs when a borrower cannot roll over or renew short-term funding backed by collateral.

The repo market, the largest short-term funding market, has undergone substantial change in recent years. However, it still remains susceptible to asset fire sales and runs when a borrower cannot roll over or renew short-term funding backed by collateral.

Borrowers in the repo market obtain funding from repo dealers by posting collateral; repo dealers, in turn, often borrow cash from cash-rich lenders. The Federal Reserve, U.S.-based foreign banks, U.S. banks and broker-dealers, and mortgage real estate investment trusts (mREITs) are significant participants in repo markets (see **Figure 2-35**). Repo markets are vulnerable to runs for several reasons. Repo contracts tend to be short-term. In a market disruption, firms relying on short-term repos could quickly lose access to their funding sources when existing contracts expire and new ones become hard to obtain.

Figure 2-36. Market Liquidity Indicators

	Indicator	Data Requirements	Aspect of Liquidity Measured	Strengths and Weaknesses	Reference
Breadth	Trading volume	Volume	Higher volume implies more trading, suggesting more opportunities to buy or sell at a given price level.	Strengths: Readily available across multiple asset classes. Simple to update and understand. Weaknesses: Higher volumes may not imply higher liquidity, due to concomitant increased volatility. Double-counting of trades is frequently a problem in practice.	Blume, Easley and O'Hara (1994)
	Turnover	Volume, shares outstanding	Measures the pace of trading relative to the total amount of a security outstanding. Higher turnover suggests greater availability of possible buyers.	Strengths: Data are readily available across multiple asset classes. Simple to calculate and understand. Weaknesses: Frequently underestimates market depth, because some willing buyers and sellers do not participate in actual trades. Structural changes in markets can lead to false signals.	Amihud and Mendelson (1986); Datar, Naik, and Radcliffe (1998)
	Conventional liquidity ratio	Price, volume	Price change (impact) per dollar volume traded.	Strengths: Simple to calculate; data typically readily available. Weaknesses: Does not adjust for firm size and ignore daily lows and daily highs.	Gabrielsen, Marzo, and Zagaglia (2011)
	Martin's liquidity index	Price, volume	Price change per unit of volume traded. The higher the index, the higher the price dispersion relative to volume, and the lower the liquidity.	Strengths: Simple to calculate; data typically readily available. Flexibility to run across various asset classes and time horizons.	Martin (1975)
Depth	Average rolling differential	Volume, daily high/low prices, shares outstanding	Average of rolling 5-day windows of absolute percentage price change (from lowest daily low to highest daily high of 5 days) per unit volume, adjusted for market capitalization.	Strengths: Captures the full extent of price fluctuations by incorporating daily low and daily highs. Adjusts for market capitalization. Uses responsive five-day estimation periods. Weaknesses: Five days may still be too long for the index to detect certain market anomalies, because asset prices can adjust quickly to liquidity problems. Daily low/high prices are often unavailable.	Hui and Heubel (1984)
	Average daily share price impact	Return, volume	Captures the average of the daily price impacts over a given sample period.	Strengths: Applicable in markets where the bid-ask spread is not available. Weaknesses: Ignoring the bid-ask spread introduces minor imprecision. Volumes are not price-weighted.	Amihud (2002)
	Average trade price impact	Price, number of trades	Captures average absolute percentage of price change across all trades.	Strengths: Simple intuition – many small transactions imply more liquidity than one large transaction. Not affected by firm size. Suitable for both dealer and auction markets. Weaknesses: Ignores volume.	Marsh and Rock (1986)
	Micro-structure invariants	Price, volume, volatility	Measures the impact of a standardized quantity of order flow in a consistent way across markets.	Strengths: Price impact is normalized in a way that makes it directly comparable across markets and over time. Rationale for stable percentage price impact has a theoretical foundation. Weaknesses: Relatively new measure; needs broader testing.	Kyle and Obizhaeva (2014)

Sources: Gabrielsen, Marzo, and Zagaglia (2011), OFR analysis

continued on next page

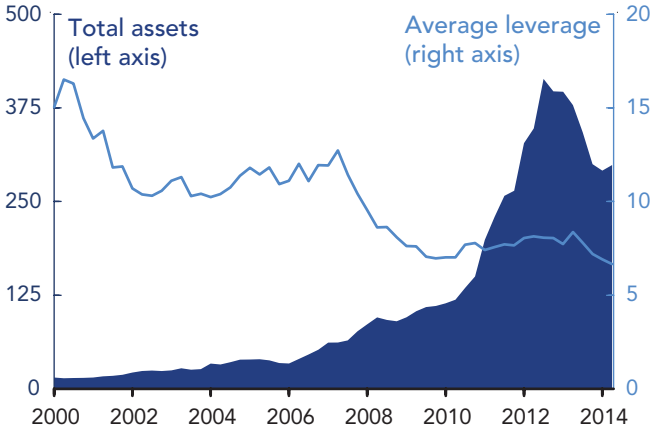
Figure 2-36. Market Liquidity Indicators (continued)

	Indicator	Data Requirements	Aspect of Liquidity Measured	Strengths and Weaknesses	Reference
Resiliency	Variance ratio	Price	Measures the impact of execution costs on price volatility over short horizons. Higher liquidity reduces variance of transaction prices around the equilibrium price.	Strengths: Applicable to contexts indirectly connected with market liquidity, such as volatility and intraday effects. Weaknesses: Can be sensitive to the time interval chosen for calculating the returns variance. Assumes unobservable equilibrium prices, but is measured from observed transaction prices.	Hasbrouck and Schwartz (1988)
	High frequency time series econometrics	Model dependent	Often using VAR and cointegration techniques, these methods provide insight to price discovery mechanisms and other microstructure aspects of liquidity.	Strengths: These methods allow for highly sophisticated analysis of market microstructure aspects of liquidity. Weaknesses: Complicated to conduct and require rigorous analysis to ensure appropriate interpretation.	Hasbrouck (1993); Chung, Han, and Tse (1996); Hasbrouck (2002); Harris, McInish, and Wood (2000)
Quality	Published bid-ask spread	Bid and ask quotes	Measures costs that market participants pay for "immediacy."	Strengths: Simple to calculate and interpret. Data are available for most exchange-traded instruments. Weaknesses: Innovations in electronic trading have reduced the spread in many cases to the minimal tick size, removing much of the information value.	Huang and Stoll (1996); Amihud and Mendelson (1991)
	Implied bid-ask spread	Price and/or return	Infers the effective spread from the autocorrelation that arises as an artifact of prices "bouncing" randomly between bids and asks.	Strengths: Simple, reduced-form equation; data are readily available; flexibility to run across various asset classes. Weaknesses: No insights on factors affecting the estimated spread. Fails to capture asymmetric information effects. Assumes no informed traders and homogeneous information across traders.	Roll (1984)
	Bid-ask spread decomposition	Bid/ask quotes, prices, source of order flow (buy vs. sell side)	Decomposes the bid-ask spread into order processing, inventory, and adverse information costs.	Strengths: Data requirements are modest (source of order flow can be imputed from bid/ask quotes and transacted prices). Provides attribution for source of transaction costs. Weaknesses: Bid-ask spreads are often tick constrained. Detailed transaction information is often unavailable. Appears to reveal little about overall market liquidity.	Stoll (1989); Huang and Stoll (1997)
Immediacy	Short-term reversals	Daily returns	Uses returns on a contrarian long-short strategy to estimate the cumulative impact of short-term price reversals due to noise traders' transitory effect on dealer inventories.	Strengths: Data requirements are very modest and model implementation is straightforward. Weaknesses: Initial implementation limited to equities.	Rinne and Suominen (2010)
	Quantity structure of immediacy	Daily risk-free interest rates, volatility of daily returns, trades and bid-ask quotations	Estimates immediacy costs separately for purchase and sale orders as the price deviation needed to induce a dealer to transact immediately for the full amount of an order.	Strengths: Data requirements are modest (source of order flow can be imputed from bid/ask quotes and transacted prices). Weaknesses: Model assumption of a monopolistic dealer may be inappropriate for some markets.	Chacko, Jurek, and Stafford (2008)

Sources: Gabrielsen, Marzo, and Zagaglia (2011), OFR analysis

Figure 2-37. Total mREIT Assets and Average Leverage ($ billions and percent)

Agency mREITs have delevered but still are susceptible to shocks



Note: Leverage is total assets divided by total equity of 14 mREITs. Not all mREITs existed in all time periods in the figure.

Sources: SNL Financial LC, OFR analysis

Embedded within the U.S. market structure are numerous economic incentives that influence where and how brokers route client orders. These incentives have implications for liquidity provisioning.

Repo contracts allow borrowers to boost returns by combining leverage with maturity mismatches, which contributes to contagion and fire sale risk. If a market shock leads to concerns about risky counterparties, a repo lender may demand higher margins or terminate the counterparty exposure altogether (see Copeland, Martin, and Walker, forthcoming). The demand for higher margins could force a highly leveraged counterparty to sell some of its assets to meet the new requirements, leading to fire sales. The downward spiral could accelerate if many firms sell assets simultaneously. The resulting drop in prices would lower the value of the collateral, causing counterparties to demand more collateral or raise haircuts. A haircut is an additional buffer of collateral that is held to protect against declines in the assets' market value over the life of the transaction. Chapter 3 describes policy changes to address vulnerabilities in wholesale funding markets.

Agency mREITs are one, but not the only, example of a leveraged financing vehicle that is vulnerable to run risk and asset fire sales. Agency mREITs borrow in short-term repo markets to purchase longer-dated real estate assets, typically MBS issued by Fannie Mae or Freddie Mac. Repo funding represents about 90 percent of their liabilities and the weighted average maturity of repo funding is relatively short compared to the duration of their assets, because repo borrowing is a cost effective way to obtain leverage. This makes agency mREITs vulnerable to runs by repo investors. Given the agency mREITs' relative importance in the repo market, any instability among large agency mREITs could aggravate broader short-term funding markets.

Their large MBS holdings also expose agency mREITs to risk from interest rate fluctuations, which they hedge using U.S. Treasury bonds, interest rate swaps, or similar instruments. However, mortgage bonds are negatively convex — as interest rates rise, their projected lives also extend, because fewer homeowners are likely to refinance — and agency mREITs must adjust their hedges as interest rates change. This hedging strategy exposes agency mREITs to the risk of fire sales (see FSOC, 2013). These exposures increased concern among investors and regulators following the rise in interest rates and volatility in mid-2013, leading agency mREITs' share prices and equity book values to decline. Some agency mREITs sold a portion of their MBS holdings, which exacerbated the widening in agency MBS spreads, or shifted into short-duration assets (see OFR, 2013a).

We used an agent-based model to assess how vulnerable agency mREITs are to a withdrawal of funding or an asset price shock. (See Section 4.2 for the mechanics of the model.) The goal of this exercise was to incorporate both funding and interest rate risks to see how interest rate shocks reverberate through the system and to determine how capital levels react.

In our model, we used two groups of agency mREITs — one with high leverage and another with low leverage. Both had the same business objectives: to achieve a target amount of leverage and maintain a stable interest rate exposure. Both also hedged the interest rate risk of their MBS portfolios by shorting U.S. Treasury bonds, that is, by selling borrowed bonds with the expectation they can buy them back when prices have fallen. Adjusting the size of their MBS and U.S. Treasury bond positions allowed the mREITs to maintain a constant interest rate exposure. They met leverage targets by borrowing funds to purchase assets.

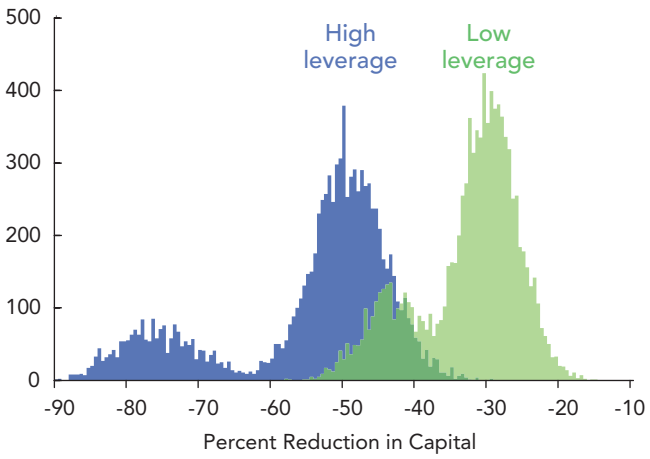
The scenario that we modeled began with a price shock that cut the value of MBS by 7 percent (a similar magnitude to the price decline that occurred in mid-2013), which reduced the agency mREITs' equity value and increased their leverage. As leverage rose above the target, both low-leverage and high-leverage agency mREITs were forced to delever and sell assets at a time when prices were already declining. The forced sales reduced MBS prices further, creating an adverse feedback loop.

Next, our model assumed that sharp movements in the MBS market would create uncertainty and increase risk aversion, raising concerns about counterparty and collateral risks that also affect the agency mREITs' funding. We introduced a funding shock by increasing the haircut substantially (by 7 percentage points to a cumulative 14 percent) on MBS assets pledged as collateral to obtain repo funding (see **Figure 2-38**). We ran the simulation 10,000 times to allow for some random variation in prices and capital stocks held prior to the shock.

On average, the simulations showed the capital of the agency mREITs with low leverage fell by 35 percent, followed by an additional reduction of up to 10 percent over the next two quarters. In the third quarter, the funding shock occurred and reduced capital again by up to 6 percent. The impact on the highly leveraged group was more extreme. Capital fell by a total of 52 percent and did not stabilize for eight quarters.

Figure 2-38. Illustrative Stress Test of Agency mREITs (number of simulations and percent)

Highly leveraged agency mREITs are more negatively affected by asset price and funding shocks



Note: The bimodal distribution represents the fact that if a fire sale occurs in the first period, a larger number of fire sales is likely to occur over the subsequent periods.

Sources: Bloomberg L.P., SNL Financial LC, OFR analysis

However, it is important to emphasize that these results are not forecasts. The strength of agent-based modeling lies not in the magnitude of the results but in its ability to compare scenarios — in this case, the loss was nearly twice as much for the more leveraged mREIT compared to the less leveraged mREIT.

The model also showed how the actions of one firm affect another. Our simulations showed a strong correlation and dependence between the two groups of agency mREITs. If one group was forced to sell assets, the resulting price drop forced the other group to sell during the following quarter. In most of our simulated scenarios, all the mREIT firms experienced significant losses but survived. In other instances, capital fell significantly — to a point where solvency was at risk. This divergence reflects the fact that in the majority of simulations, the imposed shock did not trigger any fire sales. But when the model produced fire sales, they lasted for a prolonged period and resulted in a dramatic reduction in capital.

Since then, agency mREITs have reduced their total assets, obtained longer-term funding, cut dividend payouts, and reduced their leverage (see **Figure 2-37**). However, the duration of their assets has extended by more than their liabilities, resulting in larger duration gaps compared to a year ago. Agency mREITS are still sensitive to a rise in interest rates or liquidity risks because of their reliance on repo funding and a sizeable duration gap. Their portfolios are also highly concentrated, increasing their vulnerability to an outsized price shock in the agency MBS or real estate market. Raising new equity has been difficult for agency mREITs because of depressed book values. To boost returns, agency mREITs may seek to increase leverage or increase the riskiness of assets they are accumulating (see **Assessing the Vulnerability of Agency mREITs**). Currently, agency mREITs are not as tightly supervised as other financial entities that are thought to pose systemic risks (see Pellerin, Sabol, and Walter, 2013).

MARKET INFRASTRUCTURE RISK

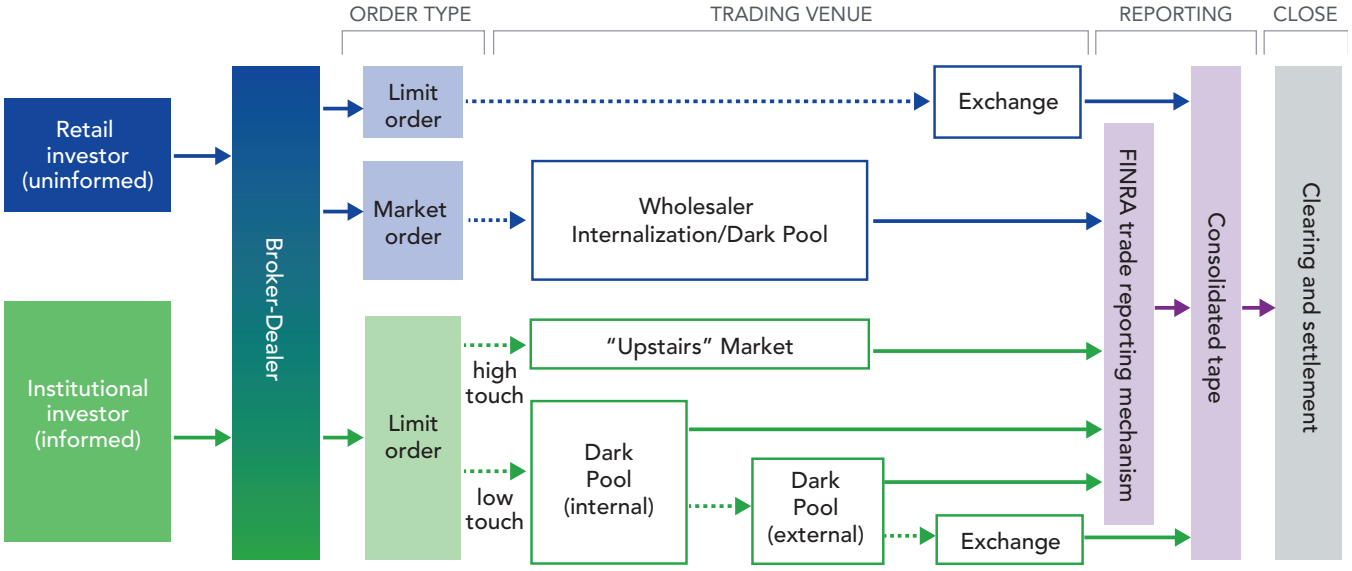
This section focuses on two characteristics of U.S. equity markets — complexity and fragmentation — that could contribute to systemic risk. Future efforts will extend this analysis to other markets, with an emphasis on the transmission of risks across market structures.

Policymakers are well aware of the adverse effects of market structure vulnerabilities in U.S. equity markets. The Financial Stability Oversight Council (Council), in its 2014 annual report, cited weakness in the financial infrastructure as a potential risk to financial stability. The SEC outlined several key initiatives the agency is taking to enhance market structure. Further, the Financial Industry Regulatory Authority (FINRA) implemented a new rule to improve transparency of off-exchange trading volumes. Congress has also conducted hearings on structural vulnerabilities in equity markets.

Financial markets are complex systems. Complex market systems are assembled from several subsystems that are independently controlled and managed without an overarching authority. Trading systems for many asset classes fit this description. Automated algorithm-based trading strategies and technologies for routing orders are layered on top of these trading systems and add to the complexity. Given the rapid speed at which trades are executed, mitigating errors when automated controls fail is a challenge.

These vulnerabilities are not unique to equity markets. Similar fragilities are also evident in other types of markets. For instance, high-frequency trading and algorithm trading are widely used in futures, options, foreign exchange, and

Figure 2-39. Routing Practices Differ Based on Investor Type and Order Type



Note: A limit order is an order to execute a securities trade only at a specified price (the limit) or better. A market order is an order to execute at the best available price. Wholesalers are dealers who execute trades on behalf of clients introduced by retail brokers. Internalization refers to trades in which dealers fill orders from their existing inventories. An upstairs market is an off-exchange market for large securities transactions. Dark pools are private electronic trading venues where traders anonymously buy and sell securities.

Source: OFR analysis

some fixed-income markets. Regulators need to cooperate to monitor and understand interconnections across markets (see Kara Stein, 2014).

Complexity and fragmentation are two key attributes of equity markets. Complexity arises from several factors, including the diverse needs of market participants, technological advancements that enable more complex trading strategies and faster speeds, and regulatory rules that may stem from good intentions but occasionally may bring unintended consequences. For instance, the proliferation of trading venues is largely attributed to the SEC's Regulation National Market System (Reg NMS) and Regulation Alternative Trading Systems (Reg ATS), implemented in 2007 and 1999, respectively. Both regulations fostered significant competition among trading centers and benefited investors through lower trading costs. However, they also increased complexity and market fragmentation.

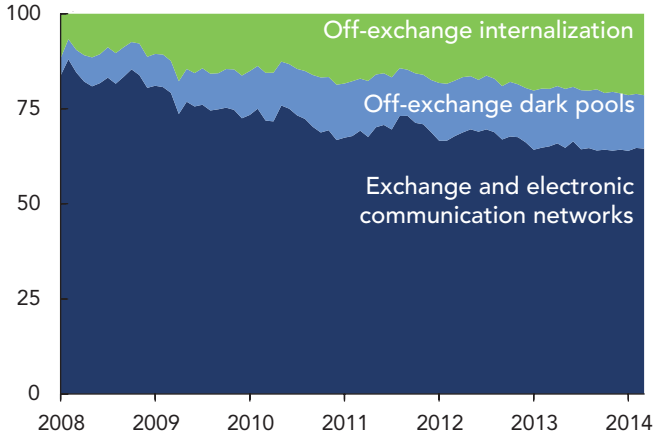
Complexity is underscored by the highly segmented process by which an equity order is routed through the system (see **Figure 2-39**). Reg NMS requires brokers to seek the best price (the national best bid offer) for each client trade. Brokers must connect and route orders to a number of trading venues to ensure best execution for client orders and connecting and accessing multiple venues adds significant complexity to order routing practices. Economic incentives embedded in order-routing practices have important implications for liquidity provisioning.

Another important element of complexity is the large number of order types. Each exchange and off-exchange trading venue offers numerous specialized order types, many of which are very complex. Order complexity feeds into a number of problems, including broker conflicts of interest, slower trade execution during times of stress, and an uneven playing field. The large number of venues where trading may occur on exchanges and off exchanges via dark pools, broker-dealer internal inventories (internalization), and electronic communication networks, further adds to the complexity (see **Figure 2-40**).

Complexity and fragmentation may constrain the normal functioning of markets by limiting the financial system's ability to provide basic services. Price discovery and providing liquidity are key services of effective markets. More often than not, equity markets function in a highly efficient and effective manner, with price discovery and liquidity provision effectively serving the interests of all investors.

Figure 2-40. Share of Trading Volume by Venue (percent of shares)

Off-exchange trading has increased for market orders and limit orders



Source: Rosenblatt Securities Inc.

However, complexity and fragmentation can impair these key services.

Price discovery. Unlike "lit markets," such as exchanges, where publicly displayed quotes determine the national best bid and offer, trades conducted in dark pools or through internalization are transacted at prices that are a derivative of those determined in lit markets. These off-exchange dark trades offer important benefits to investors (such as a reduction in information leakage, ability to conduct trades anonymously, and minimization of market price impact costs). But they also raise important questions regarding price discovery. In June 2014, SEC Chair Mary Jo White publicly expressed concerns about dark pools, noting that "dark trading can sometimes detract from market quality, including the information efficiency of prices" (see White, 2014). Other factors that may impede price discovery include "single points of failure," which bring trading to a halt when critical infrastructure components malfunction.

Liquidity provisioning. Market liquidity refers to the ability to trade a substantial amount of stock at close to the current market price. This liquidity is supplied by market intermediaries. During normal market environments, liquidity provisioning enables buyers and sellers to interact with one another efficiently. However, this mechanism can break down during times of market stress.

Market prices may be more sensitive to liquidity shocks in fragmented markets, resulting in more extreme price changes during periods of stress (Madhavan, 2011).

Historically, stock markets relied on intermediaries known as market-makers and specialists who are expected to buy and sell a particular stock at a publicly quoted price to maintain fair and orderly markets. Today, their role has significantly diminished as newer market participants, using high-frequency trading strategies, have emerged. Firms using high-frequency trading strategies are an important liquidity source under normal conditions, but do not have an explicit obligation to provide liquidity during times of stress.

The so-called flash crash in equity securities on May 6, 2010 is one such example. As prices of many U.S.-based equity products fell sharply and suddenly that day, market-makers acted in their own best interests and withdrew from the market, leading to a brief liquidity shock. By the end of the day, stocks had recovered most or all of their losses. A joint SEC and Commodity Futures Trading Commission (CFTC) investigation later concluded the crash was triggered when a fund sold a large number of stock index futures that exhausted available buyers, and then was exacerbated by aggressive selling by other computer-driven traders. That example shows how a future flash crash occurring at the end of a trading session could severely disrupt the close and the pricing of index derivative products, with effects spilling into overseas markets and subsequent trading sessions.

Embedded within the U.S. market structure are numerous economic incentives that influence where and how brokers route client orders. These incentives have implications for liquidity provisioning. Retail market orders are almost entirely routed to wholesalers. Meanwhile institutional orders may route through any number of dark and lit venues prior to execution, potentially exposing these orders to other traders which results in information leakage and adversely impacts the institutional investor. Complex order routing decisions have implications for all market participants, including those that supply liquidity on exchanges. Specifically, brokers may be disincentivized to post orders on a particular exchange because it offers lower liquidity rebates than other exchanges, even though that exchange offers the best possibility of order execution (see Battalio, Corwin, and Jennings, 2014).

Investor confidence deteriorates when price discovery and liquidity do not operate efficiently and effectively. To an extent, liquidity shocks are inherent in market structure as market intermediaries are not constant sources of liquidity. Liquidity and price discovery are ultimately determined by the combined interests of end investors who interact in the market via intermediaries.

MIGRATION OF ACTIVITIES AND FINANCIAL INNOVATION

Financial activities and risks are constantly evolving in response to market forces, regulatory developments, and technological innovation. Financial innovation can make the system more effective and efficient, provide value to customers, and promote economic growth. But it can also create, transfer, or amplify risks in ways that are not apparent. This section describes recent examples of activities shifting from banks to nonbank institutions, among subsidiaries of the same firm, and from firms to markets. This migration is sometimes driven by firms' desire to circumvent regulations, known as regulatory arbitrage.

Historically, improvements in technology, changes in competition, and new regulations have triggered financial innovations and other changes that lead to a migration in activity from one sector to another. Some of these changes are benign from a financial stability standpoint. For example, shifting a cash investment from an uninsured deposit to a money market fund may not increase the likelihood of a run on the investment.

But migration could increase risks to financial stability if the new activities are not subject to prudential regulation. If the regulatory playing field is not level across the financial system, the shift of certain activities to more lightly regulated sectors could increase risk-taking and reduce transparency in market practices. For example, financial institutions may try to reduce their regulatory capital requirements by shifting activities out of subsidiaries with relatively high capital requirements, such as banks and insurance companies, to subsidiaries, special purpose vehicles, or third parties that are subject to less stringent regulatory requirements. Financial innovation that creates new products without regulatory precedent also could introduce unforeseen risks that are poorly understood.

For these reasons, the migration of financial activities and financial innovation requires close monitoring. The remainder of this section discusses examples of migration and innovation that may require monitoring for their potential to pose financial stability risks including captive reinsurance, nonbank mortgage servicers, and single-family rental securitizations.

Captive Reinsurers

Captive reinsurance companies are affiliates of insurers not subject to the same prudential reserve and capital requirements as a primary insurer. Captive reinsurance companies are created for the purpose of assuming insurance risk transferred from a regulated insurance affiliate.

Life insurers' use of captive reinsurance has expanded dramatically in the past decade. By transferring ("ceding") life insurance and annuity risk to captive reinsurance companies, life insurers reduce their reserve and capital requirements.

Use of captives has grown rapidly since 2000, when the National Association of Insurance Commissioners (NAIC) passed its Valuation of Life Insurance Policies Regulation. The regulation, which most states have adopted, requires insurers to hold higher reserves on newly issued term and universal life insurance. Reserves ceded through captive reinsurance grew from $11 billion in 2002 to $364 billion in 2012 and now have expanded to include risk-sharing on products such as annuities that are not covered by the regulation.

The adoption of the regulation may have spurred the growth of captive reinsurance. As of 2012, the reported risk-based capital ratio for the average life insurer ceding risk to captives would have been 53 percentage points lower and the reported default probability more than three times higher without the use of reinsurance transactions, according to one study (see Koijen and Yogo, 2014; also see **Figure 2-41**).

U.S. life insurance companies now use captive affiliates more than they use nonaffiliated or third-party reinsurers (see Koijen and Yogo, 2014). NAIC, the Council, and the Federal Insurance Office have raised concerns about the solvency of captives and the potential that losses at captives could negatively affect their holding companies.

In 2013, the New York Department of Financial Services called attention to the use of risky assets to capitalize captive reinsurance companies (see **Figure 2-42**) and found that some insurers used the reserves freed via the use of captive reinsurance to boost risk-based capital (see NYSDFS, 2013). No other state regulators have publicly issued reviews of reinsurance practices. Although the NAIC has strengthened public disclosure around the quantity of

Figure 2-41. Captive Reinsurers Can Affect Capital and Default Risk

	Risk-Based Capital			10-Year Default Probability		
	Reported	Adjusted for captive reinsurance	Difference	Reported	Adjusted for captive reinsurance	Ratio
2002	160%	150%	-10%	0.8%	1.4%	1.8
2012	208%	155%	-53%	0.9%	3.3%	3.5

Source: Koijen and Yogo (2014)

Figure 2-42. Relatively Risky Assets Are Sometimes Used to Capitalize Captive Reinsurers

Type of Asset	Description of Asset
"Hollow assets"	A letter of credit from a bank is backed by a parental guarantee and recorded as an asset on the books of the captive reinsurance company. Unlike other assets such as cash or bonds, this does not provide for specific assets that can be used to support reinsurance recoverables.
Naked parental guarantee	The parent company promises to indemnify potential losses of the captive reinsurance company without setting aside dedicated resources. The asset is referred to as a "naked" parental guarantee because it does not involve the use of a letter of credit obtained from a bank.
Conditional letter of credit	The bank places a restriction on the letter of credit, such as making the letter of credit the last available fund before a drawdown can be initiated.

Sources: New York State Department of Financial Services, OFR analysis

Figure 2-43 Use of Captive Reinsurance Varies across U.S. Life Insurers ($ billions and percent)

Consolidated data for life insurers that wrote more than $2 billion of direct premiums in 2013

SNL Top-Tier Entity	Life Insurance in Force ($B)	Total Ceded to Captives ($B)	Ceded to U.S. Captives ($B)	Ceded to Non-U.S. Captives ($B)	As Percent of Total Life Insurance in Force		
					Total ceded to captives	Ceded to U.S. captives	Ceded to non-U.S. captives
MetLife Inc.	4,388.45	1,614.30	99.89	1,514.41	36.79	2.28	34.51
Prudential Financial Inc.	3,724.81	606.89	606.89	0.00	16.29	16.29	0.00
AEGON NV	1,506.49	447.26	241.72	205.54	29.69	16.04	13.64
Voya Financial Inc.	1,506.87	393.66	393.66	0.00	26.12	26.12	0.00
Protective Life Corp.	829.45	187.24	187.24	0.00	22.57	22.57	0.00
Lincoln National Corp.	1,277.66	126.04	126.04	0.00	9.87	9.87	0.00
Manulife Financial Corp.	642.76	94.53	0.00	94.53	14.71	0.00	14.71
AXA	541.20	71.64	71.64	0.00	13.24	13.24	0.00
Sammons Enterprises Inc.	236.81	52.21	52.21	0.00	22.05	22.05	0.00
Nationwide Mutual Group	243.24	35.64	35.64	0.00	14.65	14.65	0.00
Primerica Inc.	589.04	13.89	13.89	0.00	2.36	2.36	0.00
American International Group Inc.*	920.14	0.01	0.01	0.00	0.00	0.00	0.00
Northwestern Mutual Life Insurance Co.	1,462.93	0.00	0.00	0.00	0.00	0.00	0.00
New York Life Insurance Group	1,253.50	0.00	0.00	0.00	0.00	0.00	0.00
Massachusetts Mutual Life Insurance Co.	508.76	0.00	0.00	0.00	0.00	0.00	0.00
Aflac Inc.	157.02	0.00	0.00	0.00	0.00	0.00	0.00
State Farm Mutual Automobile Insurance Co.	798.97	0.00	0.00	0.00	0.00	0.00	0.00
Guardian Life Insurance Co. of America	494.19	0.00	0.00	0.00	0.00	0.00	0.00
Securian Financial Group	978.04	0.00	0.00	0.00	0.00	0.00	0.00
Hartford Financial Services Group Inc.	951.84	0.00	0.00	0.00	0.00	0.00	0.00
Pacific Mutual Holding Co.	299.26	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL*	23,311.43	3,643.31	1,828.83	1,814.48	15.63	7.85	7.78
INDUSTRY*	43,627.36	6,390.10	4,426.26	1,963.84	14.65	10.15	4.50

Note: Data as of September 11, 2014, are from annual filings to the National Association of Insurance Commissioners (NAIC) and may include business directly written outside the United States if reported in NAIC statements. Direct premiums represent a consolidation of credit life insurance, group life insurance, ordinary life insurance, and industrial life insurance.

*Data for American International Group, Inc. include adjustments for intercompany reinsurance.

Source: SNL Financial LC

reinsurance that firms obtain from captives, more public data about the quality and quantity of captives' capital would be useful to evaluate risk migration.

The practice of using captive reinsurance is not uniform across the life insurance industry and some risk is being ceded to offshore captive reinsurance affiliates, which are not subject to U.S. regulatory oversight (see **Figure 2-43**). While the growing use of captive reinsurance could be driven by factors such as differences in tax and regulatory regimes, it remains difficult not only for policyholders and investors, but also in some cases for state regulators, to determine the capital adequacy and financial strength of captive reinsurers (see **Section 6.2**).

Mortgage Servicers

Mortgage servicers collect payments from borrowers; set aside escrows and insurance payments; forward principal and interest to the mortgage owners, including payments to investors in agency MBS; and handle tasks such as foreclosing. Rights to service mortgages for fees — mortgage servicing rights (MSRs) — are assets that can be bought and sold.

When federal bank regulators set standards for bank capital under the Basel III international accord, they limited how much MSR assets could count toward bank capital. MSRs now cannot count as more than 10 percent of a bank's Tier 1 common equity capital (or 15 percent when deferred tax assets are taken into account), reflecting the difficulty in valuing these assets. Beyond that level, excess holdings of MSRs must have dollar-for-dollar capital allocated to them. Additionally, regulators increased risk weights for the portion of MSRs included in capital from 100 to 250 percent.

These regulatory changes have created incentives for banks to sell MSRs to nonbanks. Over the past two years, the top five nonbank servicers alone have increased their share of servicing nationwide from 5 percent to 14 percent, and further growth is likely. Mortgage servicing activity and the accompanying risks appear to be migrating to sectors of the financial system that do not have comparable prudential supervision or capital standards and that rely on debt or securitization to finance servicing. Additionally, these firms have much less diversified revenue streams than banks and generally do not hold mortgages on their balance sheets, which can act to hedge MSR risk.

More so than most mortgage assets, MSRs are highly sensitive to interest rates and mortgage defaults. They drop in value when interest rates fall, because of the risk that borrowers will prepay and refinance their mortgages. Mortgage servicers face additional risks because they must continue to service loans and advance payments to investors after a borrower defaults, although they can recoup servicing fees and payments advanced only after foreclosure and sale of the home. As a result, servicers must finance activities that produce no revenue during tight funding environments that typically accompany periods of rising mortgage defaults. Mortgage servicing can also carry the risk of litigation arising from operational failures, another potential expense that nonbank servicers may not be prepared for. Issues with transferring mortgage servicing, even without a firm failure, are an ongoing problem in the industry (see CFPB, 2013). If a large servicer fails, shifting its activities to another servicer while ensuring the continued transfer of timely payments to investors could prove difficult, particularly given the risk that nonbank servicers would experience stress simultaneously.

One potential mitigant to these risks would be for state regulators to define prudential standards for nonbank servicers, including standards for capital, liquidity, and operating practices, a recommendation the Council made in its 2014 annual report. State regulators, through the Conference of State Bank Supervisors, have launched an initiative to evaluate potential prudential standards.

Two additional reforms would also be helpful. First, reforming the model for servicer compensation could align the interests of servicers more closely with those of investors and borrowers. Second, establishing industrywide standards for transferring servicing files would make it easier to transfer servicing rights if a servicer failed.

Single-Family Rental Securitizations

Since the crisis, investors have purchased large numbers of single-family homes with distressed mortgages and converted them into rental properties, betting on combined returns from rental income and home price appreciation. This practice was concentrated in a handful of metropolitan areas where home prices had declined sharply during the crisis. More recently, home prices in these areas have increased more than the national average.

Several investment firms have recently issued floating-rate securities backed by pools of single-family rental properties they purchased. As of September 2014, there have been nine of these deals, totaling close to $5 billion in par value outstanding. At this point, there is no evidence of an impact on financial stability from this practice, but the activity should be monitored.

The structures and risks of these rental securitization bonds are more similar to commercial mortgage-backed securities than residential MBS in two ways: (1) they rely on medium-term debt to fund long-term assets, and (2) there is little or no amortization of principal. These features create maturity mismatch, which means the securities must be refinanced at regular intervals, creating risk for investors and sponsors.

These bonds are structured through special purpose vehicles, which relieve deal sponsors of any legal obligation to bail out a failing entity. Although not required, a sponsor may bail out a failing vehicle to prevent damage to the sponsor's reputation, which happened with similar products many times during the recent crisis and in earlier episodes (see Gorton and Souleles, 2007).

However, in severe stress, concerns about possible failure could trump reputation risk. Sponsors retain equity stakes in these vehicles, but bankruptcy protections create an incentive for deal sponsors to let the vehicles default if home prices drop significantly. Such a price drop could spur large-scale sales of investment properties, losses for investors, and possible spillover to households. In addition, deal sponsors have some incentive to sell properties that increase in value, although this risk is mitigated by deal provisions.

Although financial stability risks from these deals are currently limited, how much of a threat they might pose in the future depends on how large the market becomes, whether standard practices develop, and how rental-backed securities are used as collateral elsewhere in the financial system. The market is expected to grow — perhaps rapidly. Analysts disagree on the potential size of the market, with estimates ranging from $20 billion or less (see Goodman, 2014) to as much as $900 billion (see Rahmani, George, and O'Steen, 2013). To grow beyond the $20 billion estimate, the market — which currently finances mainly rental properties held by large institutional investors — would need to expand to finance small investors who own only a few rental properties.

EVALUATING MACROPRUDENTIAL POLICY TOOLS

3

Macroprudential policies are essential to increase the resilience of the financial system and address emerging vulnerabilities. Since the crisis, bank regulators have taken important steps intended to shore up capital, liquidity, and risk management standards at large banking organizations. Routine stress testing and resolution planning have further changed the regulatory approach to these companies. Regulators have also developed some new tools to strengthen nonbank financial institutions and financial markets. However, implementation at this new frontier has so far been limited. Additional measures would help prevent a significant migration of financial activity to institutions and markets subject to less prudential regulation. Also, several countries are experimenting with policy tools to address cyclical excesses, such as housing booms; assessments of their effectiveness are preliminary.

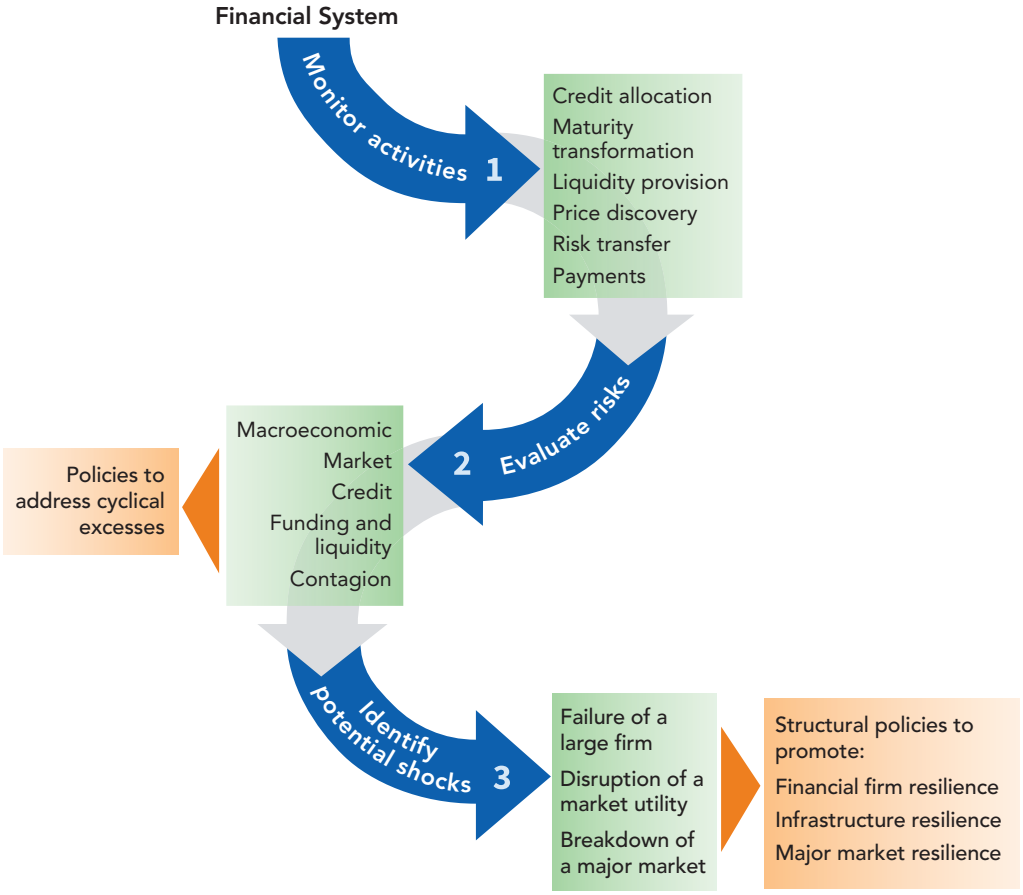
3.1 Framework for Policy Tool Evaluation

Macroprudential policy aims to make the financial system more resilient to shocks by addressing cyclical and structural vulnerabilities. To formulate macroprudential policy and to evaluate its effectiveness, we need to: (1) monitor financial developments for potential weaknesses, keeping an eye on innovation and the movement of financial activities to less regulated institutions, markets, and products; (2) identify the best tool for the job, through quantitative limits, buffers, or incentives that increase the price of risk-taking; (3) examine how tools may interact with each other and with microprudential oversight and monetary policy; and (4) understand how these tools may limit the transmission or amplification of shocks across national borders.

Macroprudential policies are, by definition, intended to address vulnerabilities across the financial system. But financial regulation is traditionally implemented through oversight of financial institutions or particular markets.

Macroprudential policies that address the financial stability risks described in Chapter 2 can be cyclical or structural (see **Figure 3-1**). Most of the policies discussed in this chapter address structural vulnerabilities. There are also many potential tools to address the cyclical risks discussed in Chapter 2, such as rapid credit growth and deteriorating underwriting standards in leveraged lending; "time-varying" tools — which can be used to respond to a cyclical buildup of risks — are being developed and used outside the United States. How those tools are used should shed light on their effectiveness and utility.

Figure 3-1. Financial System Activities, Risks, Potential Shocks, and Policy Responses



Source: OFR analysis

Macroprudential policies are, by definition, intended to address vulnerabilities across the financial system. But financial regulation is traditionally implemented through oversight of financial institutions or particular markets. Consequently, a robust policy response to financial stability risks will likely need to include prudential and market oversight and to span more than one regulatory jurisdiction. Post-crisis regulations have begun to recognize that reality. For example, the Dodd-Frank Act widened the Federal Reserve's supervisory umbrella to include designated nonbank financial institutions. But much remains to be done.

Structural Policies to Promote Resilience in Financial Institutions. To address risks posed by the largest financial firms, regulators have tightened standards for bank capital, liquidity, and risk management (see **Section 3.2**). These regulations are intended to increase banks' buffers against shocks, which the financial crisis revealed to be insufficient. However, some of the specific provisions of these regulations may have unintended consequences, which could pose financial stability concerns.

The use of stress testing as a core supervisory tool for U.S. bank regulators is an important innovation; a number of agencies on the Council are also developing stress testing regimes for nonbank financial companies. Another innovation is the requirement that large, complex financial institutions file resolution plans, or "living wills," that describe how they could be resolved in a rapid and orderly manner under bankruptcy laws to limit possible spillovers from a failure. The creation of new legal authorities to wind down or resolve such firms in an orderly way is also new.

The Council has designated three large nonbank financial institutions and eight financial market utilities for heightened supervision, and regulators are working to develop supervisory and regulatory frameworks tailored to the businesses of those companies.

Structural Policies to Promote Market Resilience. Regulators have also taken or proposed measures intended to address potential risks posed by certain market activities (see **Section 3.3**). They have taken steps to address run risks

in money market funds, suggested remedies to reduce the likelihood of fire sales in repo markets, and proposed new standards for mortgage markets. However, there remains more work to do to promote market resilience.

Structural Policies to Promote Resilience in Clearing Infrastructure. The Dodd-Frank Act directed all standardized swaps to be cleared through a central counterparty (see **Section 3.4**). To address risks posed by these central counterparties, the Act also gave regulators, through the Council, the power to designate them for heightened supervision. To date, the Council has designated eight financial market utilities, including two central counterparties that clear swaps.

Policies to Address Cyclical Financial Excesses. Both through-the-cycle and time-varying macroprudential policies can help mitigate cyclical excesses, such as credit, leverage, or liquidity transformation, that could lead to financial instability (see **Section 3.5**). Although supervisors have firm-specific tools, such as enforcement actions and supervisory rating downgrades, they have few systemwide tools to address market and credit excesses during the current extended period of low interest rates.

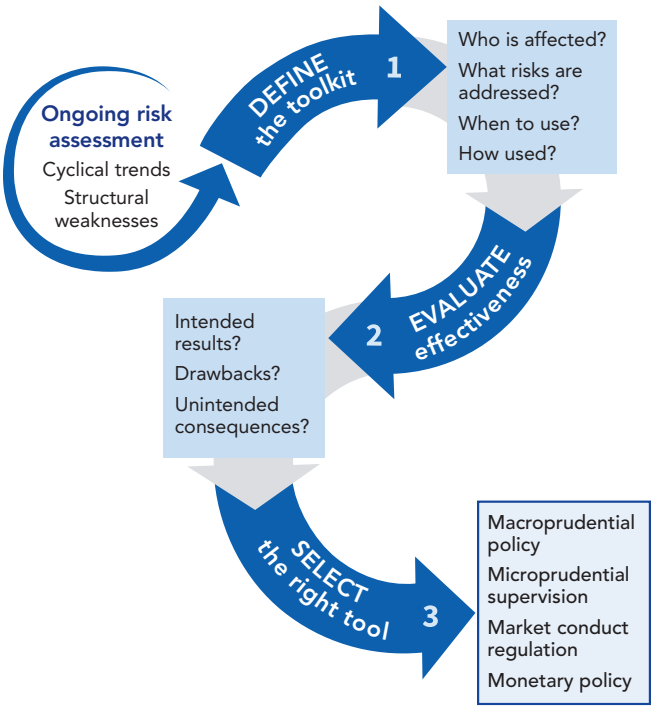
An important test case is the regulators' response to increased risk-taking in leveraged lending markets. Although bank regulators have issued updated guidance intended to strengthen banks' risk management in leveraged lending activities, it is not clear whether the guidance or other supervisory actions are curbing those activities or merely encouraging the activity to continue to move to products offered by asset managers, such as high-yield bond funds, exchange-traded funds (ETFs), hedge funds, and other private funds.

In the OFR's *2013 Annual Report*, we introduced an analytical framework for evaluating potential structural and cyclical macroprudential policy tools (see **Figure 3-2**).

Current vulnerabilities influence decisions about appropriate policy options. Policymakers need to define the toolkit in advance; prepare to evaluate the effectiveness of options, including potential drawbacks and unintended consequences; and then pick the right tool for the job. Policymakers must also be vigilant about whether macroprudential policy, traditional microprudential regulatory tools, and monetary policy complement or conflict with each other.

The macroprudential toolkit is far from complete and will be a moving target. Financial innovation and the migration

Figure 3-2. Macroprudential Policy Framework



Source: OFR analysis

Although supervisors have firm-specific tools...they have few systemwide tools to address market and credit excesses.

of activities will create new vulnerabilities, and new structural and cyclical challenges will continue to emerge as institutions, markets, and products evolve. By assessing vulnerabilities in the context of the basic functions of the financial system, as detailed in our first annual report in 2012, policymakers can make progress towards a better and more complete financial stability toolkit.

3.2 Structural Policies to Promote Resilience in Financial Institutions

This section discusses changes to the existing supervisory framework that address the risk of a large financial firm failing. These policies can play a crucial role in reducing risks to financial stability. However, these policies can also have unintended consequences that could conflict with financial stability.

The failure of a large, complex, and interconnected financial institution could have a negative impact on the real economy, shrinking credit to households, initiating a cascade of losses at other financial companies, or limiting access to payment and settlement services, if few substitutes are available.

This section describes key tools regulators have introduced or significantly changed since the crisis to promote the resilience of financial firms, such as stronger bank capital and liquidity standards, stress tests, resolution planning, and designation of nonbank financial companies. These tools are inherently microprudential — that is, they are used by regulators to ensure the safety and soundness of individual financial companies. But they also have implications for macroprudential policy because they affect large financial institutions' risk-taking.

Bank Capital and Liquidity Standards

Stronger regulatory capital rules and new liquidity standards for banks have been central to post-crisis regulatory reform. The financial crisis of 2007-09 revealed that a number of the largest U.S. banks lacked sufficient high-quality capital to weather a severe economic downturn without government financial assistance, such as the Troubled Asset Relief Program. The crisis also revealed material liquidity risk at U.S. banks and bank holding companies, as evidenced by large-scale Federal Reserve discount window lending and the introduction of special liquidity programs the Federal Reserve used to provide hundreds of billions of dollars in loans to banks and their broker-dealer affiliates.

The Basel Committee on Banking Supervision and U.S. bank supervisors introduced reforms to capital regulation and new quantitative liquidity metrics to force firms to rely less on public support and limit leverage and maturity transformation. Since early 2013, bank regulators have issued final rules implementing Basel III capital requirements, including the countercyclical capital buffer (see **Section 3.5**) and capital conservation buffer (July 2013), supplementary leverage ratio (October 2013), enhanced supplementary leverage ratio (May 2014), and liquidity coverage ratio (September 2014). A rule modifying the calculation of the supplementary and enhanced supplementary leverage ratios also was issued in September 2014. Regulators have also begun to discuss another proposal that would introduce a new type of loss-bearing liability instrument to support recapitalization during the resolution of a large bank; together with existing capital requirements, this has been called the Total Loss Absorbing Capacity.

With these new measures, regulators have sought to strengthen banks' ability to weather stress. However, analysis of the economic and financial stability impacts of the regulations is warranted. For example, it is possible the new capital and liquidity standards could reduce banks' ability to lend. Large banks' loan growth has been slow relative to the growth in gross domestic product in recent years (see **Figure 3-3**). That could (1) interfere with the credit channel and efforts by the central bank to stimulate economic activity, and (2) shift lending activity from banks to capital markets and other forms of nonbank financing that do not have a federal government backstop and generally are subject to less prudential oversight. While regulators have tried to lessen these effects through long phase-in periods for revised or new prudential regulations, large banks have worked towards early compliance.

RISK-BASED CAPITAL REQUIREMENTS

In Basel III, regulators here and abroad agreed on several new global risk-based capital requirements. First, regulators increased the quality and quantity of capital and introduced a common equity Tier 1 capital requirement for all banks and bank holding companies. Banks and bank holding companies will also phase in a capital conservation buffer that will limit dividends and discretionary bonuses paid when a bank's total capital ratio is less than 250 basis points above the regulatory minimum of 10.5 percent. For bank

holding companies that regulators have identified as globally systemically important banks (G-SIBs), there will be an additional capital surcharge of 100 to 250 basis points of risk-weighted assets.

The forthcoming U.S. G-SIB proposal will use the G-SIB framework developed by the Basel Committee as a starting point. However, the Federal Reserve is considering implementing standards beyond the Basel framework in two areas: (1) the surcharge levels for U.S. G-SIBs would be higher than those finalized in the Basel framework, and (2) the surcharge formula would directly take into account each U.S. G-SIB's reliance on short-term wholesale funding.

Risk-based capital standards are based on the risk of each asset and exposure. Smaller, less complex banks may use a set of standard risk weights for assets defined by regulators, simplifying compliance. Larger banks may determine their own capital requirements based on internal risk-based models (reviewed by regulators) that can be complex and diverse across banks. The Basel Committee's fundamental review of the trading book shows that regulators are concerned about the accuracy and rigor of these models, because many parameters are needed to estimate a single firm's capital requirement. In the United States, a section of the Dodd-Frank Act requires that the standardized approach should serve as the minimum for all U.S. banks' risk-based capital requirements.

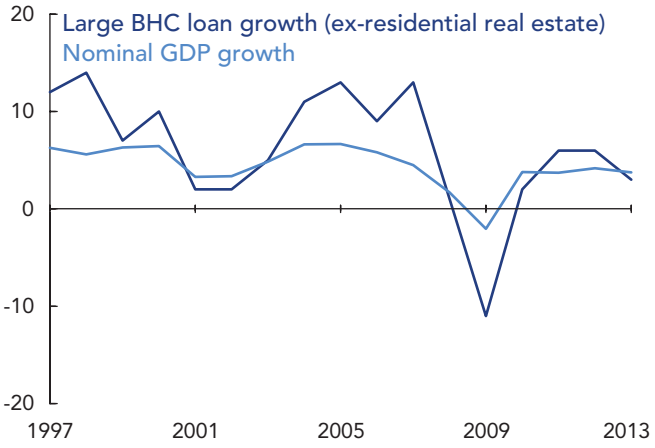
The advanced approach may also increase the procyclicality of bank lending, because internal risk-based models tend to base risk calculations on the recent historical performance of each asset class, resulting in higher capital requirements during a downturn and lower requirements during a boom (see Andersen, 2011). Some companies and regulators have tried to reduce this problem by developing models that use longer historical data series to estimate potential loss.

SUPPLEMENTARY AND ENHANCED SUPPLEMENTARY LEVERAGE RATIO STANDARDS

U.S. bank regulators have also strengthened the leverage ratio, a simpler capital standard based on total exposures, to include a broader definition of off-balance-sheet items. In the leverage ratio, the measure of total assets includes exposures with no risk weights, as well as off-balance-sheet exposures, such as derivatives and repos. Some regulators have even argued that advanced approaches to risk-based capital should be discarded in favor of greater reliance on

Figure 3-3. Large Bank Holding Company Loan Growth, Excluding Residential Real Estate Loans (percent change)

Annual loan growth at large banks remains weak relative to growth in GDP



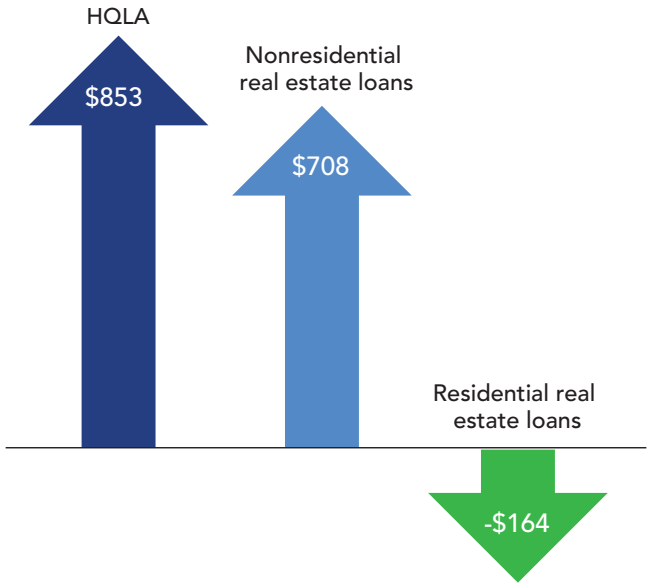
Note: Large bank holding company (BHC) loan growth is calculated using the median rate for bank holding companies with assets greater than $50 billion.

Source: Bureau of Economic Analysis, Federal Reserve Form Y-9C

The advanced approach may also increase the procyclicality of bank lending, because internal risk-based models tend to base risk calculations on the recent historical performance of each asset class, resulting in higher capital requirements during a downturn and lower requirements during a boom.

Figure 3-4. Large U.S. Bank Balance-Sheet Trends ($ billions)

The strongest area of bank balance-sheet growth since 2010 is high quality liquid assets (HQLA)

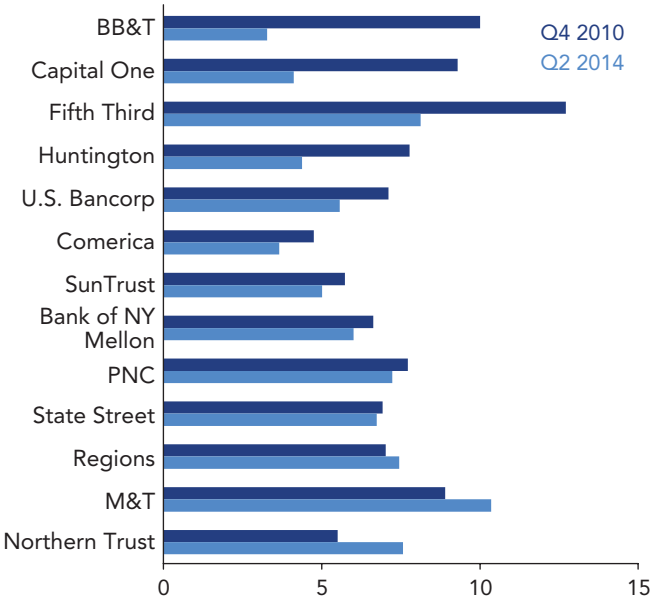


Note: Growth is measured from June 30, 2010, to June 30, 2014. High-quality liquid assets include cash, U.S. Treasuries, agency debt, and agency mortgage-backed securities.

Source: Federal Reserve Form Y-9C

Figure 3-5. Weighted Average Maturity of Banks' Bonds Outstanding (years)

Some large banks are reducing weighted average maturity



Sources: Bloomberg L.P., OFR analysis

supervisory stress tests, the leverage ratio, and the U.S. statutory floor (see Tarullo, 2014).

U.S. supervisors also adopted stronger requirements for U.S. bank holding companies with $700 billion or more in assets. These firms must begin to report an enhanced supplementary leverage ratio in January 2015 and must meet a minimum 5 percent enhanced supplemental leverage requirement beginning in January 2018. (Currently, eight bank holding companies would qualify.) Their affiliated banks must meet a minimum ratio of 6 percent. Both covered bank holding companies and banks must meet the required ratios to be free from restrictions on capital distributions and discretionary bonuses to executives.

Based on large banks' public reporting, it appears that the enhanced supplementary leverage ratio is likely to prove more of a constraint than risk-based standards for some large banks and may lead to unintended consequences. Leverage ratios tend to encourage banks to hold higher-yielding but riskier assets relative to low-risk assets, such as excess central bank reserves and repurchase agreement (repo) transactions backed by government securities. Also, in a stressed environment, the leverage ratio may create an incentive to sell securities rather than finance them in the repo market, potentially promoting asset fire sales. This type of risk is poorly understood but could be assessed in stress tests.

LIQUIDITY COVERAGE RATIO

The liquidity coverage ratio (LCR) requires certain companies to maintain sufficient high-quality liquid assets (HQLA) to cover potential net cash outflows over a 30-day stress period. The ratio applies to consolidated bank holding companies with assets greater than $250 billion or foreign exposures greater than $10 billion and affiliated banks with assets greater than $10 billion. The Federal Reserve also adopted a separate modified LCR rule for bank holding companies with assets greater than $50 billion, which in practice allows these firms to hold HQLA sufficient to meet 70 percent of anticipated net cash outflows.

The requirement is aimed at the perceived runoff risk of different types of liabilities, drawdown rates on commitments, and contractually scheduled cash flows over a 30-day period. Although capital and liquidity have long been given equal weight in assigning U.S. banks' supervisory ratings, supervisory assessments of liquidity have lacked a standardized quantitative metric. For this reason, the LCR metric

is a useful common yardstick, but it also represents new territory for supervisors.

Banks can comply with the LCR by increasing holdings of liquid assets, changing the maturity or composition of their liabilities to reduce projected cash outflows, or shortening the maturity of assets to increase projected cash inflows. Banks have been getting ready for the LCR's 2015 phase-in mostly by acquiring liquid assets (see **Figure 3-4**).

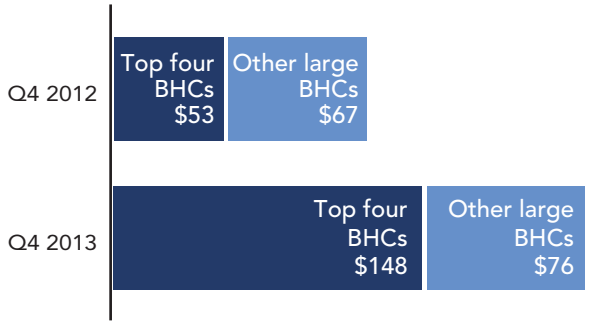
Just as capital standards promote some types of assets as less risky than others, the LCR promotes some types of liabilities over others. For example, the LCR requires banks to hold HQLA to cover the risk of heightened withdrawals by depositors, but only a fractional amount for bonds and other debt with a maturity of 30 days or more. Banks may be responding to the approach of the LCR by issuing more bonds and using the proceeds to acquire HQLA. In some cases, they also have shortened the weighted average maturity of their outstanding bonds to reduce their interest expense, offsetting the lower interest income on HQLA (see **Figure 3-5**).

In anticipation of the phase-in of the LCR, four of the largest banks increased their use of financing from the Federal Home Loan Banks (FHLBs) by 150 percent between March 2012 and December 2013 (see FHFA, 2014). Much of this funding was used to acquire high-quality liquid assets that can include the debt of the FHLBs and other government-sponsored enterprises (GSEs) under the rule. However, this development could heighten the risk of contagion through an increase in interconnectedness between banks and FHLBs (see **Figure 3-6**). The LCR also assumes that banks can roll over 75 percent of FHLB borrowing due within 30 days, which is more favorable than other forms of wholesale funding. If bond markets were to freeze up and FHLB issuance became difficult, it is not clear if the FHLBs hold sufficient liquidity to roll over maturing bank borrowings.

Does the LCR also increase the cost of bank lending? The answer depends. When banks make loans, deposits increase in the banking system, requiring banks to acquire liquid assets or otherwise build their LCRs. If deposits increase enough to make banks subject to the LCR noncompliant with the minimum requirement, the banks would have to acquire liquid assets or otherwise build LCR, which would increase net funding costs. Banks can absorb the cost and reduce profitability or take measures to offset the increased regulatory costs, such as raising interest rates or fees,

Figure 3-6. Large U.S. Banks' FHLB Borrowings ($ billions)

The largest banks are ramping up FHLB borrowing to acquire buffer assets to comply with LCR



Note: The four largest bank holding companies (BHCs) are Bank of America Corporation, Citigroup Inc., JPMorgan Chase & Co., and Wells Fargo & Company. Other BHCs include all other bank holding companies with total assets greater than $50 billion.

Source: Federal Reserve Form Y-9C

In anticipation of the phase-in of the LCR, four of the largest banks increased their use of financing from the Federal Home Loan Banks (FHLBs) by 150 percent between March 2012 and December 2013...the risk of contagion could be heightened through an increase in interconnectedness between banks and FHLBs.

Figure 3-7. Results of Selected Studies on Liquidity Coverage Ratio Economic Impacts

Study	LCR compliance gap size and closure method	Sample	Lending spread increase	Lending volume decline	Impact on GDP
BIS-MAG (2010)	25% increase in liquid assets/total assets	International	14.9 basis points (bps) (median country estimate in 18 quarters)	-3.2% (median country estimate)	-11 to 14 bps Standard macro and DSGE model (median country)
Interagency Study (2011)	$1.2 trillion bank by bank LCR gap closure for US. individual banks using estimate of "least cost" mechanism	U.S.	15 to 27 bps (median estimate for different loan sectors)	n/a	-2-33 bps decline in level of nominal GDP
EBA LCR impact study (2013)	EUR 264 billion compliance gap from supervisory data	E.U.	6.9 bps (short-term) 3.6 bps (steady state)	n/a	-3 to 7 bps impact on level of real GDP in transition
IIF (2011)	Banks issue term debt to buy buffer assets to close $1.8 trillion LCR gap (but also includes impact of higher capital standards and Dodd Frank)	U.S. (all countries)	468 bps (364 bps)	-4.6% (-3.2%)	300 bps decline in real GDP
Covas/Driscoll (2011)	Banks cut loans and increase liquid asset holdings by 20%	U.S.	20 bps (long-run estimate)	-5%	-70 bps change in level of output

BIS-MAG = Bank of International Settlements-Macroeconomic Assessment Group
EBA = European Banking Authority
IIF = Institute of International Finance

Source: Office of the Comptroller of the Currency (2014b)

investing in riskier assets with higher returns, or cutting expenses.

Studies estimate the effects of the LCR requirement could be significant, with lending declining 3 to 5 percent and interest rates rising 15 to 30 basis points (see **Figure 3-7**). However, those studies date from 2011 and consider an early version of the LCR, which the Basel Committee subsequently made less stringent. The final U.S. rule is a stronger requirement than the final Basel rule. Although it is early to analyze the economic impact of the LCR in practice, these studies provide some preliminary analysis of the question.

It remains unclear whether the LCR will work as a buffer that banks can draw down during times of financial stress (see BCBS, 2012), one of the key intended benefits of the regulation. In the final rule, regulators say they "should not discourage or deter a banking organization from using [high-quality liquid assets] when necessary to meet unforeseen liquidity needs arising from financial stress that exceeds normal business fluctuations" (see OCC, Board of Governors, and FDIC, 2014).

However, publicly listed banks might be hesitant to allow LCRs to fall below the regulatory minimum during a crisis if they were required to report breaches to comply with disclosure regulations, because that could signal weakness to their investors. The final rule does not provide a clear mechanism, such as a reduction or waiver of the LCR requirement by U.S. supervisors, to allow banks to use their liquidity buffers during a systemic stress without potentially triggering disclosure issues. Such a mechanism could allow supervisors to use the LCR as a countercyclical macroprudential tool to address liquidity shocks (see van den End and Kruidhof, 2013).

NET STABLE FUNDING RATIO

The net stable funding ratio (NSFR), which was finalized in October by the Basel Committee for implementation by January 2018, is a structural balance-sheet measure to address liquidity risk beyond the LCR's 30-day horizon. Unlike the LCR, which is a measure of a bank's short-term cash flow profile under stressed conditions, the NSFR is intended to address more normal market conditions. The

Basel framework for the NSFR states that available stable funding must equal or exceed required stable funding (see BCBS, 2014b).

The Basel framework's calculation of available stable funding is weighted by the perceived stability of each liability — higher for more stable funding, such as time deposits or equity, and lower for less stable funding, such as short-term loans from another bank. The calculation of required stable funding is weighted by the perceived liquidity of a bank's assets and off-balance-sheet exposures — lower for liquid assets (zero for cash and 5 percent for unencumbered U.S. Treasuries) and higher for loans and other long-term assets.

Stress Tests

The Dodd-Frank Act introduced significant new capital stress testing requirements for financial companies, including Federal Reserve-run supervisory stress tests and company-run stress tests with supervisor-prescribed scenarios to complement firms' internal stress test processes.

Supervisors give companies three economic scenarios to use for their stress tests: (1) a baseline scenario that reflects the consensus view of the U.S. economy, (2) an adverse scenario that reflects a decline in economic activity and other risks, and (3) a severely adverse scenario that reflects a significant decline in the U.S. economy.

Both the adverse and severely adverse scenarios include a trading shock. Stress testing is an important macroprudential tool because it allows supervisors to evaluate financial institutions' resilience under various stress scenarios, which supervisors can tailor to address perceived systemwide threats.

The three federal bank supervisors — the Federal Reserve, the Office of the Comptroller of the Currency (OCC), and the Federal Deposit Insurance Corporation (FDIC) — collaborate on common scenarios and have examination teams review stress-testing model governance and capital planning, a critical but resource-intensive component of the process.

FEDERAL RESERVE STRESS TESTS

The Federal Reserve this year performed supervisory stress tests on the 30 largest bank holding companies. In the future the three nonbank financial companies the Council has designated for heightened prudential supervision will be included in this stress test, although not in 2015. The Federal Reserve specifies baseline, adverse, and severely adverse scenarios for the tests. The Federal Reserve uses the results from its own models and the company-run models in its comprehensive capital analysis and review process (CCAR), which assesses capital adequacy and the strength of each company's capital planning.

The Federal Reserve's 2014 test estimated total losses of $501 billion for the 30 companies under the severely adverse scenario, which included a deep recession in the United States, Europe, and Japan; sharp declines in asset prices; and an economic slowdown in developing Asia. Despite those steep losses, banks' capital ratios remained about the level experienced during the financial crisis. In its CCAR results, the Federal Reserve again noted qualitative issues with the capital planning processes at several banks.

COMPANY-RUN STRESS TESTS

The Dodd-Frank Act also mandated company-run stress testing be performed by certain financial companies. The law requires semiannual company-run stress tests for bank holding companies with assets greater than $50 billion, as well as Council-designated nonbank financial companies.

In one semiannual cycle, the firms use supervisor-prescribed scenarios and their results are compared to those of the Federal Reserve's CCAR model. In the other cycle, firms provide to supervisors stress test results based on their own internally generated scenarios.

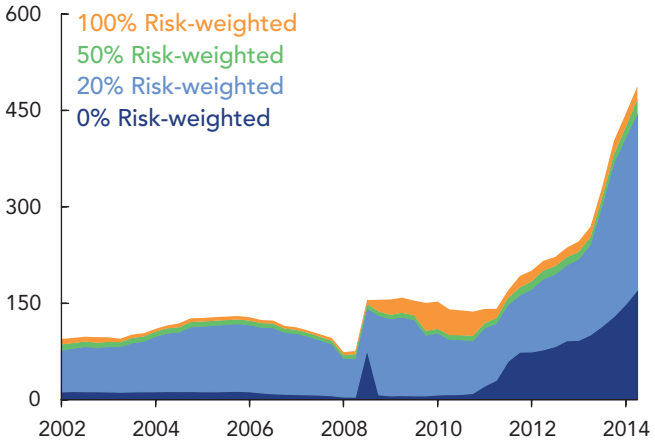
Dodd-Frank also required annual company-run stress tests for any financial company with assets greater than $10 billion and regulated by a primary federal financial regulatory agency. The Federal Reserve, OCC, FDIC, and Federal Housing Finance Agency (FHFA) have finalized rules implementing this requirement. The SEC and CFTC have not yet proposed rules. The National Credit Union Administration approved a proposed rule last year requiring annual stress tests at any credit union with more than $10 billion in assets, although it was not required to do so under the Dodd-Frank Act.

A number of companies recently held their first company-run stress test under the Dodd-Frank Act, including Fannie Mae, Freddie Mac, and banks and bank holding companies supervised by the Federal Reserve, OCC, and FDIC with assets in the $10 billion to $50 billion range.

Large insurance companies are not subject to the Dodd-Frank Act company-run stress testing, unless designated by the Council for heightened prudential supervision.

Figure 3-8. Held-to-Maturity Securities Portfolios at U.S. Banks ($ billions)

Revised capital standards are contributing to rapid growth



Source: Federal Financial Institutions Examination Council Call Reports for all FDIC-insured banks

Stress tests also could be more valuable if they were flexible enough to consider a broader range of possible supervisor-prescribed stress scenarios.

State insurance regulators traditionally have required stress testing only in certain industry sectors; for example, asset-liability testing by life insurers. State insurance regulators, acting through the National Association of Insurance Commissioners, recently adopted a model and supporting guidance that, if adopted by states, would require larger insurers and insurance groups to annually perform an "Own Risk and Solvency Assessment" including a prospective solvency assessment in both normal and stressed environments. The new model and guidance do not prescribe a specific degree of stress or a specific methodology of application.

STRESS TESTS AND FINANCIAL STABILITY

OFR staff's initial work in this area suggests that there remains room for further enhancements to the current stress test framework (see Bookstaber and others, 2014). For example, bank supervisors provide 28 high-level, national and international variables in the supervisor-prescribed stress scenarios. Although agencies also provide a description of the macrofinancial scenario, to estimate losses banks must extrapolate those variables into several hundred more variables. The results may be neither consistent with the scenario nor comparable across firms, which could affect company-run stress test results. Stress tests also could be more valuable if they were flexible enough to consider a broader range of possible supervisor-prescribed stress scenarios, although this could be difficult to implement in the current process. This is particularly important as the range of sizes and business models of banks subject to stress tests has grown and become more diverse.

Supervisory stress tests currently assume credit losses are the driver that will pressure capital. It is also possible that the driver of a bank's stress is not a macroeconomic shock, but a funding stress that arises inside the financial sector or a credit shock that could be magnified by funding stress. Potential liquidity and solvency interactions receive little consideration. For example, banks have increased securities holdings in held-to-maturity portfolios by nearly half a trillion dollars since the crisis — in part, this reflects new capital standards that require advanced approach banks to take a capital charge for unrealized losses on available-for-sale securities, but not held-to-maturity securities (see **Figure 3-8**). Under stress, banks may need to use these securities to generate liquidity, either by selling them (which could result in a capital loss) or by financing them through repos (which could reduce a bank's leverage ratio and LCR).

Resolution Plans and Orderly Liquidation Authority

Despite the recent enhancements in prudential standards for the largest banks and bank holding companies, the risk of a systemically important bank failure cannot be reduced to zero. The financial crisis illustrated that the U.S. Bankruptcy Code is not always able to handle a rapid and orderly resolution of a large, complex insolvent financial institution. However, the resolution of such a financial firm should occur efficiently and quickly to minimize market disruption and potential systemic consequences. Title I and Title II of the Dodd-Frank Act introduced a new regulatory approach to help expedite the orderly resolution of large firms.

Title I required certain companies to prepare resolution plans to demonstrate how they could be resolved in a rapid and orderly manner under the Bankruptcy Code, without extraordinary government assistance, in the event of their material financial distress or failure. The Federal Reserve Board and the FDIC have joint authority to review and set information requirements for the plans, in addition to the information requirements set out in the Dodd-Frank Act.

Title II gave the FDIC the back-up authority to resolve a financial company if it is determined that the firm cannot be resolved through bankruptcy without serious, adverse effects on financial stability. After the Federal Reserve and either the FDIC, SEC, or Federal Insurance Office make a recommendation, the Treasury Secretary, in consultation with the President, must make a determination to begin a Title II proceeding. Under Title II, the FDIC would be appointed as receiver, succeeding to all rights and title to the company's assets, and would manage the insolvency process. The Dodd-Frank Act provided for an Orderly Liquidation Fund, subject to certain parameters, as a backup source of liquidity support.

Title I required periodic submission of resolution plans by the largest bank holding companies and designated nonbank financial companies to the FDIC and the Federal Reserve (see Board of Governors and FDIC, 2013). Eleven companies submitted plans in 2012 and revised them in 2013 and 2014. About 120 institutions submitted their first plans in 2013 and have submitted revised plans in 2014. The three nonbank financial companies designated by the Council (American International Group, Inc., General Electric Capital Corporation and Prudential Financial, Inc.) submitted initial resolution plans in 2014.

After reviewing the revised 2013 plans of the 11 largest, most complex banking organizations, the Federal Reserve and FDIC jointly directed the companies to address shortcomings and demonstrate they are taking actions to be able to be resolved under the Bankruptcy Code (see Board of Governors and FDIC, 2014). Directed actions included rationalizing corporate structures, amending financial contracts to stay, or suspend, certain early termination rights of external counterparties, and taking action to ensure continuation of critical services. Firms are expected to respond to regulatory feedback in their 2015 resolution plans.

Resolving a large, complex insolvent financial firm raises many challenges under the Bankruptcy Code. These include the risk of multiple, competing insolvency proceedings in different jurisdictions, domestic and international; the threatened discontinuity of critical operations; and potential systemic consequences of counterparty actions.

In addition, in some cases, a diversified, global company may be resolved under the strategy called "multiple-point-of-entry," which means its subsidiaries would enter resolution under different bankruptcy regimes. Lack of convergence in insolvency law makes this exercise complicated.

An alternative is the single-point-of-entry strategy, which may provide for a more rapid and orderly resolution under the bankruptcy code. The FDIC has proposed this approach as one of several possible strategies available for implementing its Title II back-up authority (see FDIC, 2013).

Under the single-point-of-entry proposal, the FDIC would be appointed receiver only of the top-tier U.S. holding company, while subsidiaries would remain open and continue operating. The FDIC would organize a bridge financial company that would receive the failed parent company's assets, primarily investments in and loans to its subsidiaries. Losses would be apportioned first to the equity holders and then to other claimants of the failed company according to the order of statutory priority. In theory, the bridge financial company could be created quickly, possibly over a weekend, potentially allowing for continuation of subsidiaries' critical operations with minimal disruption.

However, the single-point-of-entry strategy does not solve all concerns with a Title II resolution. A key requirement of the single-point-of-entry strategy is that bank holding companies must have sufficient long-term, unsecured debt ("bail-in debt"), so losses could be covered by the claimants of the parent company and a new company or companies

could be capitalized when they break away from the bridge company. The reaction of foreign regulators is also uncertain. For example, the single-point-of-entry strategy may not work if foreign regulators ring-fence assets, that is, prevent the assets of a failing firm from leaving their jurisdiction.

Another concern is that a one-business-day stay on a counterparty's rights to terminate qualified financial contracts such as derivatives will not bind counterparties overseas or those with contracts governed by foreign law. This concern, however, is reduced by a new protocol developed by the International Swaps and Derivatives Association (ISDA), providing for temporary stays on certain default and early termination rights within standard ISDA derivatives contracts. So far, 18 large banking organizations have agreed to sign on to the protocol.

Firms have also been considering the possibility of using the single-point-of-entry approach under the Bankruptcy Code as a potential resolution strategy under Title I. Under a Title I resolution using the single-point-of-entry approach, the creation of a bridge company could be initiated by the firm itself or by the firm's primary regulator. Regulators have discussed possible changes to the Bankruptcy Code to allow the single-point-of-entry approach.

Designation of Nonbank Firms for Heightened Oversight

The financial crisis illustrated that the potential impact of the failure of a financial firm is related not only to the size of the institution but also to its business mix and the nature and extent of its connections to other market participants. The Dodd-Frank Act gave the Council the authority to designate nonbank financial companies that could pose a threat to financial stability for enhanced prudential standards and supervision by the Federal Reserve. The Council designated three companies in 2013 — AIG, General Electric Capital Corporation, and Prudential. Under a separate Dodd-Frank Act authority, the Council in 2012 designated eight financial market utilities, which are companies that manage or operate systems for transferring, clearing, or settling financial transactions.

The designation of nonbank financial companies has potential benefits for financial stability. The most important potential benefit is that it provides for consolidated supervision of the largest, most complex firms. Evaluating risks across a firm's businesses by a single supervisor reduces the likelihood that risky activities in one business line could be transmitted to other business lines in the same company but outside of regulators' authority. And it is intended to address "too-big to-fail" risk — that large, complex institutions might benefit from an implicit government backstop — by requiring that the risks posed by the largest, most complex financial institutions are prudently managed and subject to adequate oversight. The Federal Reserve is working to develop ways to supervise and regulate designated nonbank financial companies to ensure that standards and oversight are appropriate given the companies' business mixes, models, and practices.

There are also potential challenges associated with designation. The most important of these is the difficulty of developing and implementing appropriate prudential oversight for financial companies with diverse business models and mixes, because what is appropriate for some businesses may not work for others. In addition, regulatory costs for designated firms will rise on designation, and that could promote a migration of businesses or activities to other parts of the financial system.

Given those potential benefits and challenges, it is premature to assess the net effects of designation at this early stage. Some academic researchers have analyzed market pricing to evaluate whether market participants adjust their views of insurance companies identified under a separate international process by the Financial Stability Board. This research argues that there may be some erosion in market discipline (see Dewenter and Riddick, 2014).

Recognizing that tools other than firm-specific designation may be appropriate remedies for risks in some types of nonbank financial companies, the Council directed member agency staff to undertake a more focused analysis of industry-wide products and activities to assess risks associated with the asset management industry. For example, some industrywide activities that could introduce risk, such as investment in certain types of derivatives, may be more appropriately addressed through market-based or industrywide regulation.

3.3 Structural Policies to Promote Market Resilience

This section discusses policies that address the risk of a breakdown of a major market, which could include asset fire sales, runs on short-term liabilities, and a sudden loss of market liquidity.

Even as new measures strengthen regulatory requirements on banks and expand the universe of institutions subject to consolidated supervision, the credit intermediation of other types of financial institutions is growing. For example, the asset holdings of registered funds are now greater than bank assets (see **Figure 3-9**). As the OFR concluded in its 2013 study on the asset management industry, regulators need to consider potential financial stability risks associated with asset management activities, in addition to individual companies (see OFR, 2013b).

This section describes three types of microprudential tools that focus on activities and can promote market resilience: redemption policies and regulation, limits on haircuts and collateral, and risk retention rules. Registered investment funds have some built-in safeguards to protect investors, such as restrictions on exposure, leverage, and illiquidity, and requirements related to reporting and governance. Unregistered funds and other types of nonbank market participants have fewer built-in safeguards.

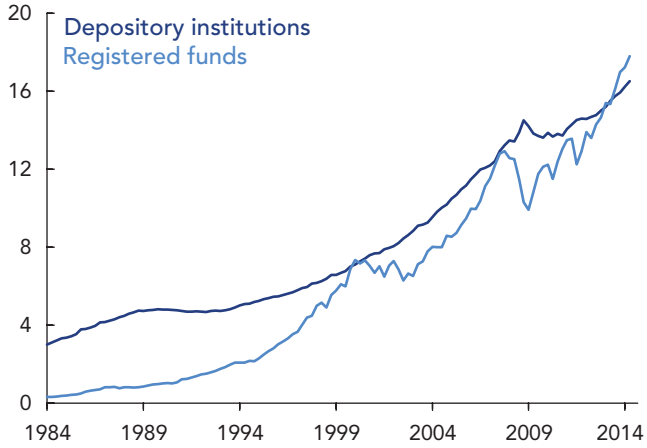
Redemption Policies and Regulation

Investors in collective investment vehicles are exposed to market risk and may have an incentive to redeem ahead of other investors in market downturns to reduce their losses. Individual fund managers can impose redemption policies to mitigate the impact of redemption risk on the fund and to improve its resilience in the event of widespread redemptions. Managed funds' redemption policies collectively can affect the spread of contagion during a systemic event based on how many assets funds are forced to sell to meet redemption obligations.

Each fund's redemption policy exerts an effect on its peers. If fund managers are allowed to compete for investors through their redemption policies, they may individually construct policies that in aggregate make the industry undesirably fragile. Funds with liquidity mismatches compared to the stated redemption policies can create market fragility. Although this is not a concern for funds invested in

Figure 3-9. Financial Assets in Registered Funds and Depository Institutions ($ trillions)

Asset holdings of registered funds are now greater than bank assets



Source: Haver Analytics

If fund managers are allowed to compete for investors through their redemption policy, they may individually construct policies that in aggregate make the industry undesirably fragile.

Figure 3-10. Redemption Policies

Fund Types	Earliest Redemption		Cost (ex-distribution fees and broker commissions)	
	Current Practice	Regulation	Current Practice	Regulation
Money Market Funds	Pricing: End of day Settlement: End of day	7 days or fewer depending on the prospectus If money market fund share is about to fall below its par value, board can suspend all redemptions and liquidate the fund. In 2016, discretionary redemption gates if weekly liquid assets fall below 30%.	None	In 2016, default liquidity fee; 1% liquidity fee when the fund's weekly liquid assets are less than 10% unless the board decides a fee is not in the best interest of the fund Discretionary liquidity fee; not exceeding 2% when the fund's weekly liquid assets are less than 30%, unless the board decides a fee is not in the best interest of the fund
Mutual Funds	Pricing: End of day Settlement: Transaction plus 1 day	7 days or fewer depending on the prospectus	Some charge 0.5% to 2% redemption fees against fund withdrawals too soon after fund purchase to discourage opportunistic trading	None
Exchange-Traded Funds	Pricing: End of day Settlement: Transaction plus 3 days	3 days for retail investors	None	None
Hedge Funds	Pricing and settlement determined by offering; that is one-to-two year "lock-up;" infrequent redemption once per month or once per quarter.	None	Some funds allow "soft lock; " early withdrawal with 2% to 10% penalty fee	None

Source: OFR analysis

highly liquid assets, such as large-cap equities or Treasuries, some funds offer exposure to less liquid assets, such as emerging markets, high-yield bonds, or syndicated bank loans. Prudential regulation could overcome this coordination problem for less liquid funds. For this reason, recent reforms to the valuation and redemption of money market fund shares are an area of interest and ongoing analysis for the OFR.

Redemption policies vary primarily in terms of speed (how quickly investors can liquidate) and cost (whether fees are associated with investor withdrawals) (see **Figure 3-10**).

SPEED LIMITS

Managers of private funds can suspend redemptions for a certain period of time using redemption restrictions, or "gates." Practices vary in the hedge fund industry. Hedge funds can limit redemption requests to only once per month or once per quarter and may require as much as six months advance notice. Hedge funds, which may invest in illiquid assets, might also impose a "lock-up period," often one or two years from the initial investment, during which an investor cannot withdraw funds without penalty.

Mutual funds are generally able to meet redemption requests within seven days, as required by current regulation. However, some mutual funds and exchange-traded funds (ETFs) offer exposures to less liquid asset classes, such as emerging markets, high-yield bonds, or syndicated bank loans (see **Exchange-Traded Funds and Liquidity Mismatches** in **Section 2.3**). Managing liquidity for mutual fund or ETF portfolios invested in less liquid asset classes may require additional risk management and regulatory tools.

Redemption restrictions should take into account the likelihood that market liquidity will become impaired during market stress and serve as a mechanism to limit systemic spillovers at those times. Under normal circumstances, money market funds offer same-day redemption because they invest in highly liquid assets. However, recent money

Money Market Fund Reform

The financial crisis illustrated the vulnerability of money market funds to mass redemptions and prompted regulators to implement a series of reforms in this market.

Under reforms implemented in 2010, the SEC requires at least 10 percent of money market fund assets to be cash, U.S. Treasuries, or other securities that can be converted into cash within a day; 30 percent must be able to be converted into cash within a week. The SEC's reforms also limited the maturity and credit risk in fund portfolios and introduced Form N-MFP, which requires detailed monthly disclosures (see SEC, 2010).

In November 2012, the Council issued for public comment a proposed recommendation that the SEC require either a floating or a fixed net asset value with significant new safeguards. This represents the first time the Council used its authority under Section 120 of the Dodd-Frank Act, which authorized the Council to recommend that a primary federal regulator apply new or heightened standards to address a risk to financial stability (see FSOC, 2012).

The SEC announced reforms in July 2014 addressing those concerns (see SEC, 2014b). Its rule requires institutional prime money market funds to implement a combination of floating net asset value, redemption restrictions, and liquidity fees by October 2016. The rule also made enhancements to the SEC's existing stress testing regime by requiring a fund to test its ability to maintain weekly liquid assets of at least 10 percent and to minimize principal volatility in response to certain specified hypothetical stress scenarios.

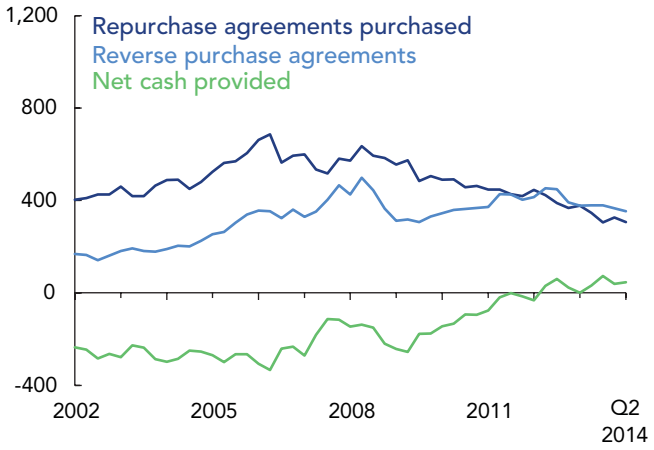
With the implementation of floating net asset values, institutional investors may leave prime money market funds for government money market funds, which invest mostly in government securities, cash, or repurchase agreements backed by government securities. Under the SEC rule, these funds retain their ability to transact at a stable net asset value. Investors may also increase their bank deposits and holdings of other cash products offered by banks. Some large institutional investors might also switch to separately managed cash accounts, which could be harder for supervisors to monitor (see **Chapter 6**).

The rule also sought to address potential preemptive runs by allowing boards of directors of funds the discretion to apply redemption restrictions. Redemption restrictions, often referred to as "gates," have been adopted in many overseas markets to limit fund outflows during financial crises (see Axenov, 2014). However, in Europe these gates are always in place as described in fund offering documents, but only rarely used. Some research has suggested shareholders might run preemptively if they feared redemption restrictions would be imposed (see Cipriani and others, 2014), meaning discretionary gates could worsen a run. Others have argued that liquidity fees may exacerbate institutional investor runs during a crisis (see Fecht and Wedow, 2014).

The benefit of the new rule cannot be evaluated until the money market industry again faces strain and run risks. The ongoing concentrations of money market fund assets within a few large asset managers may raise more systemic stability concerns and require enhanced monitoring of potential cash reallocation.

Figure 3-11. Use of U.S. Banks' Repo and Reverse Repos ($ billions)

Insured banks have become net cash providers in the repo market for the first time



Sources: Federal Financial Institutions Examination Council Call Reports for all FDIC-insured banks, OFR analysis

In October 2014, the Financial Stability Board (FSB) published a regulatory framework on minimum haircuts on securities-financing transactions that are not centrally cleared.

market fund reforms introduced discretionary redemption restrictions to better manage heavy redemptions if market liquidity is impaired. These reforms provide for discretionary gates by allowing the fund's board of directors to suspend redemptions under certain circumstances for up to 10 days (see **Money Market Fund Reform**). However, other mutual funds are not permitted to impose redemption gates under SEC rules.

COST

Funds can impose redemption fees on the dollar amount of shares an investor requests to sell. Some mutual funds impose fees only on redemptions by investors who move frequently into and out of the same fund to discourage opportunistic trading. Redemption fees can help force redeeming shareholders to bear the cost of liquidation. Research shows that liquidity fees can reduce the volatility of fund flows during periods of market illiquidity, when increasing redemptions might otherwise hurt shareholders who do not redeem shares (see Greene, Hodges, and Rakowski, 2007). However, it is a challenge to calibrate fees so that they reduce volatility, while still providing for a viable investment vehicle.

Haircuts and Collateral Requirements

Regulators have several options to address the risk of asset fire sales and other forms of contagion in the event of a market shock. First, firm-focused policies aim to reduce the reliance of individual banks and dealers on short-term funding to make it less likely they will sell assets preemptively to raise liquidity in a crisis. Banks' use of short-term secured funding now carries a higher FDIC deposit insurance assessment and higher capital and liquidity requirements under Basel III. Partly due to these reforms, repo liabilities for U.S. banks have declined sharply. Banks' repo assets have also contracted, but they have not fallen as sharply. As a result, U.S. banks now are net providers of repo funding to nonbanks (see **Figure 3-11**).

Market-focused policies address a specific type of fire sale risk, the risk of a broader fire sale of assets by repo investors, who keep securities collateral after a dealer defaults (see Begalle and others, 2013). These include requirements on the quality of collateral in repo transactions and floors on haircuts to limit the buildup of leverage and mitigate potential losses in an event of a fire sale.

In October 2014, the Financial Stability Board (FSB) published a regulatory framework on minimum haircuts on securities-financing transactions that are not centrally cleared (see FSB, 2014c). The framework sets standards for haircut calculation methods, as well as minimum haircuts for some assets that are not government securities.

For some countries, the framework is a step forward. By raising the cost of short-term secured funding, haircut floors may encourage borrowers to extend the maturity of their liabilities. However, the FSB's haircut floors are below levels currently prevailing in the U.S. triparty repo market, which are published by the Federal Reserve Bank of New York on a monthly basis and used by many market participants to gauge their risk management practices.

Although not binding today, minimum haircuts could reduce procyclicality in haircuts during credit expansions. Under the FSB framework, market participants still would be expected to conduct their own analysis in setting haircuts, taking into account counterparty and collateral characteristics.

Large haircuts may be needed on assets where the collateral is illiquid or its price is volatile, but excessive haircuts could also exacerbate asset fire sales. This is because a holder of collateral subject to a large haircut could have little incentive to liquidate collateral in an orderly fashion. Instead, the large haircut allows the collateral holder to effectively pass losses incurred during an asset fire sale on to the pledging institution, an unfortunate incentive that could have negative systemic implications (see Duffie, 2014).

At a recent workshop on wholesale funding risks conducted by the Federal Reserve banks of New York and Boston, participants discussed the possibility of eliminating preferential treatment of repos backed by nongovernment securities in bankruptcy to help prevent collateral fire sales and limit spillovers to the broad market. However, possible unintended consequences may include a rapid contraction of the repo market and a reduction in the availability of credit. Domestic repo market participants also could have an incentive to migrate their repo funding overseas, where they would be able to access their collateral without having it delayed by a lengthy bankruptcy resolution process.

Addressing Risks in Securitization Markets

Today, because the vast majority of residential mortgage securitizations are originated by the government-sponsored housing enterprises (GSEs), risk in private residential mortgage securitizations is not a current financial stability issue. As housing markets recover, private securitization may revive and require careful assessment of potential risks to financial stability.

Flaws in the securitization process and loan underwriting standards, especially in mortgage lending, contributed to a buildup of risks in securitized products before the financial crisis. Reforms have sought to address investors' over-reliance on credit ratings of asset-backed securities and to improve disclosures by securitization issuers. But part of the problem may also have been that the issuers of securitized products lacked sufficient incentives to scrutinize the products they created (see FCIC, 2011; and FSOC, 2011). Risk retention rules mandated by the Dodd-Frank Act seek to correct this by requiring securities issuers to have "skin in the game" by retaining unhedged exposures equal to at least 5 percent of the value of the collateral underlying any issuance.

Regulators issued the final credit risk retention rule in October 2014 (see OCC and others, 2014b). For a number of types of securitizations (for example, collateralized loan obligations) this rule may help align banks' incentives as loan originators with those of investors in securitized products. In the case of residential mortgage-backed securities, the Dodd-Frank Act required regulators to define a qualified residential mortgage (QRM) as a loan with relatively low expected default risk that would be exempt from risk retention. In an earlier QRM definition proposed by regulators, a mortgage would not qualify for the exemption if, among other things, the loan-to-value (LTV) ratio was above 80 percent, the borrower was currently delinquent on other obligations, or the borrower had recently been seriously delinquent or bankrupt (see OCC and others, 2011).

In addition, the Dodd-Frank Act required that the definition of a QRM may be no broader than that for a qualified mortgage (QM), which is a standard set by the Consumer Financial Protection Bureau (CFPB) to provide a lender safe harbor from the borrower's-ability-to-repay requirement under the Truth in Lending Act. The final QM definition excludes the types of mortgage products with the worst performance during the crisis, such as interest-only loans, negative-amortization loans, and hybrid adjustable-rate mortgages underwritten with low initial "teaser" rates.

Under the final risk retention rule, the additional credit standards on LTV and borrower creditworthiness were removed, and QRM was defined as equal to the definition

Figure 3-12. Historical Mortgage Defaults by LTV and Credit Score

		Loan-to-Value Ratio							
		<40	40	50	60	70	80	90	100+
FICO Score	<580	22.2%	22.3%	24.8%	27.4%	32.7%	39.9%	46.2%	66.2%
	580	16.7%	19.9%	20.3%	26.4%	31.7%	42.9%	41.8%	59.3%
	590	17.6%	17.5%	20.3%	22.5%	28.5%	40.7%	40.1%	53.9%
	600	15.6%	19.9%	19.3%	23.6%	28.2%	39.2%	37.9%	45.9%
	610	15.3%	15.5%	18.8%	21.5%	28.0%	36.9%	34.2%	43.4%
	620	14.5%	17.6%	16.0%	20.8%	25.6%	34.5%	33.1%	38.8%
	630	9.9%	15.2%	19.1%	20.5%	24.4%	31.7%	31.6%	37.8%
	640	10.2%	12.2%	16.4%	18.2%	22.4%	29.5%	30.3%	32.1%
	650	11.9%	10.8%	13.3%	17.8%	20.8%	28.4%	29.2%	28.3%
	660	10.8%	11.7%	12.1%	15.3%	18.5%	26.3%	29.4%	29.8%
	670	6.6%	7.6%	10.9%	12.6%	17.1%	25.3%	27.7%	24.5%
	680	6.5%	5.2%	9.6%	12.2%	15.3%	23.6%	27.5%	23.2%
	690	5.5%	4.1%	5.5%	10.3%	14.1%	21.7%	26.7%	22.5%
	700	2.6%	4.2%	7.2%	9.6%	11.6%	18.8%	25.7%	18.9%
	710	6.4%	3.2%	5.7%	6.1%	10.7%	18.2%	24.9%	19.8%
	720	5.8%	3.5%	5.3%	7.2%	10.3%	16.3%	22.6%	19.2%
	730	3.2%	4.5%	3.3%	5.1%	9.2%	14.0%	24.8%	17.5%
	740	1.0%	2.2%	2.6%	4.3%	8.1%	11.4%	23.1%	13.6%
	750	1.1%	2.0%	1.9%	3.5%	5.2%	10.2%	18.3%	11.8%
	760	1.1%	1.0%	1.8%	2.3%	5.1%	8.3%	18.2%	14.0%
	770	0.2%	1.3%	1.3%	2.8%	4.6%	7.0%	18.5%	15.1%
	780	0.6%	0.2%	2.1%	2.0%	3.7%	6.0%	14.8%	12.1%
	790	0.2%	0.7%	0.9%	2.3%	2.7%	6.3%	15.2%	16.5%
	800+	1.4%	2.0%	2.1%	2.5%	4.2%	6.5%	12.2%	18.4%

Note: This sample consists of first-lien mortgages on single-family homes originated in the years 2003-06 and included in pools backing private-label mortgage-backed securities. Qualified mortgage (QM) eligibility is represented here by excluding interest-only and negative-amortization loans and including only full-documentation loans that fully amortize over a term of 360 or fewer months and have at origination a back-end debt-service-to-income ratio of 43 percent or less. Default is defined here as a loan being 90 or more days delinquent, written off, or sold in a foreclosure sale, real estate owned sale, or short sale. To be conservative in assumptions, loan-to-value (LTV) is defined as first-lien LTV, excluding pledged assets. Missing second-lien data in any case make comprehensive calculations difficult. LTV ratios and Fair Isaac Corporation, or FICO®, scores are rounded down; for example a 749 FICO® score is categorized here as a 740.

Source: CoreLogic, Inc.

of QM. Due to the QM's debt-to-income ratio test and product feature requirements, QM-qualifying mortgages should have lower expected default rates on average than non-QM loans. However, the QM rule is an ability-to-pay standard designed to protect consumers; it is not a broader credit risk standard designed to protect lenders or investors (see Cordray, 2013).

Historical default rates can provide some insight into the impact of setting the QRM standard equal to QM. Figure 3-12 shows default rates for securitized loans made before the crisis that roughly met the QM standard. The figure illustrates with historical data that LTV and borrower credit history (represented by Fair Isaac Corporation, or FICO®, scores) differentiate between high-quality and high-risk mortgage loans. The differences in default rates for loans with different LTV ratios and borrower credit scores can be dramatic. OFR calculations, which use more than half a million privately-securitized loans that met an approximation of the QM standard, show that loans originated before the crisis with LTVs over 80 percent and FICO scores below 640 defaulted during the crisis more than four times as often as loans that had LTVs less than 80 percent and FICO scores higher than 640. Under the final risk retention rule, future securitizations of loans similar to those in Figure 3-12 would all be exempt from risk retention, despite the wide variation in historical default rates.

Regulatory measures taken since the crisis will partly mitigate these concerns by helping to ensure that investors have sufficient information to evaluate securitizations. In particular, the QM rule included income documentation

requirements, and the SEC's Regulation AB II required loan-level disclosure requirements for registered public offerings of mortgage-backed securities. However, these loan-level disclosure requirements do not apply to non-public offerings to institutional investors, which comprise the bulk of non-GSE issuance.

Both theory and empirical evidence in the academic and policy literature support the notion that "risk retention, if properly structured, can address some of [the risks in securitization revealed in the crisis] by requiring an originator or securitizer to have ongoing exposure to the credit risk of the underlying assets" (see FSOC, 2011, p. 3). The risk retention rules have only recently been finalized and have not yet gone into effect, and private residential mortgage securitization activity is dormant, limiting the ability to evaluate the impact of the rules on securitization markets or on financial stability. However, in the event that this activity picks up, it will be important to monitor volumes, pricing, and the risk embedded in securitizations, especially for mortgages because of their importance in the capital markets. Looking across the chain of mortgage activity from origination to securitization, it will also be important to study the alignment of incentives for borrowers, investors, loan originators, and securitizers.

Regulators and the OFR will be monitoring whether or not a robust non-QM eligible market develops and what that implies for QRM. The rule requires the agencies to review the QRM definition within four years after it is implemented, and every five years thereafter. This could result in revisions to the rule if all six agencies responsible for the rule agreed that changes were needed.

If non-QM loans remain a small part of the market, the risk retention requirement will not apply for nearly all mortgages, including many that performed poorly during the crisis.

3.4 Structural Policies to Promote Resilience in Clearing Infrastructure

The Dodd-Frank Act mandated that over-the-counter derivative trading and clearing shift from an opaque and complex network of bilateral trading to organized trading platforms and centralized clearing mechanisms subject to supervision. As the industry adjusts to this new infrastructure, supervisors should monitor potential risk implications arising from the implementation of new regulatory requirements.

Over-the counter (OTC) derivatives can allow firms to manage economic and financial risk, but also may create risks for financial institutions and for financial stability in some cases. Firms are unable to observe the risk concentrations of their trading counterparties' derivatives positions and might not properly evaluate the risk a counterparty poses. Derivatives also allow entities to take on leveraged exposures. These risks were realized during the financial crisis, when counterparties to insurer AIG stood to lose billions of dollars had AIG failed to meet payments due on credit default swaps written by a subsidiary.

The Dodd Frank Act introduced key changes in the OTC derivatives market, including: (1) mandated central clearing through central counterparties (CCPs), (2) an organized trading platform, (3) required reporting to a trade repository, (4) new margin requirements for both cleared and uncleared swaps, and (5) heightened supervision and regulation of financial market infrastructures, such as CCPs the Council designates as systemically important.

The New Framework

Mandatory central clearing of swaps under the Dodd-Frank Act began in the U.S. when the CFTC implemented its rule for OTC derivatives under its jurisdiction (referred to as "swaps") in 2013. The CFTC initially mandated central clearing for a narrow range of interest rate derivatives and credit default swap index products for most market participants but will likely extend the clearing mandate to additional products. The SEC has regulatory authority over security-based swaps, which are defined as swaps based on a single security or loan, a narrow-based group or index of securities, or events relating to a single issuer or issuers of securities in a narrow-based security index. The timeline for an SEC final rule phasing in central clearing for security-based swaps is uncertain.

REDUCED COUNTERPARTY RISK THROUGH CENTRAL CLEARING

Before the Dodd-Frank Act, most derivatives in over-the-counter swap markets were bilaterally netted. Central clearing was standard primarily in exchange-traded derivatives markets, such as futures and options, but only occurred with certain interest rate swap and credit default swap products on a voluntary basis.

Bilateral markets create substantial risks that are complex to manage. Every dealer, for instance, interacts directly with every other counterparty (another dealer or client), incurring market risk on the open position and credit exposure to the counterparty. A single firm's failure could have systemic impacts if a large number of bilateral swaps form a complex, interlinked network of counterparties.

But in centrally cleared markets, central counterparties stand between the counterparties to every contract, becoming the buyer to every seller and seller to every buyer. The CCP guarantees settlement for both parties, so each is no longer exposed to the other's default. But central clearing is not a solution to the problem of a firm building up an excessive market risk concentration in derivatives, as occurred with AIG. Monitoring firms' derivative positions both within and across CCPs can help identify when a firm has developed a risk concentration.

The CCP nets or clears transactions between members on a multilateral basis, resulting in much smaller net exposure than bilateral netting. In bilateral netting, parties can only net transactions with the same counterparty. Despite its advantages over bilateral netting, the effectiveness of multilateral netting is still limited by lack of netting across different product lines and different CCPs. Eventually, cross-margining across CCPs may provide further opportunities for netting, but it will have to be supported with adequate margin, taking into account cross-product correlations to protect against risks of default.

ORGANIZED TRADING PLATFORM

To provide greater transparency and foster efficient markets, the Dodd Frank Act also created a new type of marketplace called a swap execution facility.

Through swap execution facilities, multiple participants have the ability to trade swaps by accepting bids and offers made by multiple participants via multilateral execution methods such as request-for-quote and central limit order book. The CFTC has temporarily registered 22 swap execution facilities since it introduced rules in October 2013. Under these rules, swaps mandated for central clearing, offered for trading on a swap execution facility, and determined to be appropriate for organized platform trading by the CFTC, must be traded through a swap execution facility.

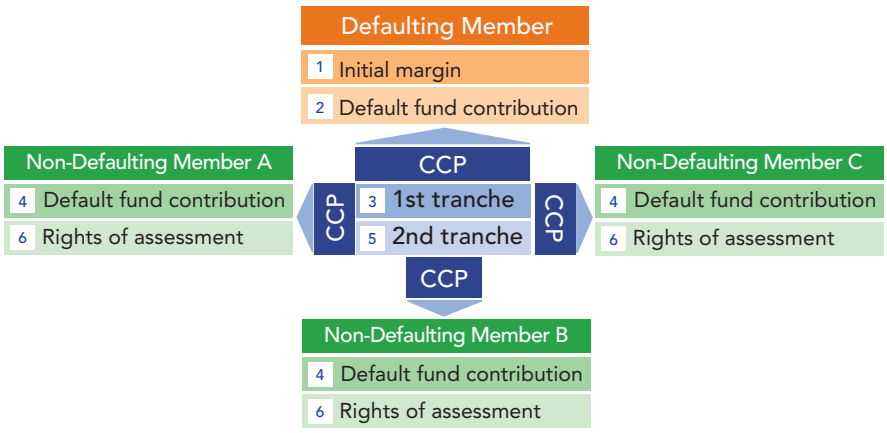
Swap execution facilities, central counterparties, and swap dealers are required to submit trade data to swap data repositories for access by regulators and the public (see **Chapter 6**).

ENHANCED MARGIN REQUIREMENTS

Margin requirements are an important part of the new regulatory framework. Under the Dodd-Frank Act, margin is required to be posted both for cleared and uncleared swaps. Specifically, the Dodd-Frank Act required central

Figure 3-13. Default Waterfalls in the Event of a Member Default

Default waterfalls are designed to strengthen CCP resilience, but they can transmit risk to nondefaulting members



Source: OFR analysis

counterparties to collect margin from clearing members to protect against potential price movements and member default. Similarly, the Dodd-Frank Act imposed margin requirements on uncleared swaps to reduce counterparty risk in those markets and promote use of standardized swaps that can be centrally cleared.

The CFTC and SEC have issued proposed rules for margin and capital requirements that would apply to swap entities not regulated by another regulator (see CFTC, 2014; SEC, 2012). In September 2014, the CFTC and banking regulators released revised proposed rules on margin requirements for swaps not centrally cleared (see CFTC, 2014; OCC and others, 2014a). The rules outline specific collateral eligible to be used to satisfy initial margin requirements and limit variation margin payments to cash. Under the proposed rules, a swap entity's transactions with nonfinancial firms, municipalities, or sovereigns do not require initial and variation margin; only those with financial firms do.

DEFAULT WATERFALL

In the event of a member default, central counterparties manage their obligations to each party to a swap by tapping a predetermined sequence of resources known as the default waterfall (see **Figure 3-13**). These waterfalls are broadly similar across CCPs, although the details vary.

Funds collected in advance from the defaulting party in the form of initial margin are the first to be drawn in the event of a default. The initial margin is used to offset losses for the CCP when it unwinds the swaps or auctions off the defaulting party's swaps to other members.

An optimal waterfall structure would balance the incentives for CCPs to manage their own risks and for clearing members to monitor the credit risk of their counterparties, even when transacting through a CCP.

Heightened Supervision and Regulation of Central Counterparties

The new central clearing system concentrates risks in a small number of large central counterparties, transforming the network to a hub-and-spoke system that can better manage a larger number of dealer failures but is highly vulnerable to the failure of a CCP that can transmit risk to all members. Because of that vulnerability, the Dodd-Frank Act authorized the Council to designate certain central clearing counterparties as systemically important financial market utilities, subject to heightened prudential supervision and regulation, including capital and liquidity requirements. To date, the Council has designated eight financial market utilities, five of which are CCPs. Two of these companies centrally clear OTC derivatives, ICE Clear Credit and the Chicago Mercantile Exchange. CCPs must register with the CFTC or the SEC or both, depending on the type of products they clear.

The Dodd-Frank Act required regulators to take into account relevant international standards when setting rules for designated CCPs. Subsequently, international standards were issued in April 2012 by a joint committee of global regulators as the Principles for Financial Market Infrastructures. The international standards were supplemented by consultative reports that focused on resolution and recovery issues specific to these companies (see CPSS-IOSCO, 2012b; CPSS-IOSCO, 2012c; CPSS-IOSCO, 2013). In November 2013, the CFTC issued a final rule establishing enhanced risk management standards for designated derivatives clearing organizations, consistent with those principles.

Banks and some bank regulators have called for more meaningful levels of capital at the CCP as an incentive to strengthen risk management, because there has been no proof of the ability to request additional funds from clearing members in the event of a member default. Banks and bank regulators have expressed concern that CCPs facing a member default can transmit large quantities of risk to CCP members that do not default. It is challenging for banks and bank supervisors, given available data, to determine the resiliency of CCPs, which is an issue relevant to monitoring and managing banks' CCP exposure (see Clearing House, 2012).

A critical benchmark in CCP risk management is the ability of the CCP to cover the default of its two largest counterparties, which is called the "cover 2" standard. A recent Bank of England working paper illustrated that where the risks are distributed more uniformly among clearing members, the cover 2 standard may not be sufficiently prudent (see Murphy and Nahai-Williamson, 2014).

Remaining Challenges

The transition to central counterparties has several unresolved issues important for financial stability. Most major dealers are subsidiaries of bank holding companies and also clearing members of multiple CCPs. Basel III encourages banks to use central clearing by assigning a relatively low

capital risk weight of 2 percent for swaps cleared through qualifying CCPs and a relatively high risk weight for bilaterally cleared swaps for counterparty risk (see CFTC, 2013).

Although central clearing reduces risks for clearing members, some bank regulators have expressed concerns about the concentration of counterparty credit risk and potential contagion risks, since the largest banks are members of multiple CCPs (see OCC, 2014a). Banks could face significant losses if a CCP experienced losses and transmitted them to clearing members. In addition, some U.S. banks are also members of foreign CCPs, where less may be known about risk management practices.

Additionally, margin requirements for swaps enhance financial stability by reducing counterparty risk, but they can increase liquidity demands on market participants. As prices fluctuate, a party to a swap subject to margining may need to quickly post additional cash or other high-quality collateral, which is known as "variation margin." CCPs themselves can also decide to increase margins for a specific firm or product, which could also be a source of liquidity demands. To guard against this risk, financial institutions and supervisors should analyze firms' ability to handle variation margin calls. A shock to initial or variation margin requirements could alter participants' willingness to enter into new derivative transactions and, in turn, affect derivative prices.

Margin requirements for CCPs vary across jurisdictions and countries, increasing the incentive for companies to move their trading to jurisdictions with weaker standards. Companies that are unable to meet strict margin requirements may decide to transact business through CCPs with weaker requirements, concentrating risk in those CCPs least able to bear the risk. Concentration may pose a financial stability risk in the event of a participant's failure. These issues highlight the need for continued coordination among domestic and international regulators as new CCPs are established.

Figure 3-14. Examples of Cyclical Macroprudential Policy Tools in Other Countries

Regulatory Policy	Countries	Impact
Reserve requirements	3 OECD 18 non-OECD including the BRIC group	Results are mixed.
Differentiated or time-varying capital requirements or risk weights	11 OECD 9 non-OECD	Some countries have sizeable slowdowns in credit growth rates, although this decline is often followed by a reversal to higher rates. Generally seen to improve banks' capital positions.
Liquidity requirements	4 OECD 5 non-OECD	Generally seen to have improved liquidity positions; not a clear impact on credit growth.
Dynamic or increased provisioning	3 OECD 9 non-OECD	Some countries have shown a limited effect on credit growth rates. Generally seen to improve banks' capital positions.
Limits on credit growth or new loans	5 OECD 11 non-OECD	Effects seen as muted, as lending shifted to foreign banks or less-regulated financial intermediaries.
Limits on loan-to-value ratios or debt-to-income ratios	11 OECD 10 non-OECD	Asian countries have curtailed real estate price appreciation and reduced defaults, although the evidence is less clear on these tools' ability to control leverage by households and banks. Evidence is limited in other countries where implementation is more recent.
Limits on exposures, credit concentrations, net open positions, or maturity mismatch	10 OECD 16 non-OECD	Direct impact on aggregate credit growth rate is difficult to detect, but positive effect on the resilience of financial institutions seems to exist. Circumvention problems have been reported, especially in the case of exposure or credit concentration limits.

OECD = Organisation for Economic Co-operation and Development
BRIC = Brazil, Russia, India, China
Source: Crowe and others (2011)

3.5 Policies to Address Cyclical Financial Excesses

Countercyclical macroprudential policy tools, or simply, cyclical policy tools, are designed to address potential cyclical excesses in credit growth, leverage, and maturity transformation or liquidity transformation. This section describes the countercyclical capital buffer, discusses how regulators could use existing policy levers to moderate a hypothetical residential housing boom, and analyzes the supervisory response to the current boom in leveraged lending.

Central banks may face difficult choices if they attempt to use monetary policy alone to achieve price and financial stability, because the two objectives may conflict. For example, when inflation is low, achieving price stability may require monetary policy settings that encourage excessive risk-taking and foster future financial instability. In addition, monetary policy affects credit provision across the economy and is too blunt an instrument to address excesses in specific credit markets (see Stein, 2013; Yellen, 2014).

In such circumstances, either policymakers must trade off current and future objectives or draw on additional tools to help. As noted in our 2013 annual report, effective policymaking requires at least as many tools as objectives. Cyclical macroprudential tools may be needed to limit credit booms or excessive risk-taking.

Many countries have experimented with cyclical macroprudential policies in recent years to address perceived excesses in specific sectors (see **Figure 3-14**). Studies have produced mixed results on the success of such policies. The effectiveness of cyclical macroprudential policy may be blunted as a result of its interaction with monetary policy (see Wang and Sun, 2013) and it may "leak" as financial activities shift to institutions and markets not directly affected (see Aiyar, Calomiris, and Wieladek, 2014; Ono and others, 2014; Bank of England, 2014).

Macroprudential policies are sometimes difficult to implement, because one of their purposes can be to restrict credit to less creditworthy borrowers. As with monetary policy, market participants may disagree with policymakers about potential long-term risks when asset prices are rising and credit risk seems low (see Fischer, 2014). Although the United States has a long history with such tools, it has not put in place a cyclical macroprudential policy regime since the financial crisis (see Elliott, Feldberg, and Lehnert, 2013).

Countercyclical Capital Buffer

So far, the only new cyclical tool the United States has introduced since the crisis is the countercyclical capital buffer for large and internationally active banks, part of the Basel III risk-based capital standard discussed in Section 3.2.

Under Basel III, bank regulators can require banks to hold an additional capital buffer up to 250 basis points of risk-weighted assets during booms to protect against losses and limit credit excesses in specific markets. The easing of a countercyclical capital buffer could, by contrast, boost lending and economic activity during a downturn.

Since 2010, at least 12 countries have implemented a version of the buffer and as many as 25 countries will likely have a rule implemented by the end of 2015. Several countries' regulators have taken first steps in determining not only the triggers, but also a timeframe. Three have activated it (see **International Experience with Countercyclical Capital Buffers**).

In 2013, the Federal Reserve and OCC implemented the buffer only for advanced approach banks and bank holding companies (see OCC and Board of Governors, 2013).

The countercyclical buffer also enhances banks' safety and soundness, but it is clearly a cyclical tool. For example, if the primary purpose of the buffer were to enhance safety and soundness, then all insured U.S. banks would be required to hold additional capital buffers during periods when supervisors determined risks of credit shocks could be high.

U.S. regulators have not announced specific metrics or thresholds that could trigger the activation of a countercyclical capital buffer. Under the final rule, regulators may activate the buffer based on a "range of macroeconomic, financial, and supervisory information indicating an increase in systemic risk" (see OCC and Board of Governors, 2013). Federal Reserve officials have mentioned the possibility of using the buffer to target overheating sectors, although the final rule did not specifically mention that (see Yellen, 2014).

An unresolved question is whether the countercyclical buffer would affect lending as intended. A recent Bank of England working paper found that microprudential changes in capital requirements do affect bank lending (see Bridges and others, 2014). The authors found that this

Three of the 25 countries that have made the countercyclical buffer part of their macroprudential toolkit have already activated it in response to perceived market excesses. Their experiences provide the first evidence about the potential for this cyclical macroprudential tool. In every case, policymakers said they were using the buffer primarily to promote bank resilience to a downturn, not to "pop" a credit "bubble."

SWITZERLAND

Switzerland was the first country to activate a countercyclical capital buffer under Basel III. Between 2008 and 2013, Swiss housing prices rose more than 35 percent and mortgage volumes increased by 23 percent. In February 2013, the Swiss National Bank said it would activate a countercyclical capital buffer of 100 basis points of risk-weighted assets — but only for exposures to residential mortgages.

The central bank gave banks nine months to comply with the higher capital requirement. Mortgage markets continued to boom and in January 2014, the Swiss National Bank raised the buffer to 200 basis points and gave banks five months to comply (see **Figure 3-15**).

NORWAY

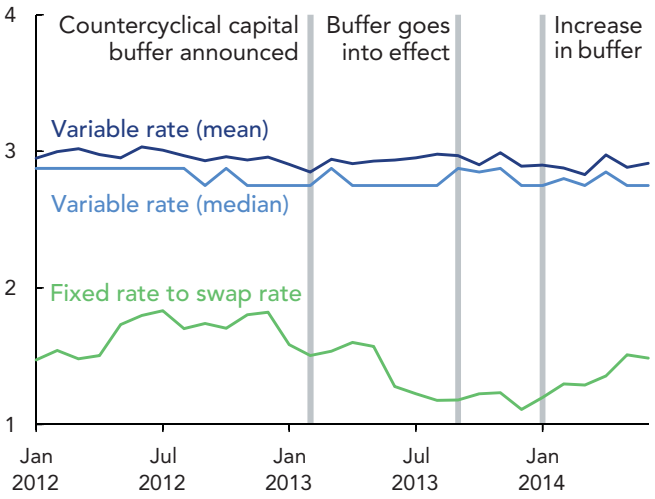
Norway's Ministry of Finance activated a countercyclical capital buffer of 100 basis points in December 2013 on the recommendation of the Norwegian central bank, responding to rapidly growing residential and commercial property prices and the rising ratio of private sector debt to gross domestic product (GDP) (see **Figure 3-16**). High private sector credit–to-GDP ratios are a concern for regulators, because high debt burden increase the likelihood of loan defaults. Banks have 18 months to adjust their balance sheets. Unlike in Switzerland, the Norwegians placed a capital surcharge on all types of bank loans, not just one sector. The ministry said it expected the buffer to help prepare banks for high future loan losses.

SWEDEN

After Sweden's Stability Council expressed concern about historically high household debt, the Swedish Financial Supervisory Authority (FSA) announced in May 2014 that it would activate a countercyclical capital buffer to address credit growth in the residential mortgage market. The FSA announced in September 2014 the buffer will be 100 basis points and take effect in summer 2015. The Swedish regulator also said it will increase the capital risk weight floor for Swedish mortgages from 15 percent to 25 percent.

Figure 3-15. Swiss Mortgage Rates (percent)

The first Swiss CCB activation had little effect on mortgage rates

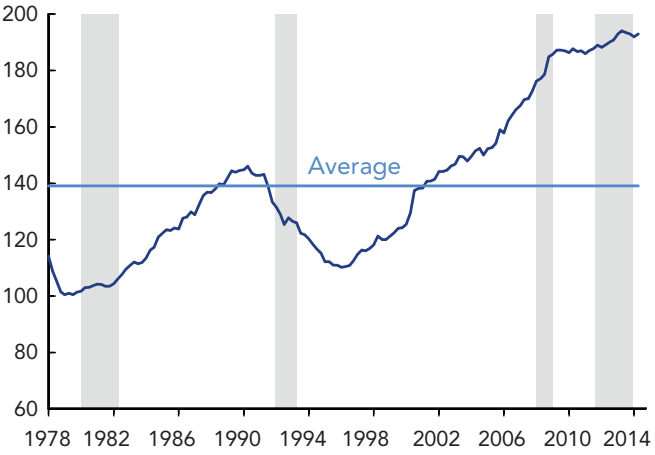


Note: The fixed rate is the 10-year fixed mortgage rate, and the swap rate is the 10-year Swiss swap rate.

Sources: Haver Analytics, Swiss National Bank

Figure 3-16. Norway Private Sector Debt to GDP (percent)

Norwegian private sector debt-to-GDP is high



Note: Gray bars signify recessions in Norway.

Sources: Center for Economic Policy Research, NorgesBank

response varied based on the lending sector, with secured household loans decreasing relatively less and commercial real estate loans decreasing more.

Another question is whether nonbanks not affected by the capital buffer requirement could merely serve as alternative sources of credit to overheating sectors. Basten and Koch (2014) did not find evidence of macroprudential policy leakage after the activation of the buffer in Switzerland — banks subject to the buffer raised mortgage rates, but insurance companies unaffected by the regulation raised mortgage rates by an even greater amount. OFR will continue to study other countries' experiences with the countercyclical capital buffer and other cyclical macroprudential policy tools.

Cyclical Macroprudential Policy in Housing

How would the United States respond to another housing boom? None of the cyclical tools described in Figure 3-14 have been adopted in the United States. The creation of a new policy tool could take a long time if a rulemaking were needed. In theory, in the face of unexpected housing market excesses, it might be easier for regulators to vary existing fees to change the incentives of market participants and influence the rate of credit growth.

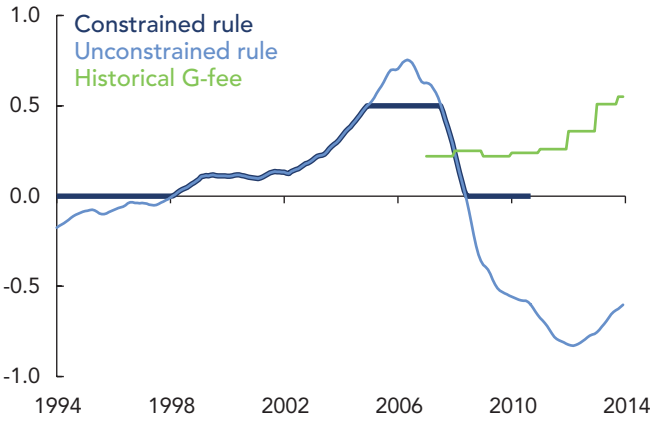
This section focuses on two existing tools that could be used this way in the United States: (1) the assessment rates that FDIC-insured banks pay for deposit insurance; and (2) the guarantee fees the GSEs charge lenders to guarantee loans, currently set by the FHFA. In both cases, policymakers could adjust the pricing of guarantees to influence borrowing costs in the housing market. This discussion is hypothetical and the results of OFR researchers' analysis it is based on are preliminary.

For example, the FDIC could increase the weights of housing-related assets in its deposit insurance assessments in response to signs of housing market excess. Facing higher weights, banks would have an incentive to reduce their exposure to housing credit or face higher assessments. Although the FDIC already varies these risk weights across assets, this approach would allow the FDIC to also vary them cyclically.

Similarly, the FHFA could adjust guarantee fees, called G-fees, in response to financial conditions. A key advantage of using G-fees is that the impact on mortgage prices would be relatively transparent, because an increase in

Figure 3-17. Proposed and Historical G-Fees (percent)

Both alternative countercyclical G-fee rules would suggest current G-fees are too high



Sources: Federal Housing Finance Agency, OFR analysis

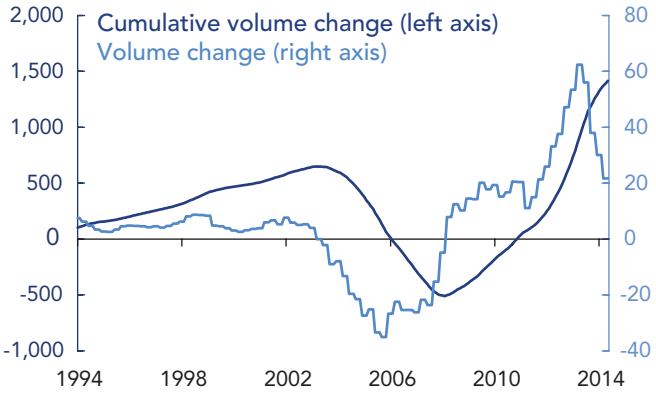
borrowing costs can have a direct and material effect on borrowing. Studies have shown that an increase of just 1 percent in interest rates — in other words, a 4 basis point increase based on current rates of about 4 percent — would reduce loan demand by roughly 2.5 percent (see Gross and Souleles, 2002; Čihák, Iossifov, and Shanghavi, 2008). This relationship suggests a 25 basis point reduction in G-fees would result in a 15 percent increase in lending at current mortgage rates, assuming G-fees changes fully pass through to interest rates. Green (2013) estimates that for every basis point increase in G-fees, mortgages rates increase by 2.5 basis points, in which case the effects would be even larger.

A forthcoming OFR paper develops a housing conditions index and proposes a policy rule for setting G-fees to implement countercyclical macroprudential housing policy. The index, which combines a large number of housing data series, is normalized to a value of 100 in March 2003, when housing finance conditions were relatively stable and healthy.

OFR staff members calculated how countercyclical changes to G-fees might have been adjusted historically to achieve conditions similar to those in 2003 in housing finance. For example, in the early 1990s, this countercyclical rule suggests the G-fee could have been lower to stimulate housing finance. But in the mid-2000s, countercyclical G-fees should have been significantly higher to offset excessively easy credit conditions in housing. To illustrate, the middle line (in dark blue) in Figure 3-17 depicts this proposed method, and the line to the upper right (in green) reflects G-fees from 2007 to 2013. The difference in G-fees between the

Figure 3-18. Estimated Effects of the Proposed G-Fee Policy Rule ($ billions)

The proposed G-fee policy could reduce the boom-bust cycle in housing credit



Sources: Federal Housing Finance Agency, Freddie Mac, Mortgage Bankers Association, OFR analysis

> ...a 25 basis point reduction in G-fees would result in a 15 percent increase in lending at current mortgage rates...

historical and proposed policies is roughly 25 to 50 basis points over this timeframe.

EFFECTS

OFR staff estimate that this method would have increased lending by $640 billion between 1992 and 2003. After that, as the market heated up, lending would have been $1.1 trillion lower through the middle of 2008. Since then, the method would have stimulated $1.8 trillion in additional borrowing to assist in the recovery. This would have represented a substantial increase relative to the current total outstanding conforming mortgages of about $5 trillion (see Board of Governors, 2014).

Figure 3-18 presents estimates of the results of following a G-fee countercyclical policy on conforming loan issuance. The lower line (light blue) reflects monthly estimates of the changes in loans. The upper line (in dark blue) reflects estimates of the cumulative effects of following such a policy.

Based on this analysis, the current policy of raising G-fees to invigorate private mortgage markets appears to lessen housing credit. Specifically, the 10 basis point increase mandated in the Temporary Payroll Tax Cut Continuation Act of 2011 appears to have reduced mortgage demand by about 6 percent. Because G-fees were already 6 basis points higher in 2011 than 2007, reducing G-fees back to 2007 levels could have increased mortgage demand by about 9 percent.

The total effect of varying the weights of risk factors in FDIC assessment rates could be much greater than varying G-fees. G-fees affect only new mortgages, but FDIC assessment rates are levied on banks' total balance sheets, including all new and existing holdings. However, the G-fee method is more targeted on new housing credit and would also apply to nonbank mortgages sold to the GSEs. For that reason, it is likely to have fewer unintended consequences.

Responses to Leveraged Lending

Banking regulatory agencies that are members of the Council have launched a coordinated response to identified excesses in leveraged lending, which is lending to corporations that already carry considerable debt. The response includes updated, more aggressive supervisory guidance and escalating actions to curtail risk-taking by banks. Concern centers on the deteriorating credit profiles of borrowers and the capital and liquidity implications for banks if a sudden stop in the leveraged lending market forced banks to hold the leveraged loans they originated to distribute.

Although bank regulators have taken action, a significant amount of this risk continues to migrate to asset management products, such as high-yield bond funds, exchange-traded funds, hedge funds and other private funds, and collateralized loan obligations (CLOs). Regulators have limited ability to stop this migration and there is no consensus that they should. The new risk retention rules for securitizations could dampen CLO origination activity. Still, the growing role of asset management products in funding leveraged lending adds urgency to discussions about structural vulnerabilities, such as redemption, fire sale, and maturity transformation risks in credit funds, and whether and to what extent they can contribute to financial stability risks.

SUPERVISORY ACTIONS

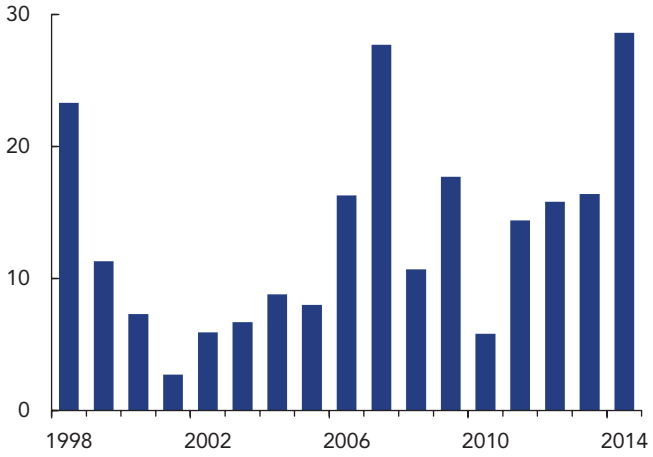
The Federal Reserve, FDIC, and OCC issued updated guidance in March 2013 to banks and bank holding companies intended to reduce risk in leveraged loans, both for those retained on banks' balance sheets as well as those repackaged for sale to other parties (see Board of Governors, FDIC, and OCC, 2013). The guidance recommended banks follow heightened risk management when the borrower's debt exceeds six times its earnings before deducting interest expenses, taxes, depreciation, and amortization, commonly referred to as EBITDA.

Unlike the agencies' previous leveraged lending guidance in 2001, the inclusion of the EBITDA ratio in the 2013 guidance introduced a specific risk metric that would raise supervisory concerns. The guidance also recommended risk management measures, such as periodic stress tests conducted by banks on their leveraged loan portfolios, and noted systemic concerns when banks sell leveraged loans to other banks or asset managers. The guidance noted that "a poorly underwritten leveraged loan that is pooled with other loans or is participated with other institutions may generate risks for the financial system" (see Board of Governors, FDIC, and OCC, 2013).

The guidance does not appear to have curbed banks' risk-taking in this sector. Underwriting standards have continued to deteriorate and the volume of leveraged loans has risen. Before the guidance was issued, new large corporate loans with leverage higher than six times EBITDA accounted for about 15 percent of total issuance. So far in 2014, new loans with higher leverage have made up one-third of corporate bank loans (see **Figure 3-19**).

Figure 3-19. New Leveraged Loan Deals with Total Leverage Greater than 6 Percent (percent)

Leveraged loans above the supervisory metric are rising



Note: Includes large corporate transactions, which are defined as issuers with earnings before interest, taxes, depreciation, and amortization (EBITDA) greater than $50 million. Data for 2014 are through June 20, 2014.

Source: Standard & Poor's

The results of the Shared National Credit program, an annual interagency review of large syndicated corporate loans, showed gaps between industry practices and expectations in the 2013 guidance.

Supervisors have followed up the 2013 guidance with supervisory actions at individual institutions and more frequent and intensive reviews of leveraged lending activities at the largest banks. The results of the Shared National Credit program, an annual interagency review of large syndicated corporate loans, showed gaps between industry practices and the expectations articulated in the 2013 guidance (see Board of Governors, FDIC, and OCC, 2014). Thirty-one percent of leveraged transactions originated within the past year exhibited structures that were cited as weak, up from 24 percent last year and 13 percent five years ago. The three bank regulators also released a frequently asked questions document in early November to clarify how banks should interpret the 2013 guidance.

NONBANK ACTIVITIES

Asset managers are purchasing an increasing share of leveraged loans on behalf of investors in hedge funds, high-yield bond mutual funds, and collateralized loan obligations. Many banks reduced their holdings of CLO securities after regulators announced the final rule in December 2013 implementing the Volcker Rule, which restricts proprietary trading by banks and limits their role in private funds.

In an example of risk migration, as banks stepped away, asset managers and pension funds stepped in. One result of this movement is a decline in the ability of regulators to address reaching for yield and herding behavior. There is debate about whether and how best to influence investment behaviors, particularly whether policy guidance to banks is more effective than measures aimed at addressing structural vulnerabilities in asset management products.

Increasing investment in corporate bond funds — more than $1 trillion by retail investors since 2009 — may pose a threat to financial stability, because investors expect liquidity within one day, even though it might take fund managers longer to liquidate assets.

One way to counter this threat is to impose withdrawal fees on certain types of funds to discourage sudden mass redemptions, or runs, by investors. Officials at the Federal Reserve discussed this possibility earlier this year. Former Federal Reserve Governor Jeremy C. Stein noted that corporate bond funds are "bank like" because their assets are illiquid but they offer investors the same quick redemption as a typical mutual fund (see Braithwaite and others, 2014). The liquidity mismatch would be particularly worrisome during a crisis. The SEC has jurisdiction to decide whether to require withdrawal or exit fees. In reviewing such policies, it would have to consider the cost to retail investors.

Meanwhile, the final risk retention rule, issued in October 2014, required that unhedged exposures of at least 5 percent be held by the CLO manager or the lead arranger of the underlying loans. Because the rule could mean banks have to retain some economic exposure, it may moderate banks' leveraged lending originations and temper credit excesses in this sector.

RESEARCH ON FINANCIAL STABILITY

4

This chapter highlights the OFR's research, which aims to create a solid foundation for our financial stability policy analysis and monitoring work. The chapter summarizes the range of research we published in the past year, including a new series introduced in 2014.

4.1 Fundamental Research Agenda

The OFR's fundamental research agenda supports our mandate to: (1) develop financial stability metrics, (2) assess the causes and consequences of financial instability, (3) evaluate policies related to financial stability and risk management practices, and (4) improve the quality and scope of financial data.

Chapter 4 focuses on three multiyear research projects. The first uses agent-based models to understand contagion in financial networks, which will help analyze how shocks can be transmitted across the financial system. The second project investigates visualization techniques to support financial stability monitoring, and the third analyzes risks in credit markets using credit default swap data.

A final section summarizes our 2014 research agenda and discusses research published since our last annual report. It also describes one new research product we introduced in 2014, OFR Staff Discussion Papers, and another product forthcoming, OFR Briefs. OFR Briefs are designed to reach a broad audience. OFR Staff Discussion Papers are a venue for OFR staff members to produce academic papers that contribute to our understanding of financial markets, financial data, and financial institution risks — topics that are the building blocks of financial stability analysis.

This chapter focuses on three research products: agent-based models to understand contagion; visualization techniques; and using credit default swap data to analyze credit market risk.

Our fundamental research activities focus on the following four areas:

1. **Developing tools and metrics to support our monitoring and analysis of the financial system.** Our fundamental research supports our financial stability monitoring activities, described in Chapter 2. Research projects include: (1) the preliminary Financial Stress Index, (2) a project to contribute to the understanding of market liquidity, and (3) the visualization project described in Section 4.3.
2. **Assessing the causes and consequences of financial instability.** Projects include: (1) network analysis that explains how financial contagion can spread through the financial system, (2) mapping projects that describe the funding durability of broker-dealers (see Aguiar, Bookstaber, and Wipf, 2014) and the movement of funds through the shadow banking system (see Pozsar, 2014), and (3) the agent-based modeling project described in Section 4.2.
3. **Analyzing policies related to financial stability and risk management practices.** Our fundamental research supports our analysis of macroprudential policy, described in Chapter 3. Research projects include: (1) a program to promote a macroprudential approach to stress testing

(see Bookstaber and others, 2014), (2) research to analyze the design and implementation of regulatory policy (see Glasserman and Kang, 2014), and (3) an assessment of the historical use and effectiveness of macroprudential policy in the United States (see Elliott, Feldberg, and Lehnert, 2013).

4. **Identifying and filling gaps in data for financial stability analysis and helping to ensure data are usable to support assessment and monitoring of threats to financial stability.** Our fundamental research also supports our efforts to address data gaps and promote financial data standards, described in chapters 5 and 6. Recent projects include: (1) analyzing the costs and benefits of standard identifiers — for example, see McCormick and Calahan (2013), highlighting the need for a unique mortgage identifier and describing how it would improve aggregation, comparability, and analysis in the mortgage industry, while protecting individual privacy, and (2) analyzing new datasets and assessing their use for financial stability analysis, such as the derivatives data described in Section 4.4.

4.2 Agent-Based Models

Financial crises involve chains of complex events, with multiple transmission channels across diverse market participants. They often include widespread losses, sharp declines in asset prices and liquidity, a rapid loss in market confidence, breakdowns in financial services, and consequent disruption of economic activity. However, every crisis is different because financial instruments and institutions change and vulnerabilities evolve. These changes make predicting and managing financial crises extraordinarily difficult. The OFR is using agent-based models as a means of addressing such changes to explore the dynamics and key transmission channels of financial crises. Such modeling helps us take an overall view of the dynamic interactions of agents in the financial system by considering the different roles each agent plays.

Stress tests are valuable for identifying potential vulnerabilities of individual institutions to the impacts of financial crises, at least as currently employed. But today's stress testing methodology doesn't reveal financial crisis dynamics and feedback effects.

Agent-based models (ABMs) have the potential to complement supervisory stress testing and address these issues. ABMs follow the dynamics of agents (market participants), assessing their reactions to events period-by-period and updating system variables accordingly. Unlike in typical economic analysis, agents' reactions in ABMs can be based on heuristics, or rules of thumb, rather than on calculations designed to maximize their own utility.

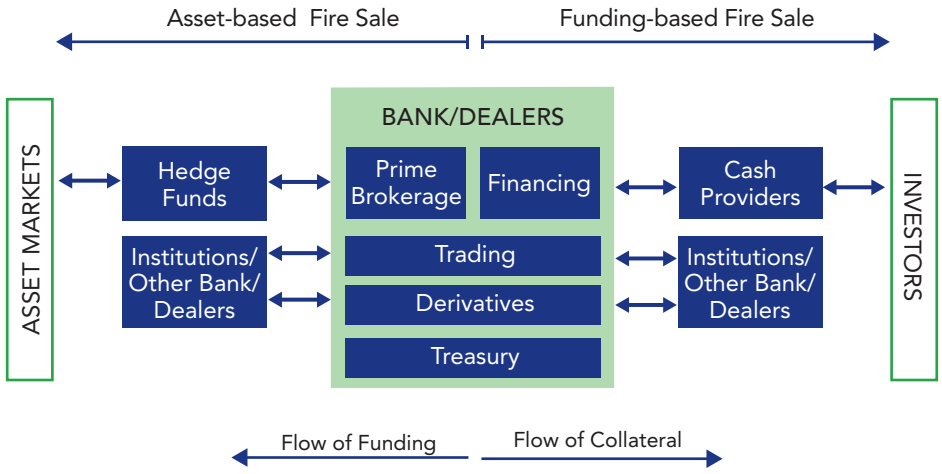
A key OFR initiative employs agent-based models to assess vulnerabilities in the financial system and resilience of the system as a whole. Parts of the project include developing models to: (1) study fire sales, (2) measure the market impact of large liquidity events, and (3) assess how the configuration of a financial network can affect financial stability.

These three related parts of the project illustrate ways to assess the resilience of the financial system by looking at its components and the transmission and amplification of shocks among them. For example, if an agent (such as a broker-dealer) experiences losses that affect its capital, it may be forced to sell assets quickly, potentially causing a fire sale. If those sales are large enough, they could have an impact on the availability of liquid assets, resulting in a large liquidity event, and the drop in liquidity could spread to other agents linked directly or indirectly through the market network. These dynamics might then lead to more losses and price drops, creating a feedback loop that worsens the impact on financial stability.

Scientists have been using ABMs for more than a decade to explain how the behaviors of individual agents can affect complex phenomena such as traffic jams and the spread of epidemics. But the use of ABMs is relatively new in finance and economics. An early OFR working paper discussed the use of agent-based modeling to assess financial vulnerabilities (see Bookstaber, 2012). Academics have proposed broader use of ABMs in financial and economic modeling (see Farmer and others, 2012) and described the potential advantages of ABMs compared to standard economic models that attempt to show what conditions lead to market balance (see Farmer and Geanakoplos, 2009).

Agent-based models are at the core of several European initiatives for evaluating crisis risk, most prominently the Complexity Research Initiative for Systemic Instabilities, or CRISIS, a consortium of universities and policymakers sponsored by the European Commission.

Figure 4-1. Model Relationship Diagram



Source: OFR analysis

Assessing the Dynamics of Fire Sales

Agent-based modeling was the subject of an OFR working paper released in July 2014 (see Bookstaber, Paddrik, and Tivnan, 2014), which focused on three types of agents operating in asset and funding markets:

1. Cash providers that act as funding sources by pooling investors' assets;
2. Banks and dealers (bank/dealers) that provide funding to hedge funds and other bank/dealers and participate in asset markets through several subagents, such as the prime brokerage and the finance desk; and
3. Hedge funds and other asset managers that participate in asset markets and may require funding.

Figure 4-1 shows the components of the bank/dealer and its links to borrowers and lenders. The figure is a simplified version of the funding map presented in a recent OFR working paper (see Aguiar, Bookstaber, and Wipf, 2014).

Figure 4-1 depicts the connections among a bank/dealer, hedge funds, and cash providers. In reality, the network is much broader. A complete picture would require a larger number of each type of agent.

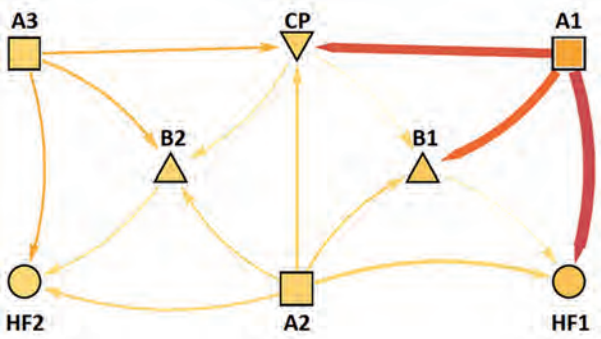
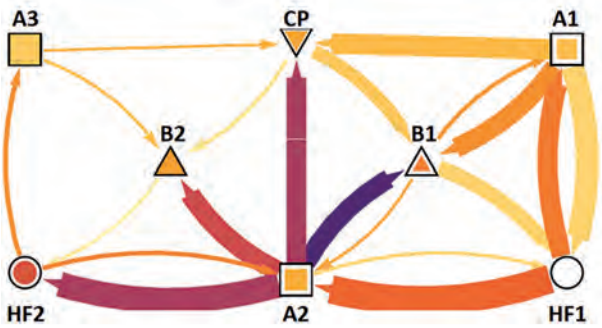
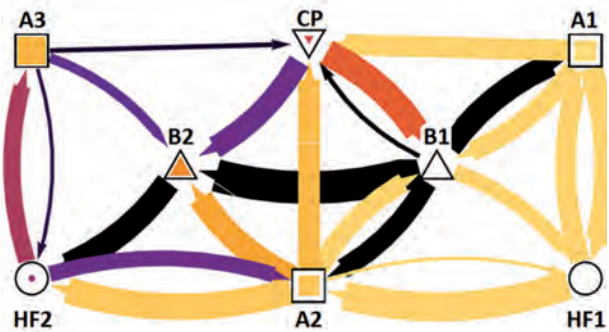
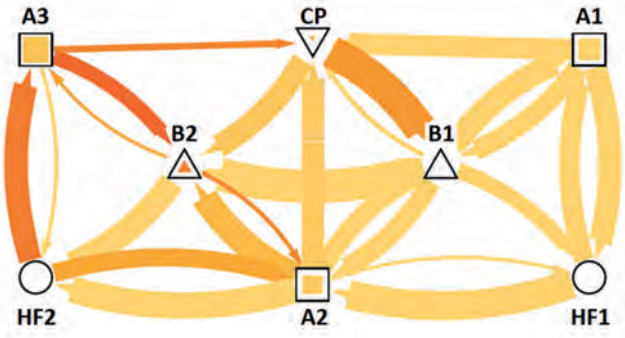
As funding, collateral, and securities flow through the system, they are not simply shuffled from one institution to another — the institutions take the flows and transform them in various ways. For example, credit quality changes as funding moves from the cash providers through prime brokers to the hedge funds. Some assets, such as mortgages, are structured into more targeted debt instruments. Market making (the service of matching buyers and sellers) enhances liquidity.

Example of the Fire Sale Model

Figure 4-2 shows the progression of one simulation of the agent-based model over time. The simulation is based on 1,000 runs of the model. The figure shows a simplified setup with two bank/dealers, two hedge funds, three types of assets, and one cash provider (denoted in the figure as CP). In Figure 4-2, Bank/Dealer 1 (B1) and Hedge Fund 1 (HF1) hold equal weights in Asset 1 (A1) and Asset 2 (A2) and Bank/Dealer 2 (B2) and Hedge Fund 2 (HF2) hold equal weights in Asset 2 (A2) and Asset 3 (A3).

In the agent-based modeling of these relationships, the network structure changes period-by-period as the agents' actions change the environment and the agents adapt accordingly. In the progression, the dark outline for each of the nodes shows the agents' relative size through the course of the scenario. The shrinking of the solid area within the node is proportionate to the decline in capital in the case of the hedge funds and bank/dealers, the reduction in funding in the case of the cash provider, and the drop in prices in the case of the assets. If the node is empty, then that agent has defaulted. Similarly, the width of the edge shows the cumulative effect of transmission from one node to another. For example, as the selling of HF1 leads to more and more of a decline in the price of A1, the thickness of

Figure 4-2. Network Shock Propagation

Description	Network Graph of Three Assets, Two Hedge Funds, Two Bank/Dealers, and One Cash Provider
Period 0 Asset 1's (A1's) price declines sharply. Because Bank/Dealer 1 (B1) and Hedge Fund 1 (HF1) hold A1, they face losses due to the shock. The Cash Provider (CP) is also affected because the value of collateral declines. In a static stress test, the analysis ends at this point.	
Period 2 B1 and HF1 must sell assets to cover losses on A1. They sell A1 and A2, causing a drop in the price of A2. This in turn affects other agents with holdings in A2, in particular, B2 and HF2. CP1 is affected because it holds collateral in A2 as well as in A1.	
Period 4 The propagation from the shock leads to a default of HF1 and B1. Credit exposure that B2 has to B1 spreads problems through the credit channel. The drop in A2 affects HF2, and its forced sale spreads the shock to A3. Note that no firms holding A3 also hold the asset that was originally shocked, A1, but they have losses because of contagion. CP markedly reduces its funding due to the drop in the value of its collateral.	
Period 6 The system finally settles down with funding all but shut off, and both hedge funds and B1 in default. A2 ultimately has a greater price drop than A1, the shocked asset.	

A1 = Asset 1
A2 = Asset 2
A3 = Asset 3
B1 = Bank/Dealer 1
B2 = Bank/Dealer 2
CP = Cash Provider
HF1 = Hedge Fund 1
HF2 = Hedge Fund 2

Source: OFR analysis

the edge will increase. The color of the edge in the figure shows the intensity of the interaction in the current period — a darker color means greater intensity or change in the system relative to other runs and periods.

Stress tests have become a standard tool in the macroprudential toolkit, but they do not address the follow-up effects of a stress event — that is, how the losses incurred by the individual banks might feed through the financial system in the face of forced selling and withdrawn liquidity. The ABM fire sale model extends stress testing by analyzing the pathways for the initial stress to spread through the financial system. Network diagrams such as Figure 4-2 visualize the severity and the sequencing of this dynamic. The model is designed to be applied to a wide range of stress scenarios. The triggering event in the figure is a price shock, but the model also allows for shocks based on a reduction in funding by the cash provider, a drop in the creditworthiness of the bank/dealer, or a sudden increase in redemptions by the hedge fund clients.

Measuring the Market Impact of Large Liquidity Shocks

The OFR is also using ABMs to gauge the market impact of large asset liquidations. Academic research and risk monitoring often focus on analyzing the day-to-day functioning of market microstructure and related liquidity measures, such as bid-offer spread and daily volume. But these analyses yield limited insights into the market effects of large-scale liquidations. During periods of sudden, outsized liquidity demand, normally sufficient liquidity suppliers may be overwhelmed. Deep pockets of liquidity beyond the short-term suppliers may be slow to respond and might even head to the sidelines after sudden, large price drops.

Two recent OFR working papers used ABMs to help measure the market impact of large asset liquidations that occur during forced selling and financial crises. One paper demonstrated the application of ABMs in a market with an electronic order book. Using actual order flow data with user identifications provided by the CFTC, the authors analyzed the stability of the order book after sharp price changes. They examined the trade-offs of different levels of microstructure data and the ability to predict sudden price changes (see Paddrik and others, 2014a).

A second working paper focused on an aspect of market behavior first discussed in Duffie (2010) — the market impact when liquidity suppliers are slower in responding to market signals than those who are demanding liquidity (see Bookstaber, Foley, and Tivnan, forthcoming). We also used the fire sale model to analyze how important it is that investors have different decision cycles — in other words, a hedge fund manager may make many buy and sell orders in the course of a few minutes, while a pension fund manager may take days or weeks to adjust positions.

Evaluating the Stability of Financial Networks

The role of financial interconnections among market participants in the 2008 crisis has prompted a surge in network-related financial system research. Network depictions can give a startling visualization of the magnitude of interrelationships. But one problem with the network approach is that it does not capture the dynamics of how the nodes transform the flows, how the flows carry risk from one node to another, and how the nodes in turn change the structure of the network.

A financial network is dynamic. Although a snapshot at any point in time can give a sense of a network's current stability, what matters is how the network evolves. Interconnections can diversify risk, but can also be pathways for shocks. The common-sense view that diversification reduces risk may be correct when failures are infrequent, but there may be a tipping point. If failures move above some threshold, a highly interconnected and diversified system may actually be a more fragile system (see Acemoglu, Ozdaglar, and Tahbaz-Salehi, forthcoming).

We are using ABMs in our research to follow the evolution of financial networks over time and assess the resilience of those networks to shocks. ABMs work well because each period of an ABM simulation depicts a network, which can change as each agent's actions affect the network environment.

In one working paper, we looked at how various agents — the nodes of a network — react to changes in the network (see Bookstaber and Monin, forthcoming). The agents collect data from other agents and those data improve their success. However, relying on connections to other agents reduces resilience if an agent drops out of the network. The result is
a system that can generate boom-bust cycles. As agents create a broader network, it becomes increasingly successful over time but then suffers a greater loss when a shock causes some connections to fail. The paper looked at the

characteristics that mitigate the cycles and evaluated metrics to assess the stability of the financial system.

In another forthcoming paper, we apply techniques used by chemical plant managers to the assessment of risks in the financial system (see Bookstaber and others, forthcoming). Process hazard analysis (the standard risk assessment tool in the chemical engineering industry) can help identify loops of interactions within the financial system that might be subject to positive feedback and instability. From a systemic risk standpoint, the network characteristics and stability concerns are surprisingly similar. The plumbing of a chemical plant allows flows in and out between processes that transform inflows into outflows, often based on complex, nonlinear interactions — in other words, the output is difficult to predict because it is not proportional to the input. Although the processes of the financial system are different from those of a chemical plant (maturity, liquidity, and credit transformations, for example), the complexity of interconnections and the potential for propagation due to leverage and liquidity lead to striking similarities from the standpoint of risk control.

To assess vulnerabilities, we have to consider the financial system as a wide and varied set of agents, each acting according to its own objectives and interacting in an environment that changes largely because of the agents' actions. Individual agents can act prudently, only to have the combined effect of their actions cascade to create instability for the system as a whole. The system can manifest stability during typical day-to-day levels of risk only to careen out of control when a shock reaches some critical threshold. Because agent-based modeling has the ability to incorporate the behavior of varied, dynamic, and interacting agents, it is well-suited for assessing these vulnerabilities.

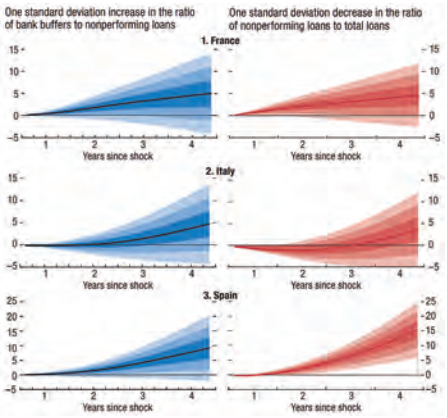
4.3 Visual Tools for Understanding Financial Stability

Financial stability analysts face a daunting challenge to make sense of a seemingly infinite stream of data. The OFR is experimenting with visualization techniques to reveal trends and relationships in data and transform massive raw data streams into useful information for analysis. The recent crisis demonstrated that need.

Good visualizations reveal key patterns and connections in complex data. Typically, visual attributes such as distances, areas, and color intensities correspond to attributes of the data. However, poorly crafted visualizations can be

Figure 4-3. Examples of Financial Data Visualizations

Small-multiple Layouts

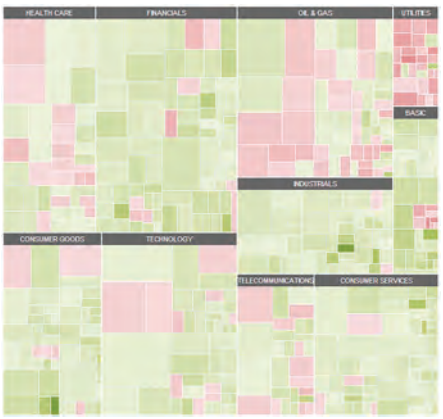


Source: IMF (2014b)

Repeated variations of similar plots differing in isolated ways, with the small plots organized into a larger grid for easy comparison

Other example: Schreck and others (2007 and 2009)

Tree Maps



Source: MarketWatch (2014)

Hierarchical data, shown as nested rectangles, with color, size, and category representing key data attributes

Other examples: Rank and Filed (2014); Merino and others (2006); Jungmeister and Turo (1992)

Radial Plots

Source: Lei and Zhang (2011)

Data depicted in polar coordinates or a circular arrangement, often to accommodate data points by placing densely populated clusters of observations near the exterior of the circle

Other examples: Wu and Phillips (2010); Sawant (2009)

confusing, distracting, and even misleading (see Lemieux, Fisher, and Dang, 2013; Sarlin, 2013; and Sarlin, 2014). Researchers and graphics experts at the OFR are exploring whether innovative visualizations can improve on the standard bar charts and time-series plots that tend to dominate presentations of financial data.

Choose the Right Tool

Visualization encompasses a range of techniques with varying strengths and weaknesses. Choosing the right tool for the task is important (for an overview of approaches, see Plaisant, 2004; and Munzner, 2009).

Selecting an appropriate graphic should include:

- **Identifying the task.** Who will see the visualization and what tasks are they performing?
- **Selecting the data.** Which particular data should the visualization depict to support the task?
- **Choosing visual forms.** How should the visualization render or represent the data?

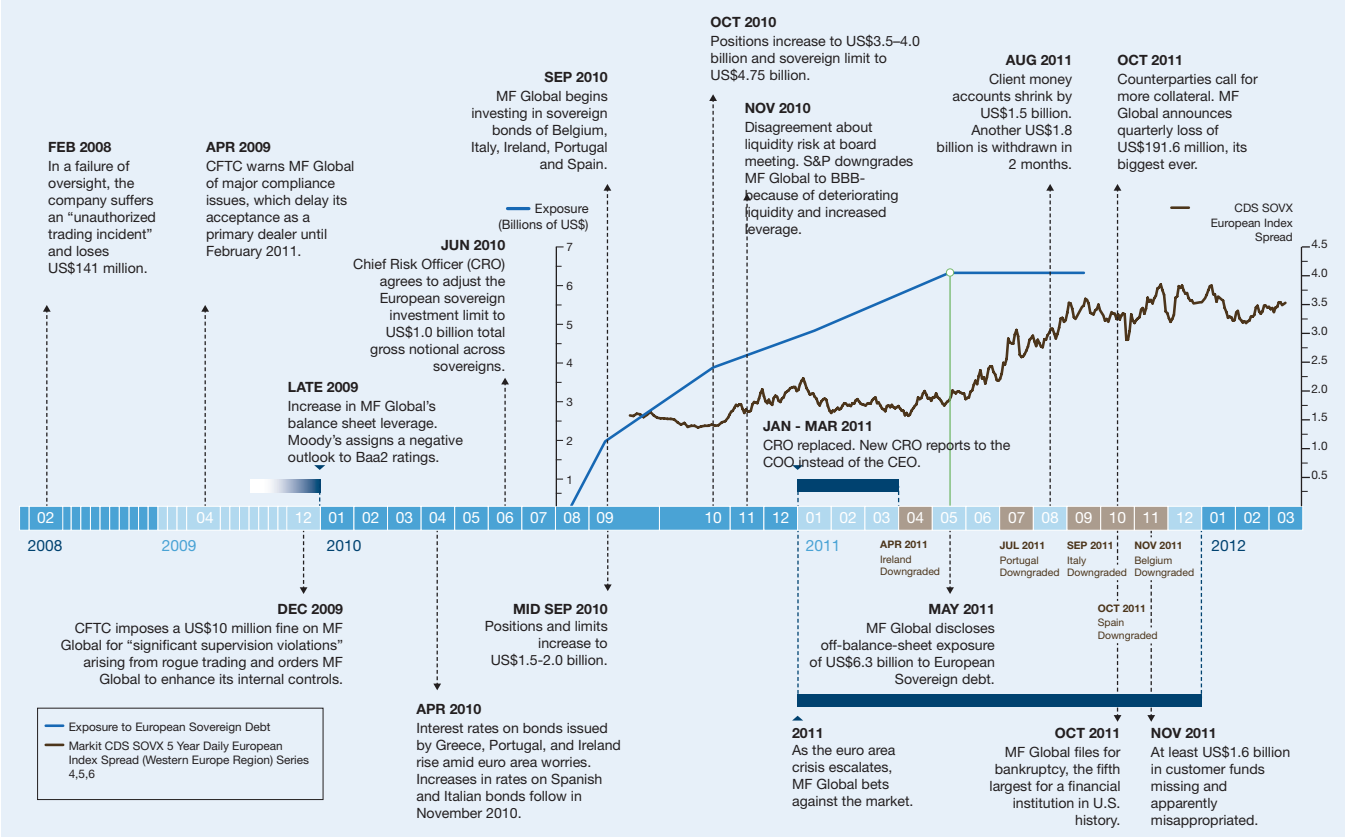
Each of these considerations can involve a large range of possibilities. Creativity, judgment, and consideration for whether users are viewing the analysis in print or on a computer screen should help guide the choice of a particular visualization. Figure 4-3 illustrates a few possibilities.

Visualization researchers have documented various aspects of such analysis. For example, Wilkinson (2005) presents a framework for assembling most of the common scientific graphics from modular visual building blocks. Ware (2012) discusses how to craft images that people can understand, given the significant strengths and weaknesses of human vision. Tufte (2001) sets out graphic design principles for well-crafted scientific visualizations. Lemieux, Fisher, and Dang (2014) survey the use of visualization tools in the financial domain.

Figure 4-4, which originally appeared in the OFR *2012 Annual Report*, shows the lead-up to the collapse of MF Global Holdings Ltd. (see OFR, 2012, pp. 66-67). This figure is a narrative visualization, a technique that tells the story of an interconnected sequence of decisions and events over

Figure 4-4. The Lead-Up to the Collapse of MF Global Holdings Ltd.

Narrative visualizations relate a sequence of unfolding events



Sources: Markit Group Ltd., Haver Analytics, Congressional hearings, news reports, OFR analysis

time (see Segel and Heer, 2010). The depiction illustrates the story line by placing events on a horizontal timeline, accompanied by renderings of two key time series, credit default swap (CDS) spreads on European sovereign debt and MF Global's exposures, measured against separate vertical axes.

Narrative visualizations like Figure 4-4 are well suited for case studies or forensic timelines, where the sequence of individual decisions, actions, and events plays a central role. These visualizations are less useful in supporting unbiased supervisory decision-making, because they emphasize the roles of particular firms and people in the sequence of events. Visualizations that support policymaking should focus viewers' attention on the broader goals and principles that underlie policy choices.

Task Orientation

The foundation for an effective visualization is a clear identification of the needs and tasks of the intended audience.

Figure 4-5 illustrates the importance of tailoring the visualization to the context of its use. A recent OFR working paper identified four high-level tasks for visualizations that support financial stability monitoring (see Flood and others, 2014):

- **Sense making.** Integrating noisy perceptions into a coherent understanding (making sense) of a situation.
- **Decision making.** Choosing from a set of available options.
- **Rule making.** Creating formal processes or boundaries to constrain behavior.
- **Transparency.** Sharing information with others in an accessible way.

Figure 4-5 shows two different perspectives on equity markets, highlighting the distinction between decision making (on the left) and sense making (on the right). As a rule, visualizations to support decision making should avoid suggesting narratives that might bias a decision one way or another. For example, the left panel shows an excerpt from a briefing book for a meeting at the Federal Reserve Board to determine monetary policy (see Board of Governors, 2008). The chart is a familiar time-series plot — concise, smoothed, and uncluttered — of the recent behavior of a single equity-market index. The uncertain future is shaded in gray, and the shift in projections since the last meeting provides context.

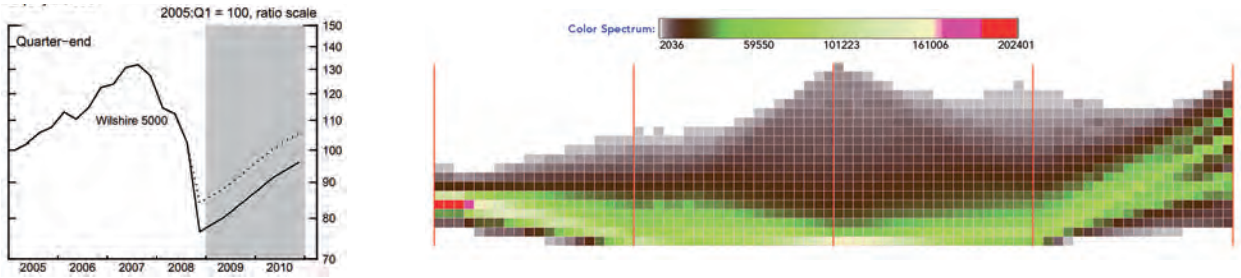
In contrast, the right panel of Figure 4-5 is a parallel-coordinates plot over eight years summarizing hundreds of thousands of monthly observations on roughly the same set of stocks as in the line graph on the left side of the figure (see Alsakran, Zhao, and Zhao, 2010; and Inselberg, 2008). Each observation is plotted on five dimensions, represented as five parallel vertical axes: return, price, volume, shares outstanding, and industrial classification. For example, the distribution of volume (the middle axis) is highly skewed, with a large cluster of the low-volume stocks (the bright green patch at the bottom) and a long tail of higher volume stocks spreading upward. Many of the low-volume stocks are clustered in three industry categories, indicated by the three green pathways extending to the rightmost axis.

A standard parallel-coordinates plot would connect each data point across the five parallel axes with a distinct line (see **Figure 4-7C**). In the right panel of Figure 4-5, however, the number of observations is much higher, making the display of information extremely dense. For that reason,

Figure 4-5. Examples of Task-Oriented Visualization

Decision making:
A familiar time-series plot

Sense making:
A large number of multidimensional data points in a single picture



Sources: Board of Governors (left); Alsakran, Zhao, and Zhao, 2010 (right)

the authors chose a custom mosaic coloring scheme to convey the varying density of the histogram rather than rendering individual data points. The intense information density of the graph is typical of sense-making plots, which are often not immediately intuitive as a result. This is not a shortcoming, but simply a by-product of capturing as much information as possible in a single image.

Data Selection

Selecting information that supports the identified task can be a challenge for financial stability analysis because data gaps may prevent direct observation of emerging problems. For example, historical context may be lacking for new financial products or trading venues.

The researcher must choose the appropriate observation frequency, level of aggregation, and data attributes or dimensions for the scope of analysis — for example, the set of firms or transactions to consider. Analyzing systemic threats to treat one component of the system in isolation is not likely to yield sound results. The analyst needs to understand the relationships between that component and the other parts of the system. Getting all of this right may require many versions of data selection and charting choices.

For example, OFR researchers are experimenting with interactive visual analytics to illuminate the workings of the CDS market (see Haynes, Paddrik, and Rajan, forthcoming).

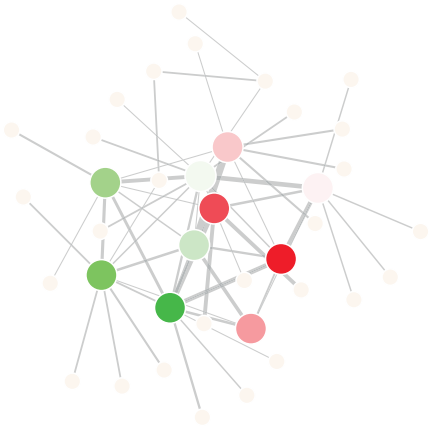
Figure 4-6 shows three views of CDS risk exposures. The top panel, Figure 4-6A, is a traditional node-link diagram (see Ghoniem, Fekete, and Castagliola, 2005) depicting the network of bilateral trade, using link thickness to indicate the proportion of bilateral trading volume and color (green or red) for dealers' net long or short activity. Although this overview gives a clear sense of the central nodes in the network, it does not reveal the details of the contracts traded.

The center panel, Figure 4-6B, is a bipartite (two-part) diagram (see Brandes, Raab, and Wagner, 2001) depicting connections from buyers and sellers on the left to the reference entities of the CDS contracts they trade on the right. The thickness of the lines indicates the net position a buyer or seller has against a specific reference entity; green entities have net long exposures and red entities have net short exposures. Here only the largest few exposures for the selected broker-dealers are included, prioritizing the holdings likely to have the largest risk impact. Although this

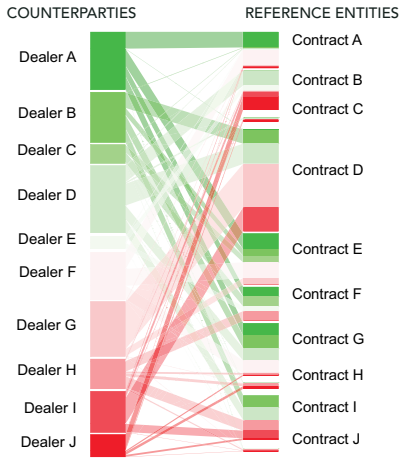
Figure 4-6. Different Perspectives on One Market

Visualizations A and B show who trades with whom and who owns certain risks. The hive plot (C) incorporates both types of risk into a single visualization

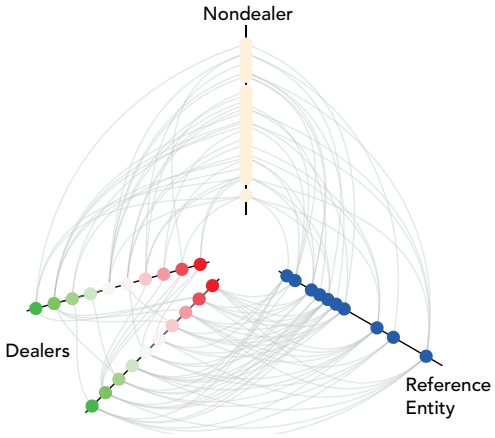
A. Top CDS Participants



B. Connecting Dealers to Risks



C. Interacting Risk Networks



Note: These figures do not use actual market data and are for representative purposes.

Source: OFR analysis

overview illustrates exposures to specific underlying credits, unlike the node diagram it does not expose the details of whom they were traded with.

Much like network metrics, these visualizations focus primarily on a single type of risk, though more comprehensively than in individual metrics. The node-link diagram depicts existing counterparty risk between entities and the bipartite diagram summarizes held reference entity risk. Both visuals efficiently capture and usefully communicate relative and absolute importance to a user. Because the market for credit contracts involves a diverse set of risk sources, visuals can be even more effective than simple numerical metrics in communicating the intricate relationships involved.

Figure 4-6C displays detailed interactions among different types of participants for a set of CDS transactions on a particular reference entity. This type of network visualization is called a "hive plot" (see Krzywinski and others, 2012). The hive plot includes two elements of traditional network diagrams, vertices and edges, representing firms and financial transactions. However, additional information is included in the hive diagram, which highlights some of the peculiar aspects of the CDS transactions.

The hive plot groups vertices on four separate axes, two of which are paired. The north axis includes all nondealer institutions which participate in the credit market. Positioning along the axis is determined by the entity's net outstanding CDS exposures. The southeast axis includes all credit reference entities, distributed along the axis relative to the entity's total gross outstanding CDS exposure. Note that some reference entities may overlap with financial firms located on the other three axes. Finally, the two southwest axes include all of the active dealers. Each dealer is included twice — once on each of the paired axes.

The division of financial entities into three axes, two of which are equivalent, tries to mirror traditional credit transaction activity. As in the previous network diagrams, transactions are usually executed first between nondealer entities and dealers and then between dealers.

The hive diagram attempts to reflect this two-stage level of credit intermediation, allowing a user to concentrate on the first or the second set of transactions, or institutions, with little distraction. It also broadens the scope of interest from an individual reference entity to a whole suite of entities to summarize exposure or concentration across sectors. This allows for a much fuller, and much more product specific, depiction of risk transfer between and across entities that should not all be considered the same.

Visual Rendering

Visual renderings of the data should convey with appropriate visual emphasis the scope (type and number), granularity (specific attributes and level of detail) and interconnections (relationships and their attributes) for the data points. The possibilities for combining visual elements into a coherent graphic are infinite, and a deep understanding of the data and the tasks to be performed is essential.

Figure 4-7 illustrates some of the possibilities for visual rendering in the context of financial stability maps. The top panel, Figure 4-7A, is a "heat map" from the OFR's *2013 Annual Report* (see **Figure 2-6** in **Section 2.2** for a description of the five main categories here).

In Figure 4-7B, distances from the center correspond to measured attributes. It is a type of radial chart known as a spider chart, taken from the International Monetary Fund's *Global Financial Stability Report* (see IMF 2014b; Dattels and others, 2010). The two loops — red and green — each represent the state of financial stability as of the publication of an issue of the IMF stability report.

The three examples in Figure 4-7 capture the multifaceted nature of threats to financial stability by simultaneously depicting high-level measures in multiple dimensions. The charts group the dimensions in higher-level categories — five in the heat map, two in the spider chart, and five in the parallel coordinates plot.

Other techniques, such as Sarlin's (2013) "self-organizing financial stability map," avoid presenting all the data and dimensions simultaneously (not shown). He clusters many data points into a smaller number of representative clusters and projects high-dimensional data (data with many variables) into a two-dimensional plane. The result is abstract but condenses a large amount of information into a single two-dimensional picture.

Next Steps in Visualization Research

One direction for our future research involves tailoring new visualizations to specific use cases in macroprudential analysis. The OFR paper by Haynes, Paddrik, and Rajan (forthcoming) is one example. In that work, we combine

experience in visualization with access to an important confidential data source from the CDS markets.

USABILITY TESTING

Usability testing is an important step in developing new visualizations (see Plaisant, 2004).

For example, in response to research on visual perception, we are experimenting with alternate renderings of the financial stability data shown in Figure 4-7. These charts present key facts in a concise and attractive way, but improvements are possible. The use of color to convey magnitudes in heat maps can be problematic, in part because of differences in viewers' perceptions, for example, as a result of color blindness (see Ware, 2012, chapter 4).

In addition, recent research indicates that users' perceptions of magnitudes are less accurate and slower when data are shown radially, in contrast to the standard layout, which uses perpendicular coordinates. For an overview of radial visualization, see Draper, Livnat, and Riesenfeld (2009). For an analysis of potential weaknesses, see Diehl, Beck, and Burch (2010).

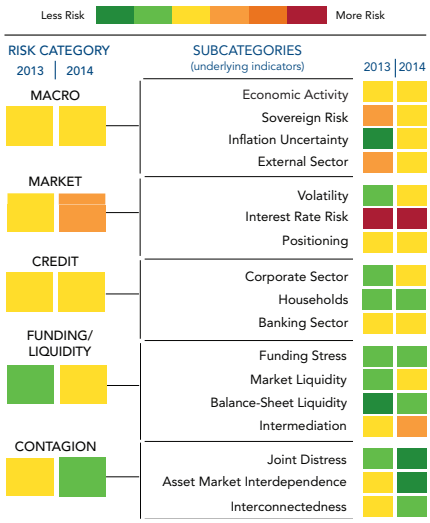
INTERACTIVE VISUALIZATION

Another area where the OFR is exploring new possibilities is interactive visualization. A number of organizations publish interactive online tools for exploring data of macroprudential interest (see IMF, 2014a; World Bank, 2014; FRB-St. Louis, 2014; ECB, 2014). One of the simplest forms of interactivity allows the user to select dates and filter out (or in) particular data. Another common type of interactivity gives the user "details on demand" (see Shneiderman, 1996) in the form of temporary pop-up information triggered by mouse-overs or similar user actions. The hive-plot visualizations of Haynes, Paddrik, and Rajan (forthcoming) incorporate this feature.

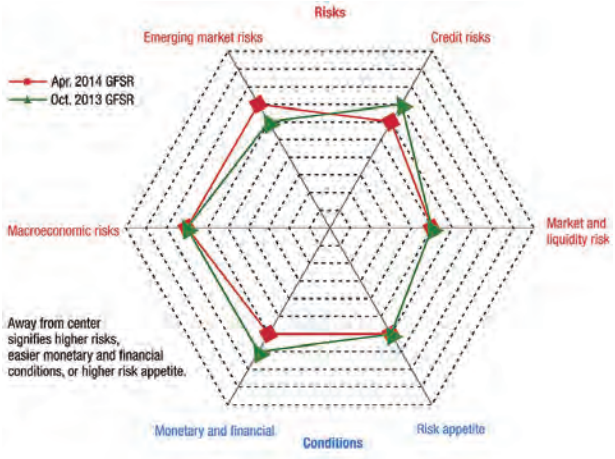
A recent OFR working paper by Flood and others (2014) discusses the other extreme of interactivity, known as "visual analytics." In visual analytics, a software application recalculates and redisplays new derived results in response to user choices. The recalculation must occur quickly to avoid distractions in user attention. The OFR is also developing a "RiskMapper" prototype (Lemieux and others, forthcoming) to allow analysts to explore the interactions of a range of systemic risk measures with different rules for portfolio selection.

Figure 4-7. Examples of Financial Stability Maps

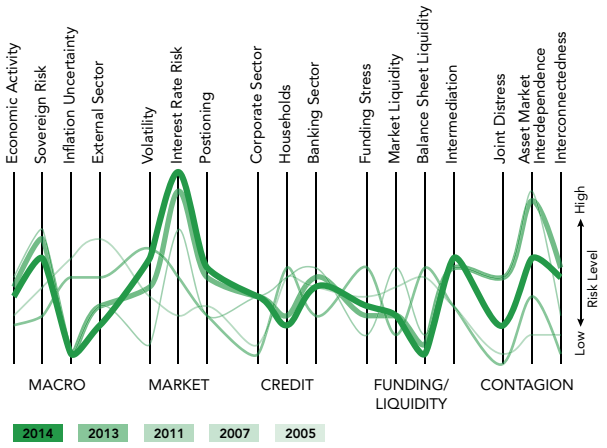
A. Heat map indicates risk by color



B. Spider charts indicate risk by distance from center



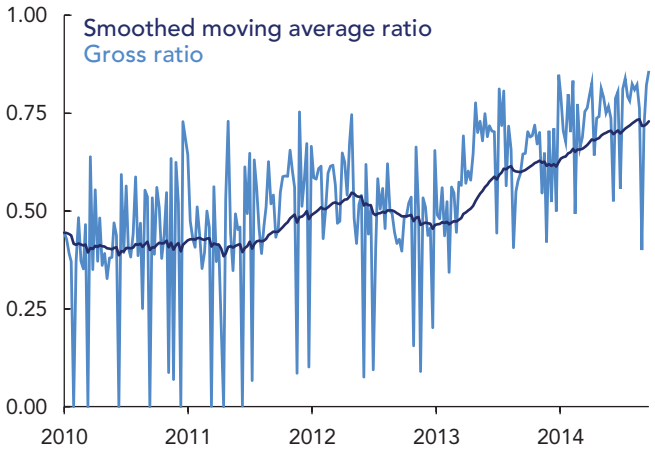
C. Parallel coordinates plot indicates risk by the position on each vertical axis



Sources (top to bottom): OFR analysis, IMF (2014b), OFR analysis

Figure 4-8. Central Counterparty Share of Transactional Volumes

CCPs' market share has grown, measured by transactions



Sources: Depository Trust & Clearing Corp., OFR analysis

OFR researchers are interested in understanding the flow of information in markets and how this flow drives the behavior of market participants. We consider sources of information available to participants and the relationship between information, market characteristics, participants' behavior, and the effects on markets.

4.4 Credit Markets

OFR's financial stability research on CDS markets has four goals:

1. understanding market characteristics,
2. identifying risks,
3. analyzing risk management practices, and
4. developing monitoring tools to inform policymakers.

This section describes that research and then focuses in detail on what we have learned about the growing role that central counterparties play in these markets.

Market participants use credit default swaps to buy and sell exposure to the default of underlying reference entities, which could be governments, corporations, or credit-linked securities. The amount of the exposure in a CDS contract is called its notional value. Since the financial crisis, reforms have sought to make these markets more transparent and to require standardized CDS contracts to clear through central counterparties (see **Section 3.5**).

Central counterparty (CCP) clearing activity continued to grow in 2014 and is nearing two-thirds of transactional volume in CDS markets on a notional basis (see **Figure 4-8**), reflecting regulatory objectives and market concerns following the financial crisis.

CDS Research Agenda

The OFR is working with data from the Depository Trust & Clearing Corp. (DTCC)'s Trade Information Warehouse on CDS positions and transactions to understand the risks these products may pose and to analyze the evolving role of CCPs. DTCC data provide insight into market concentration, size, and distribution of exposures by reference entity, counterparty, and date. A clear understanding of participants, their characteristics, and their behavior is necessary for evaluating the effectiveness of policy tools and monitoring potential risks.

UNDERSTANDING THE ROLE OF INFORMATION IN CDS MARKETS

OFR researchers are interested in understanding the flow of information in markets and how this flow drives the behavior of market participants. We consider sources of information available to participants and the relationship between information, market characteristics, participants' behavior, and the effects on markets. Sinha and Dong

(2011) demonstrated the different roles played by options versus equity markets in price discovery. Understanding the role of CDS markets relative to others (for example, bonds, equities, options) during different market conditions will help drive a better understanding of the market's functions and susceptibilities.

Using DTCC data going back to 2010, OFR researchers are studying how transaction sizes affect prices and liquidity under different market conditions. The 2012 so-called London Whale incident, in which an investment bank lost billions on large positions in the CDS market, demonstrated the effect that large transaction sizes and information flow can have on shifting market values of CDS (see U.S. Senate, 2011).

We are also looking at how external factors, such as regulations and news about firms, affect CDS prices and market depth. In addition, we are examining tools that will help us understand how different market participants originate and react to information. For example, we are asking whether customers of smaller broker-dealers routinely trade after customers of larger firms. We are also looking for patterns in the timing of market-moving trades (such as between morning and afternoon) that could interest policymakers.

ANALYZING THE RISKS OF CLEARING-MEMBER PORTFOLIO SELECTION

Hedging of credit exposures is increasingly cleared through CCPs, supported by financial regulatory reform. This development leads to research questions: How might dealers' outside exposures result in centrally cleared hedging activities? What are the implications of this connection?

OFR researchers and collaborators are analyzing the dynamics of clearing members' portfolio selection within CDS markets. OFR researchers are asking how individual clearing members' hedging portfolio values evolve and how the growth in central clearing presents new considerations for risk management. Central clearing changes the risk profile of cleared hedging portfolios and presents a possibly greater level of risk for clearing members. This research borrows from foundational work of Eisenberg and Noe (2001), which specifies systemic risk in interbank networks, but also proposes specific linkages and considers the feedback effect of negative shocks in the spirit of Acemoglu, Ozdaglar, and Tahbaz-Salehi (forthcoming).

As central clearing volumes increase and fulfill the intentions of financial reform, should policymakers be concerned about the implications for financial stability? Does the volatility of hedging portfolios threaten the solvency of clearing members and the CCPs they constitute? If so, how should policymakers balance clearing member solvency with inclination to hedge risks? OFR researchers are using data supplied by DTCC on counterparty exposures between clearing members and with CCPs, along with price histories of cleared reference entities, to try to answer these questions.

IDENTIFICATION OF COUNTERPARTY RISK MANAGEMENT

Counterparty risk management is important in derivatives markets because in periods of crisis, parties to financial contracts may come under stresses that jeopardize their ability to deliver on contractual obligations. Counterparty failure can threaten financial stability when hedges fail and market participants take losses. Consequently, counterparties must manage their exposures to each other by adjusting prices to account for contractual risk, setting aside risk buffers to offset costs of counterparty loss, and imposing limits on exposure to risky counterparties.

Counterparty risk management is a concern across a number of asset classes and markets. OFR researchers are studying counterparty risk within credit derivatives markets, where buyers and sellers face each other in bilateral CDS contracts. Buyers of CDS protection are concerned about default of the protection seller over the life of the contract. Sellers of CDS protection are concerned with contractual failure of protection buyers to pay predetermined premiums.

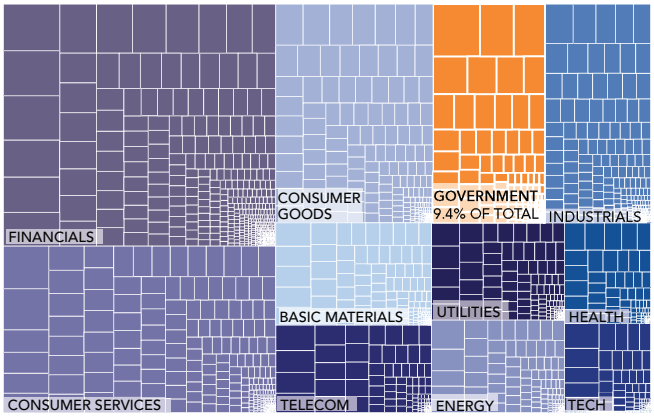
Recent academic work on counterparty risk has focused on how buyers and sellers price protection as a way to account for counterparty risk. Arora, Gandhi, and Longstaff, (2012) studied prices at which dealers are willing to sell protection and whether the prices varied with dealers' credit risk. More specifically, they found that the price at which dealers are willing to sell protection falls as the market perceptions of dealer default increase. Although the relationship was small, it was significant.

OFR researchers are studying whether transactional history corroborates the academic findings in indicative quotes and whether other mechanisms are employed in counterparty risk management. If counterparty risk is a commonly shared concern in OTC markets, what other ways besides pricing are used to manage contractual risk? Do protection buyers reduce the initial margins they pay to protection

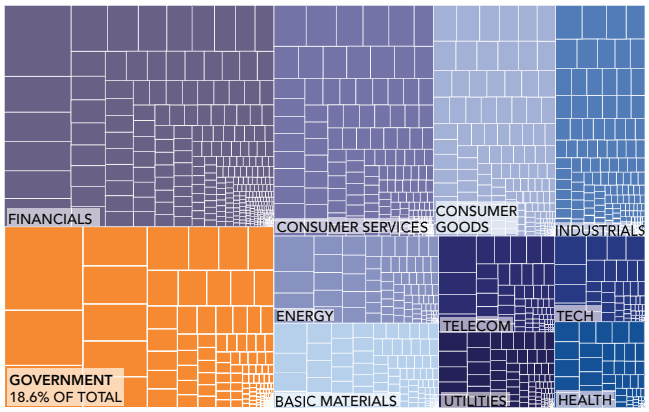
Figure 4-9. Composition of Risks Traded in CDS Markets

Sovereign default risk emerges as a major market focus

January 2010



August 2014



Sources: Depository Trust & Clearing Corp., OFR analysis

sellers when sellers are more risky? And do buyers set risk limits based on notional or mark-to-market exposures with protection sellers?

DEVELOPMENT OF MONITORING TOOLS

OFR researchers are also developing monitoring tools to make complex data on exposures and transactions accessible to policymakers. During the past year, we have focused on understanding developments in counterparty risk, distribution of credit risk, and overlap of counterparty and credit risk.

Our ongoing research highlights counterparty risk and the risks of a central counterparty clearinghouse, which helps clear and settle market transactions. This role is a recent development in credit derivatives markets and lent momentum by the Dodd-Frank Act. Central clearing puts in place clearing requirements similar to those of futures markets where exchanges are connected to a proprietary central counterparty.

Monitoring margin requirements is critical to understanding how central counterparties manage risk (see Adrian, Covitz, and Liang, 2013). Identification of CCP counterparty concentration is also important, because failure of a clearing member may pose a systemic risk. Are central counterparty clearinghouses exposed to certain clearing members disproportionately by CDS product type, transactional size, settlement currency, or status as an end-user or dealer?

The OFR is developing market monitoring systems that policymakers can use to study these considerations interactively, to assess the transition to central clearing. We have developed additional visualization tools to understand credit markets at large without exposing confidential position or transaction information. One example is a tree map to illustrate changes in the constitution of the CDS market over time. The market is increasingly a reflection on sovereign default risk and proportionately less on corporate default risk, as it was before the financial crisis. Figure 4-9 illustrates the increase in the proportion of the market related to sovereign and governmental credit risk, from 9.4 percent in January 2010 to 18.6 percent in August 2014. At the same time, indexes that were issued during the financial crisis remain significant, in terms of notional exposures, and may pose liquidity risk in a period of credit deterioration.

The Evolving Role of CCPs

The Dodd-Frank Act mandated that clearing of the most liquid over-the-counter (OTC) derivatives contracts would migrate to central counterparty clearinghouses. CCPs are expected to reduce systemic risk through centralized netting of exposures and separation of portfolio risk management from counterparty risk management. However, some policymakers and market participants are concerned about the potential concentration of risk in CCPs (see **Chapter 3**).

A CCP should always be able to net risk more effectively than dealers can in the bilateral over-the-counter market. For example, assume that three dealers transact business in the bilateral market with no central counterparty. There is one type of CDS contract on Company A. Each dealer sells to the other two dealers $10 million of protection on Company A in the CDS market. After three periods, each dealer is a buyer and seller of credit risk — in other words, they all have a "net zero" risk exposure to Company A. But counterparty exposures remain. If Company A defaults, each dealer is obliged to deliver on its protection sale and expects to be paid on its protection purchase. For any dealer that fails, another dealer purchasing protection is at a loss. This market structure creates a chain of dependencies, which when not met, can spread losses throughout the system.

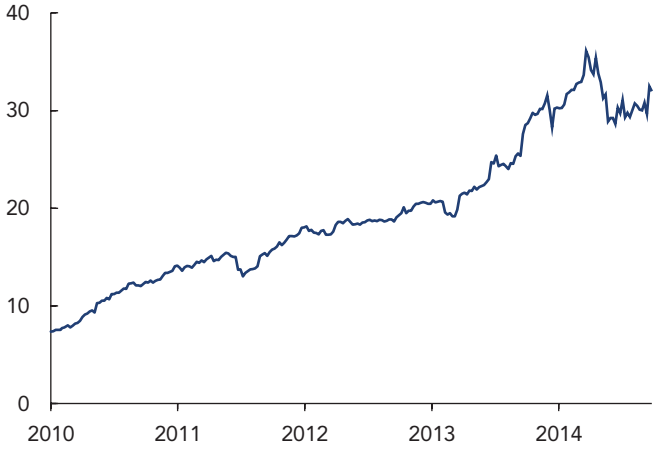
When a CCP is involved, the clearinghouse acts as counterparty to every market participant. When each dealer adds up its contingent assets and liabilities, it counts them against the same contractual entity, the CCP. The CCP intermediates the risk for each dealer-to-dealer transaction, so by the third period, all the dealers have a net zero risk exposure on the underlying risk and to their counterparties.

CCPs net the risk of counterparties, but they are at the same time exposed to the risk of any counterparty's failure. The CCP assumes the net liabilities of the counterparty. If the counterparty representing a large proportion of the CCP's liabilities fails, the CCP may be unable to pay out on cleared CDS contracts. This risk is a potential threat to financial stability.

As of October 2014, U.S.-based CCPs are counterparty to approximately $4 trillion in notional exposure, compared to the roughly $12.5 trillion of gross notional exposure outstanding in the bilateral market. Because significant netting occurs in the cleared market, the fraction of exposures CCPs are counterparty to is less than the fraction of transactional

Figure 4-10. Cleared Positions as a Percentage of All Outstanding CDS Positions

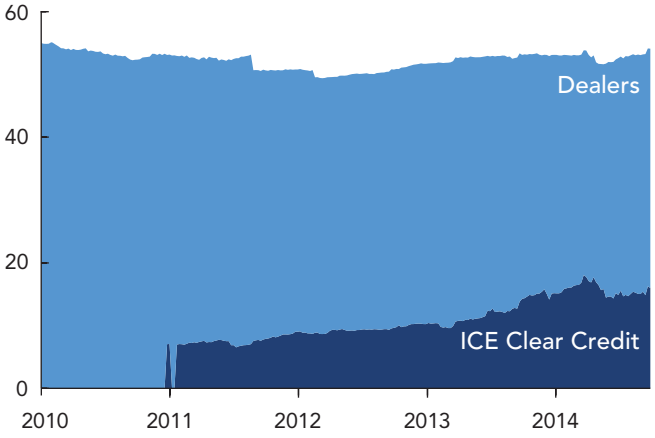
CCPs' market share has grown, measured by outstanding positions



Source: Depository Trust & Clearing Corp., OFR analysis

Figure 4-11. Top Five Counterparties for All Outstanding CDS Positions

ICE Clear Credit has been one of the top five CDS counterparties since 2011



Source: Depository Trust & Clearing Corp., OFR analysis

Figure 4-12. Top Five Reference Entities for Cleared CDS Indexes, January 2010 to May 2014

CDX.NA.IG.9	$179,113,684,096
CDX.NA.IG.19	$123,208,324,318
ITRAXX EUROPE SERIES 20	$106,620,317,497
CDX.NA.IG.22	$96,953,694,900
ITRAXX EUROPE SERIES 21	$92,919,341,812

Source: Depository Trust & Clearing Corp.

volume they clear. Nonetheless, gross notional exposures involving CCPs have risen rapidly (see **Figure 4-10**).

In 2010, dealers accounted for the top five counterparties and represented 55 percent of exposures by total volume in the CDS markets the OFR observes (see **Figure 4-11**). However, by 2011 ICE Clear Credit, LLC, had emerged to displace one among these top five entities. ICE Clear Credit's fraction of the market has only grown since 2011. By 2014, ICE Clear Credit had become the largest CDS counterparty and has reached more than 15 percent of total notional exposures. The relative proportion of the remaining four dealer-participants has diminished. CCPs already constitute the greatest source of counterparty concentration in the CDS market.

One major concern for policymakers that is also a potential threat to financial stability is the possibility of joint default of a CCP and one or more clearing members. Clearing member default can arise in several ways, one of which is stresses on its credit portfolio. Some stresses may result from the default of reference entities clearing members are exposed to and which the CCP clears.

Figure 4-12 shows that the most recent versions of the U.S. and European investment-grade credit indexes constitute the largest risk exposures among reference entities that are centrally cleared. These indexes are broad, but closer inspection reveals a degree of risk concentration that may concern policymakers. Credit indexes include reference entities from a variety of credit-sensitive sectors in the economy. When the reference entities contained in these indexes are categorized into sectors, financials emerge as the sector with the second highest exposure. A total of $182 billion resides in financials.

Policymakers are concerned about possible scenarios in which multiple stressed clearing members could strain the CCP because of common dealer exposure to financial sector risk. As of May 2014, 21 dealers held exposures to 65 financial reference entities through 12 cleared indexes that ranged from $2 billion in protection purchased to $3 billion in protection sold. Market participants could come to question the creditworthiness of several dealers concurrently in a crisis, which would present a challenge for the CCP, because the guarantee fund may not be large enough to settle losses arising from the default of several dealers at once. CCPs could require larger guarantee fund commitments from clearing members to improve safeguards in a crisis, but financing those buffers also increases the costs of central clearing in normal times.

Clearing member exposures to financial entities also introduce wrong-way risk. For example, clearing members may not be sound protection sellers at a time when the financial sector as a whole is under stress. For that reason, CCPs' protection purchases from clearing members would be least reliable when they are needed most.

Clearing member risk exposure to CCPs will continue to grow as the movement to central clearing proceeds. CCPs now account more than 15 percent of gross exposure in the CDS market, and that share has increased during a time when volumes in credit derivatives fell. As the importance of CCPs in the credit derivatives markets grows, policymakers must pay close attention to the counterparties these institutions transact with and the risks they clear.

4.5 Recent and Forthcoming OFR Research

The OFR has three research publication series: Working Papers, Briefs, and Staff Discussion Papers. These publications are designed to trigger lively discussion among researchers, market participants, and the regulatory community, and generate feedback that can help us achieve our statutory mission.

OFR Working Papers

The OFR launched the 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. The OFR Working Paper Series has sparked interest and discussion in the academic and regulatory communities. The papers have been presented at conferences and cited in the press and

academic literature. About half have also been published in academic journals.

Through November 2014, the Office had published 21 working papers, including the following nine since our last annual report:

- *Effects of Limit Order Book Information Level on Market Stability Metrics* by Paddrik and others (2014a) used an agent-based model of the limit order book to explore how the levels of information available to participants, exchanges, and regulators can be used to improve our understanding of the stability and resiliency of a market (see Section 4.2).
- *Hedging Market Risk in Optimal Liquidation* by Monin (2014) explored the optimal strategy for a financial institution seeking to sell a large block of securities. In these situations, an institution would attempt to minimize the price impact of the large sell order by spreading it out over time. The paper describes the optimal strategy for hedging the resulting market risk.
- *Structural GARCH: The Volatility-Leverage Connection* by Engle and Siriwardane (2014) proposed a new model of volatility in which financial leverage amplifies equity volatility by what the authors call the "leverage multiplier." GARCH stands for "generalized autoregressive conditional heteroscedasticity." The model estimates daily asset returns and asset volatility.
- *Design of Risk Weights* by Glasserman and Kang (2014) investigated the design of risk weights used to set minimum levels of regulatory capital for banks and introduced a formula for regulators to set weights by analyzing banks' portfolios.
- *An Agent-Based Model for Financial Vulnerability* by Bookstaber, Paddrik, and Tivnan (2014) developed an agent-based model that uses a map of funding and collateral flows to analyze the vulnerability of the financial system to fire sales and runs (see Section 4.2).
- *Shadow Banking: The Money View* by Pozsar (2014) presented an accounting framework for measuring the sources and uses of short-term funding in the global financial system. The paper also introduced a dynamic map of global funding flows to show how dealer banks emerged as intermediaries between two types of asset managers: (1) cash pools searching for safety through collateralized cash investments, and (2) levered portfolio managers searching for yield through funded securities portfolios and derivatives.
- *A Map of Funding Durability and Risk* by Aguiar, Bookstaber, and Wipf (2014) presented a funding map to illustrate the primary business activities and funding sources of a typical bank/dealer. The authors used the map to trace the paths of risk through four financial institutions during historical crises and to identify gaps in data needed for financial stability monitoring. They also introduced the concept of "funding durability," defined as the effective term of funding amid signaling and reputational considerations during periods of stress.
- *The Application of Visual Analytics to Financial Stability Monitoring* by Flood and others (2014) presented an overview of visual analytics — the science of analytical reasoning enhanced by interactive visualizations produced by data analytics software — and discussed its potential benefits for monitoring financial stability (see Section 4.3).
- *Competition in Lending and Credit Ratings* by Ahmed (2014) related corporate credit rating quality to competition in lending between the public bond market and banks. The author showed that the quality of credit ratings plays an important role in financial stability because strategic behavior by the rating agency in an issuer-pays setting dampens the influence of macroeconomic shocks. The paper also explained the use of informative unsolicited credit ratings to prevent unrated bond issues, particularly during good times.

OFR Briefs

OFR Briefs are less academic than working papers and allow us to describe our research to a broader audience. The first brief to be published later in 2014 is *Systemic Importance Indicators for Large U.S. Bank Holding Companies: An Overview of Recent Data* by Allahrakha, Glasserman, and Young (forthcoming) which uses a new dataset collected by the Federal Reserve to evaluate the systemic importance of the largest U.S. bank holding companies. The authors compared the banks' scores on several measures of systemic importance and showed that a financial connectivity index introduced in an earlier OFR working paper can be useful for measuring and monitoring interconnectedness. Overall, their analysis

shows the need for monitoring multiple aspects of systemic importance.

Future briefs may:

- profile specific financial stability metrics and monitoring tools;
- provide technical primers or reference guides on key topics, such as secured finance transactions and high-frequency trading;
- offer a digest for a broader audience of the OFR's published academic research;
- summarize ongoing research programs;
- describe the OFR's progress in addressing gaps in data for financial stability monitoring; and
- describe and promote progress on the implementation of financial data standards.

OFR Staff Discussion Papers

OFR Staff Discussion Papers are academic papers by the OFR research staff that contribute to our understanding of financial markets, financial data, and financial institution risks. These topics are the building blocks of financial stability analysis. The papers may be preliminary versions of work intended for the OFR Working Paper Series or research papers intended for submission to external academic publications in economics or finance. Staff Discussion Papers in 2014 included the following:

- *Clustering Techniques and their Effect on Portfolio Formation and Risk Analysis* by Lemieux and others (forthcoming) illustrated how the choice of a clustering technique — the method used to group similar data objects into clusters — in a large financial dataset can affect analysts' perceptions of the riskiness of different asset portfolios. The authors argued that a poor choice of technique could result in misinterpretations of the data and adversely affect the quality of financial stability analysis.
- *Trade Credit and Cross-Country Predictable Firm Returns* by Albuquerque, Ramadorai, and Watugala (2014) investigated whether trade credit links between firms are an important factor in predicting returns in international equity markets. The authors found that the propagation of shocks across borders from customers to suppliers via this mechanism is stronger when the availability of credit is lacking, such as during financial crises.
- *A Flexible and Extensible Contract Aggregation Framework (CAF) for Financial Data Stream Analytics* by Ball and others (2014) presented a framework that uses the financial contract as the common denominator to enable financial data integration and aggregation from a wide range of sources to support financial stability monitoring.
- *The Role of Visual Analysis in the Regulation of Electronic Order Book Markets* by Paddrik and others (2014b) described visualization techniques to help financial stability analysts understand investor behavior in electronic markets (building on the agent-based model of the order book described in Section 4.3). The authors argue that the prevalence of automated trading and the growing incidence of "flash crashes" highlight the need to understand not just completed trades but the underlying details of order flow and the evolving order book. The paper proposed visualizations to help with surveillance and enforcement and also to help academics interpret the data in a manner that can be conveyed to nonexperts.
- *On the Optimal Wealth Process in a Log-Normal Market: Applications to Risk Management* by Monin and Zariphopoulou (2014) described a technique for evaluating individual investors' risk preferences based on their stated willingness to lose specific amounts, as expressed through the value-at-risk and expected shortfall measures. Such models provide a direct link between risk management and the dynamics of the financial system.

ADVANCING DATA STANDARDS 5

The OFR has a mandate to promote and develop financial data standards that are critical for improving the quality and usability of those data. To fulfill this mandate, we are encouraging regulators around the world to require the use of existing standards, such as the Legal Entity Identifier (LEI), in regulatory reporting. We are also leading in the development and implementation of new standards, such as identifiers for products and transactions.

5.1 Data Standards Agenda

Data standards are basic building blocks for creating quality financial data needed for accurate reporting, quality analysis, and performance assessment. They define precisely who is involved in a financial transaction, what securities or other products are traded, how market participants report their transactions, and how listed companies report their earnings and balance sheets (see **What are Financial Data Standards?**).

The financial crisis illustrated what can happen when standards are weak or nonexistent and investors are unable to track losses, for example, from the mortgage market to their mortgage-linked securities, or calculate their exposures to failing counterparties.

Without appropriate data standards, the quality of financial data will suffer, market participants and policymakers will be misinformed, and markets will function less efficiently. Data standards are essential to create consistent, comparable, and reliable data. Standards help companies share data with investors, investors compare data across companies, and regulators combine and aggregate data to track market trends and monitor financial stability.

We provide support and leadership in developing, using, and integrating data standards that help investors and regulators by reducing data collection costs and facilitating data aggregation analysis.

Why have standards not become ubiquitous? Standards are often a classic public good, with costs borne by a few and benefits accruing over time for many. To solve the collective action problems created by these disincentives, government organizations such as the OFR must take a leadership role.

That is why Congress mandated the OFR to standardize data reported and collected on behalf of the Council and the public. The OFR can play any of three roles in a standards project: lead, collaborate with a regulatory agency, or participate in organizations that work through consensus (see **Figure 5-1**).

This chapter examines trends in information standards and then discusses the four important data standards initiatives in which the OFR is playing one or more of those roles:

What Are Financial Data Standards?

Financial markets rely on data standards to function smoothly.

Entity identifiers identify specific legal entities such as parent companies, subsidiaries, and 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. The project to create a universal loan identifier is another example.

Product identifiers provide commonly accepted definitions of products like "equities" and "swaps."

Standards for financial and business reporting describe information reported by companies to the public 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 describe information used in financial transactions. For example, the Mortgage Industry Standards Maintenance Organization developed a language that enables consistency in describing mortgage transactions.

Legal Entity Identifier (LEI). The LEI project to precisely identify each legal entity involved in a financial transaction reached two important milestones in 2014. First, approximately 300,000 LEIs had been issued as of September 30, 2014, triple the count a year ago (see FSB, 2012a). Second, the Global LEI Foundation and its new board began to assume operational management of the LEI system in June 2014. The foundation oversees 19 local operating units authorized to issue LEIs, up from five in 2013.

But widespread use of the LEI by both the public and private sectors will be the true measure of its success (see **Section 5.3**). In the United States and Europe, LEI use has been driven primarily by swaps regulation. The OFR urges all financial regulators to mandate use of the LEI in all regulatory reporting, beginning with large, complex financial companies and market participants.

Standards for Derivatives Markets. The OFR is working with the CFTC and other regulators to improve financial reporting standards for swap data repositories (SDRs). SDRs were mandated by the Dodd-Frank Act to promote transparency in over-the-counter derivatives markets (see **Section 5.4**).

Internationally, the OFR is assisting the CFTC and its global peers in developing shared taxonomies for categorizing derivatives products for analysis and regulatory action. We have developed a set of principles and requirements for derivatives product identifiers, which we continue to fine-tune in collaboration with international regulators. The OFR also contributed to a report on how to aggregate data on derivatives, released in 2014 by the Financial Stability Board, an international group of finance ministries, market regulators, and central banks. We continue to work on these initiatives.

Universal Loan Identifiers. The OFR is providing technical support to the CFPB and other regulators to create a universal mortgage loan identifier to promote transparency, data aggregation, comparability, and analysis in the home mortgage market. The Dodd-Frank Act authorized the CFPB to collect more data about individual mortgage loans and to mandate that entities reporting data under the Home Mortgage Disclosure Act (HMDA) provide a universal loan identifier for each loan or application that they are required to report. The OFR published a working paper on this subject in late 2013 (see McCormick and Calahan, 2013) and the CFPB issued a proposal in July 2014 to require a

Figure 5-1. How the OFR Sets Data Standards Priorities
The OFR considers three issues when setting data standards priorities

		Identifiers			
		Legal Entity **(LEI)**	Unique Transaction **(UTI)**	Unique Product **(UPI)**	Universal Loan **(ULI)**
Is it within the OFR's mission and scope?	Improve Council data collection	✔	✔	✔	✔
	Support financial stability analysis	✔	✔	✔	✔
	Promote regulatory data sharing	✔	✔	✔	✔
	Promote financial stability	✔	✔	✔	✔
Does it meet standardization criteria?	Uniform characteristics	✔	✔	✔	✔
	Large volume of data to exchange	✔	✔	✔	✔
	Sufficient info about data	✔	✔	✔	✔
	Multilateral exchange	✔	✔	✔	✔
	Ease of execution	✔	✔	✔	✔
What is the OFR's strategic role?	Leader	✔			
	Partner		✔	✔	
	Advisor				✔

Source: OFR analysis

universal loan identifier in data reported under HMDA (see **Section 5.5**).

Reference Databases. The Dodd-Frank Act requires the OFR to prepare and publish reference databases for financial entities and financial instruments. The global LEI system will meet the requirement for an entity reference database (see **Section 5.6**). The OFR is examining ways that open-source algorithms, symbologies, and collections of codified background knowledge could be used to build a cost-effective and useful reference database for financial instruments.

The diversity and complexity of data reporting mandates among U.S. financial regulators makes agreement critical on standards for data collections. As technologies improve, regulators increasingly seek to collect raw data that can be analyzed more easily than data reported in text, spreadsheets, and document formats. The OFR works with other financial regulators to develop standards whenever appropriate.

5.2 Trends in Data Standards

There is growing acceptance among regulators and market participants about the need for financial data standards. Our standardization work has shown that early collaboration with industry to develop standards is a key step before launching new data collections. Regulators should also identify and adopt best practices to manage datasets that are rapidly growing in size and complexity.

As the volume of financial data increases, so does the need for data standards.

Data standards can be driven by industry, government, or both. Private companies and industry groups often reach consensus on standards without government involvement when benefits are clear.

However, consensus on standards may be difficult to achieve when costly upfront work is required or where proprietary interests exist. In many cases, regulators work with industry groups on voluntary standards that build on existing industry practices and reflect industry input. Early collaboration with industry can be critical for success. Regardless of who creates a data standard, the industry will encourage its use if it gives them a tangible benefit.

Financial data standards and collections must keep pace with technology and market developments. Data requirements are continually becoming more demanding in scope, size, and complexity. For example, some high-volume, high-velocity data, such as data generated by high-frequency trading, are based on market orders that are executed in fractions of seconds. These types of very large and complex datasets might be described as "big data," but even datasets that are merely large can pose technical and organizational challenges.

As financial transactions become more complex, market participants often recognize the need to agree on precise and consistent definitions in a contract. An example is the Financial products Markup Language (FpML) used in derivatives markets. Different technologies are advancing to address the need for common meanings for financial terms. For example, XBRL is being used to document accounting definitions, while the Internet standard Resource Description Framework (RDF) is also being used to document terms in a variety of industries, including finance.

Users and owners of data standards must also keep the standards up to date as financial markets change. Revision cycles need to match the speed of financial and technological innovation. A standard that falls behind and no longer meets the needs of its users is likely to be abandoned.

Implications for Data Collection

Financial data standards contain specific definitions, formats, and content that lead to accurate and consistent data understood by all users.

Standardized Definitions used across the public and private sectors improve the value of data for analysis. When key terms are not clearly defined, financial analysts are unable to accurately interpret and compare data, resulting in a lack of confidence in the results. Standards are particularly needed when data include a common term that can be understood in various ways. Ambiguity in simple terms such as "delivered" or "annual" can be particularly troublesome.

Standardized Formats help analysts aggregate and compare data, and automate processes for storing, reporting, and processing data. It is important to consider how data may be used and to apply a standard format, even to routine information. If calendar dates are entered in a free-form text field rather than in a consistent date format, they can be difficult to analyze. For example, does "4/6/2010" mean April 6 or June 4 in 2010?

Without a standard format, some companies may report their entire address in one text field, while others report street address, city, state, and ZIP code in separate fields. When planning a data collection, regulators should examine the standards available, evaluate potential uses of the data, and choose the most appropriate standards.

Standardized Content is information produced by creating a finite list of acceptable data choices that can be entered in a particular field. This requirement reduces the data cleaning needed to remove inaccurate, corrupt, or inconsistent information from a dataset and facilitates comparison among datasets. For example, requiring a state name to be entered as a two-digit postal code eliminates the use of unstructured text such as "Calif" or "California."

Standardization also makes combining datasets easier. In the postal code example, standard content creates a one-to-one link in which "CA" always equals "California." Without that standard, combining datasets requires matching a variety of state abbreviations and spellings to "CA."

5.3 Legal Entity Identifier

The OFR is a leader in the global initiative to develop, implement, and encourage industry adoption of a unique Legal Entity Identifier for financial market participants. The LEI — a 20-digit alphanumeric code that precisely identifies parties to financial transactions — will help market participants and regulators in many ways. Regulators around the world are using a combination of regulatory mandates, international regulatory coordination, and consensus standard setting to promote the use of the LEI.

The need for a common global entity identifier became apparent in 2008, when market participants and their regulators were unable to gauge exposures to Lehman Brothers and its many legal entities. The LEI, once fully implemented and adopted worldwide, can help address these problems by acting as a common reference point — a unique, universally recognized code for every party in financial markets, including every legally distinct subsidiary or affiliate (see **Evaluating the Benefits and Costs of the LEI**). The private sector and international regulators have also collaborated to create a standard format for LEI data files so the issuers of LEIs — known as local operating units (LOUs) — can easily share and compare LEI data.

Evaluating the Benefits and Costs of the LEI

The LEI has earned support from regulators and market participants in a relatively short time for two reasons: the financial crisis plainly illustrated the need for a universal identifier, and there are no viable alternatives.

BENEFITS

The LEI will eventually allow analysts to combine and analyze multiple public and proprietary datasets (see **Section 6.4**).

Currently, companies face a costly, labor-intensive and mistake-prone process to accurately align and maintain different identification systems as companies and relationships change. This may include manually cross-referencing identifiers issued by vendors, private companies, and regulators; validating legal entity information; and maintaining an internal system of legal entity hierarchies and networks. If all companies were required to report LEIs, analysts could link related entity reports, aiding both company risk management and government oversight.

The LEI will also help reduce or eliminate confusion about counterparty identification, one of the most common reasons for errors and failures in derivatives trades (see ISDA, 2013). An International Swaps and Derivatives Association survey found an error rate above 10 percent in 2012 for the two largest categories of swaps — interest rates and foreign currencies (see **Figure 5-2**). The LEI allows financial market participants to know the identity of every counterparty throughout the life of their transactions.

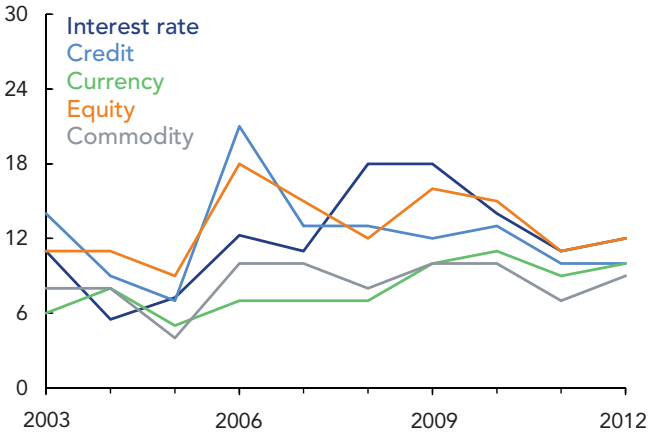
COSTS

To obtain an LEI in any country, a company pays an initial registration fee of approximately $200 (or equivalent), followed by an annual maintenance fee of approximately $100 (or equivalent). All fees are paid to the local operating unit (LOU) that issued the identifier to cover its operating costs. Each LOU is required to share a portion of those fees with the Global LEI Foundation, the nonprofit group that is now taking over management of the global LEI system.

Some have argued that the costs of obtaining LEIs, in addition to new regulatory requirements since the financial crisis, represent an unfair burden for small firms and subsidiaries that are relatively inactive in financial markets. They contend

Figure 5-2. Trading Errors by Swap Category (percent)

Swap traders surveyed from 2003 to 2012 ranked wrong names as a common error



Sources: International Swaps and Derivatives Association Operational Benchmarking Surveys, 2003-2012; OFR analysis. The 2013 survey did not include swap trading error rates.

the benefits of the LEI system will accrue disproportionately to large and complex companies facing many counterparties in derivatives and other markets. To address these concerns, a phased approach may be appropriate, with larger companies required to adopt the LEI before smaller companies.

It is premature to estimate how much the financial industry will save by adopting the global LEI system. Industry estimates of the annual savings range from $300 million to $10 billion (see Chan and Milne, 2013).

In general, the LEI system is expected to improve industry efficiencies and reduce costs for data collection, cleaning, and aggregation; transaction processing; data management; business operations; compliance monitoring; regulatory reporting; research and analysis; information sharing; and intra- and inter-organization communication.

Another benefit of the LEI once it is more broadly adopted by Council authorities will be a reduction in reporting burden. Companies spend significant time and resources managing their identification systems for reporting purposes, for themselves and their counterparties. Benefits of the LEI will grow rapidly as more companies get one.

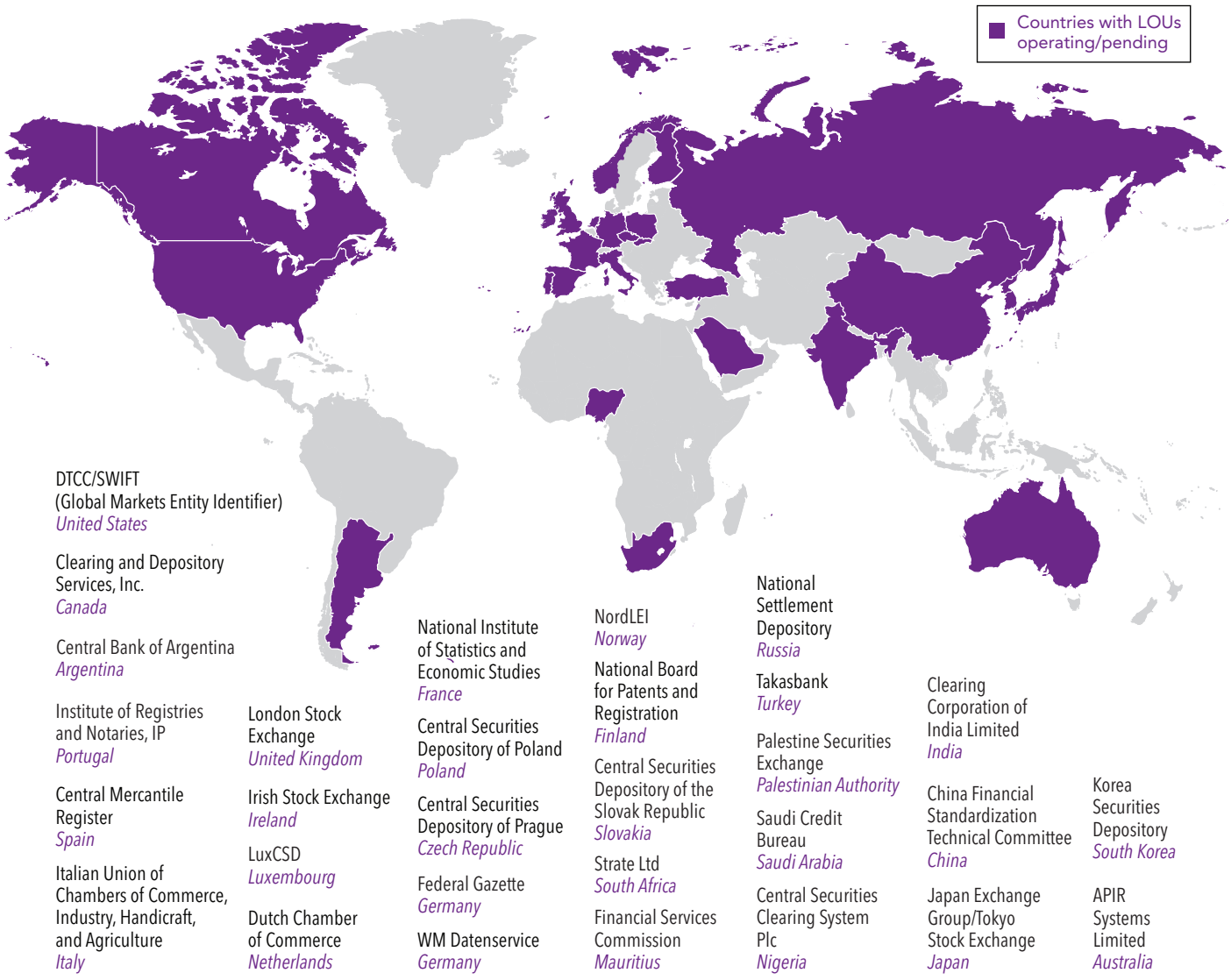
The global LEI initiative has made extraordinary progress since 2010, when the OFR issued a policy statement calling for the LEI and noting the potential benefits if regulators required its use (see OFR, 2010). The LEI Regulatory Oversight Committee, currently chaired by the OFR's Chief Counsel, ensures that the LEI system works for the public good. It consists of more than 60 international members representing market and prudential regulators as well as international organizations.

In June 2014, the new Global LEI Foundation held its first board of directors meeting. The Swiss-based foundation is assuming operational management of the global LEI system and overseeing construction of the LEI system's technology infrastructure, under the oversight of the Regulatory Oversight Committee. The foundation will also be responsible for ensuring adherence to LEI governing principles and standards, including the reliability, quality, and uniqueness of LEIs (see FSB, 2012a). The foundation plans a central database of LEIs that will be free to the public and all market participants, although privately-sponsored databases already exist.

The global reach of the LEI system significantly expanded in 2014. Approximately 300,000 LEIs had been issued to entities in more than 190 jurisdictions as of September 30, 2014, up from 100,000 LEIs at the time of our last annual report. The number of LOUs authorized to issue identifiers rose from five last year to 19 on September 30, 2014. Eleven others were in earlier planning stages (see **Figure 5-3**).

Figure 5-3. Issuers of Legal Entity Identifiers

As of September 30, 2014, 19 local operating units were issuing LEIs and 11 others were preparing to do so.



Sources: LEI Regulatory Oversight Committee, LEI local operating units

Figure 5-4. Where Is the LEI Required for Regulatory Reporting?

	Regulator	Effective Date	Purpose
Required by Regulator	U.S. Federal Reserve System	Nov. 3, 2014	Annual reports of domestic and foreign holding companies on Forms Y-6, 7, and 10
	European Insurance and Occupational Pensions Authority	Dec. 31, 2014	Annual financial report and reports filed with regulators
	Canadian Securities Administrators	Oct. 31, 2014	Swap transactions reported to trade repositories
	European Securities and Markets Authority	Feb. 12, 2014	Swap transactions reported to trade repositories
		Jan. 1, 2014	Alternative investment fund reports
	Monetary Authority of Singapore	Oct. 31, 2013	Swap transactions reported to trade repositories
	Australian Securities and Investments Commission	Oct. 1, 2013	Swap transactions reported to trade repositories
	National Association of Insurance Commissioners	March 31, 2013	Annual and quarterly investment reports filed by insurance firms
	U.S. Commodity Futures Trading Commission	March 13, 2012	Swap transactions reported to data repositories
Recommended or Listed as an Option by Regulator	U.S. Securities and Exchange Commission	June 15, 2015	Credit rating firms' disclosures of issuer ratings
		Oct. 14, 2014	Monthly Form N-MFP reports filed by money market funds
	U.S. Municipal Securities Rulemaking Board	Aug. 10, 2014	Registration Form A-12 filed by municipal securities dealers and advisors
	U.S. Commodity Futures Trading Commission	Feb. 18, 2014	Ownership Form 102 filed by futures clearing merchants, clearing members, and foreign brokers
	European Banking Authority	Jan. 29, 2014	All regulatory reports filed by EU banks
	U.S. Commodity Futures Trading Commission	June 26, 2012	Annual Form TO filed by counterparties to unreported trade options
		March 31, 2012	Annual and quarterly Form PQR reports filed by private fund managers
	U.S. Securities and Exchange Commission	March 31, 2012	Annual and quarterly Form PF reports filed by private fund managers
		Sept. 19, 2011	Annual Form ADV reports filed by investment advisors
		n/a	Effective date not yet set for Rule 613 requiring Financial Industry Regulatory Authority to maintain a consolidated audit trail
Pending Proposals by Regulators to Require LEI	European Securities and Markets Authority	n/a	Credit rating firms' reports of issuer ratings
			Market trading data reports
	U.S. Consumer Financial Protection Bureau	n/a	Home Mortgage Disclosure Act submissions
	U.S. Securities and Exchange Commission	n/a	Swap transactions reported to data repositories under Regulation SBSR

n/a = Not applicable

Sources: Regulators in United States, Europe, Canada, Hong Kong, Singapore, and Australia; OFR analysis

LOUs can be organized by public or private sector organizations and must meet certain requirements set by the global LEI system.

The LEI system's data are updated regularly. Currently, individual LOU websites provide information on which companies have obtained LEIs. Third-party websites are also available that combine this information globally.

So far, derivatives regulators have driven LEI adoption across the world. The CFTC has required use of the LEI for reporting derivatives transactions to swap data repositories since 2012 (see CFTC, 2012). Swap regulators in Europe, Canada, Australia, and Singapore also now require companies to use the LEI (see European Commission, 2012).

In the United States, required use of the LEI is expanding beyond the initial focus on swap transactions. The Federal Reserve announced that bank holding companies which have already acquired an LEI will be required to report it on several annual forms after October 31, 2014.

In other sectors, regulations recommend or allow the LEI to be used in data submitted to the government, but stop short of requiring it. For example, the LEI is now optional for reporting by private funds that file annual reports to the SEC and municipal advisors that register with the Municipal Securities Rulemaking Board (see **Figure 5-4**).

The OFR is encouraging Council member agencies and regulators around the world to require the LEI in all new data collections. The Securities Industry and Financial Markets Association has called for "more fulsome adoption and use" by U.S. regulators (see SIFMA, 2014b). In July 2014, the CFPB proposed requiring lenders to use the LEI in data reported under the Home Mortgage Disclosure Act (see CFPB, 2014).

Voluntary use was understandable when the LEI was in its formative stages but mandating that reporting entities obtain an LEI will be far more effective in propagating the LEI and helping it become ubiquitous in the long run. The OFR has also argued that several key datasets — including call reports for banks and securities financial reports and offering materials (including those for asset-backed securities) — should be modified to require use of the LEI.

Because of the global nature of derivatives markets, the OFR is working with foreign regulators to promote international consistency in SDR and trade repository reporting.

Using LEIs to Map Corporate Hierarchies

As the global LEI system expands, one of its most important uses is to help regulators and market participants understand and document complex corporate structures or hierarchies. Some of the largest multinational banks have thousands of legal entities, many with similar names, operating around the globe. Data about the relationships among corporations' legal entities can show networks of control, ownership, liability, and risks, giving financial regulators deeper insights into how financial market participants are connected to each other.

The OFR is helping a working group established by the LEI Regulatory Oversight Committee examine ways to add corporate hierarchy information to the global LEI database.

5.4 Standards for Derivatives Market Data

An important global regulatory objective is to make derivatives transactions more transparent by requiring market participants to report them to swap data repositories, whether or not those transactions are centrally cleared. The OFR is assisting domestic and international efforts to promote data standards at these trade repositories. Use of the LEI in these markets is a crucial first step, but standards will also be needed for derivatives products, transactions, and reporting.

Global regulators agreed after the financial crisis to make derivatives markets more transparent, a step requiring high-quality and comprehensive post-trade data that can be aggregated, compared, and analyzed. The United States, Europe, and a growing number of countries now require companies to report over-the-counter derivatives data to trade repositories, also known in the United States as swap data repositories (SDRs) (see **Figure 5-5**). The reporting covers most of the global derivatives market, as measured by notional (face value) amounts outstanding. Mandatory reporting of accurate and well-defined data will help regulators and market participants assess counterparty exposures and other risks.

Figure 5-5. Trade Repositories for Swap Data

As of September 30, 2014, 23 trade repositories were operating or planned.

Repository Name	Parent Company	Country	Regulator	Types of Swap Reported				
				Comm-odities	Credit	Equities	Foreign Exchange	Interest Rates
Banco de Mexico	n/a	Mexico	Banco de Mexico					
Bank of Korea	n/a	South Korea	Financial Services Commission					
BM&F Bovespa S.A.	BM&F Bovespa S.A.	Brazil	Banco Central do Brasil					
BSDR LLC	Bloomberg LP	U.S.	Commodity Futures Trading Commission					
Cetip S.A.	Cetip S.A.	Brazil	Banco Central do Brasil					
Clearing Corporation of India	n/a	India	Reserve Bank of India					
CME European Trade Repository Ltd	CME Group Inc.	U.K.	European Securities and Markets Authority					
CME Swap Data Repository[a]	CME Group Inc.	U.S.	Commodity Futures Trading Commission					
DTCC Data Repository (Japan) KK[b]	Depository Trust & Clearing Corp.	Japan	Japan Financial Services Agency					
DTCC Data Repository (Singapore) PTE Ltd[b]	Depository Trust & Clearing Corp.	Singapore	Monetary Authority of Singapore					
DTCC Data Repository (U.S.) LLC[a]	Depository Trust & Clearing Corp.	U.S.	Commodity Futures Trading Commission					
DTCC Derivatives Repository Ltd.[b]	Depository Trust & Clearing Corp.	U.K.	European Securities and Markets Authority					
Financial Supervisory Service	n/a	South Korea	Financial Services Commission					
Hong Kong Trade Repository[b]	n/a	Hong Kong	Hong Kong Monetary Authority					
ICE Trade Vault Europe Ltd.	Intercontinental Exchange, Inc.	U.K.	European Securities and Markets Authority					
ICE Trade Vault LLC[a]	Intercontinental Exchange, Inc.	U.S.	Commodity Futures Trading Commission					
KDPW Trade Repository	Central Securities Depository of Poland (KDPW)	Poland	European Securities and Markets Authority					
Korea Exchange	Korea Exchange	South Korea	Korea Financial Services Commission					
National Settlement Depository CJSC	Moscow Exchange Group	Russia	Bank of Russia					
OJSC Saint Petersburg Exchange	Moscow Exchange Group	Russia	Bank of Russia					
REGIS-TR S.A.	Deutsche Borse Group and Bolsas y Mercados Espanoles	Luxem-bourg	European Securities and Markets Authority					
SAMA Trade Repository	n/a	Saudi Arabia	Saudi Arabian Monetary Agency					
UnaVista Limited[b]	London Stock Exchange Group	U.K.	European Securities and Markets Authority					

n/a Not applicable
[a] Also authorized to operate in Australia and Canada
[b] Also authorized to operate in Australia

Sources: Financial Stability Board, trade repositories

In the United States, mandatory reporting to SDRs for transactions regulated by the CFTC began January 1, 2013. The CFTC has primary jurisdiction over interest rate swaps, credit index swaps, foreign exchange swaps, and commodities swaps. The smaller market in security-based swaps is regulated by the SEC, which has not finalized its rules for reporting those instruments to a swap data repository. Mixed swaps that involve both commodities and security-based components are regulated jointly. In Europe, over-the-counter derivatives reporting to trade repositories began on February 12, 2014, as required by the European Market Infrastructure Regulation.

We are also assisting the CFTC in efforts to improve data quality in SDRs in the United States.

Successfully converting data from the SDRs and foreign trade repositories into useful information for regulators depends on new or enhanced data standards, including unique identifiers for entities, products, and transactions, as well as mapping the relationships among corporate subsidiaries, and reporting standards.

Although over-the-counter derivatives regulators in the United States, Europe, Canada, Australia, and Japan have mandated use of the global LEI system, other important steps are necessary. Regulators and market participants need to develop and use product taxonomies to define product categories, such as cross-currency swaps or interest rate options, and to use unique transaction identifiers to efficiently match counterparties and prevent double-counting of transactions.

International Collaboration

International adoption of data standards is essential for over-the-counter derivatives data to be aggregated accurately across jurisdictions to monitor exposures in financial products (see CPSS-IOSCO, 2012a). Consistent reporting standards are also needed so market participants operating in multiple financial markets around the world can use the same set of reference data and processes, reducing errors and regulatory reporting requirements.

Since July 2013, the OFR has participated in the FSB's Aggregation Feasibility Study Group, which has recommended continued work to reach international agreement on unique product identifiers and transaction identifiers, among other things.

Establishing a unique transaction identifier is particularly important to help prevent the inadvertent duplicate counting of over-the-counter derivatives transactions. With data repositories around the world and evolving reporting requirements, parties in an over-the-counter derivatives deal may be required to report a transaction to more than one repository, or both parties may report the swap to the same repository. In Europe, for example, where regulations require both counterparties in a transaction to report the same data, a unique transaction identifier is critical to prevent double counting. Without a transaction identifier, regulators will face difficulty in spotting duplicate transactions, raising questions about the quality of aggregated data.

The FSB study group in September 2014 recommended the FSB launch a formal project to develop global product and transaction identifiers. It also recommended authorities and SDRs collaborate to harmonize data elements for aggregation. Developing a long-term aggregation solution will require a combination of technology, changes in business processes, and protocols for sharing data across national borders, according to the study group (see FSB, 2014a). In the near term, the group urged regulators to assess the costs and governance structures required to aggregate data from multiple countries and propose solutions to potential legislative and regulatory challenges, especially those regarding data security and privacy, among others. The group also urged regulators to continue developing bilateral agreements to share data.

Collaboration with the CFTC

In the United States, the CFTC requires regulated platforms for swap trading, known as swap execution facilities, to report data about transactions and prices to an SDR, which must publicly disseminate those data in real time. Three SDRs began reporting data to the CFTC in 2013, joined by a fourth in 2014. The CFTC aggregates regulatory data with the SDRs' real-time transaction-level data and publishes a weekly summary on its website.

However, the lack of shared standards in defining and collecting the swap data means market participants have submitted fragmented and inconsistent data to the SDRs. The four SDRs in the United States have different system architectures and technologies that result in data being reported differently. The differences hinder efforts by U.S. regulators to accurately aggregate and compare data. Inconsistent data reporting is also occurring in other jurisdictions.

The CFTC has taken several steps to improve SDR data quality during the past year. In January 2014, the agency asked for public comments on how to improve the SDR data and announced the formation of a new internal working group to review certain swaps reporting provisions. On March 31, 2014, the CFTC and the OFR announced a plan to assess the quality of data submitted to the CFTC and jointly pursue solutions to improve it (see U.S. Treasury, 2014).

Our partnership with the CFTC consists of three initiatives:

1. **Assess and improve the quality of data collected.** Members of the CFTC Technology Advisory Committee concluded at a meeting on February 10, 2014, that missing, incomplete, and inaccurate data made SDR data unfit to use in regulatory oversight. The committee said the CFTC's definitions for SDR reporting were not sufficiently precise and that standards must be applied when data are collected instead of trying to harmonize data later in the process. The OFR and the CFTC are collaborating to address these data quality issues with the data already collected.
2. **Develop unique product identifiers and unique transaction identifiers.** To address data quality concerns on a prospective basis, the CFTC and the OFR are examining benefits, complexities, and possible solutions for identifiers of products and transactions. Standards exist for both, and work is underway to determine if these standards can be extended to meet SDRs' current and future reporting needs. A unique product identifier is essential for each category of swaps, such as fixed-for-floating interest rate swaps, so data can be aggregated. CFTC regulations allow SDRs to use their own internal identifiers until the CFTC approves a unique product identifier (see CFTC, 2012). The first step in creating unique product identifiers is to develop a product taxonomy showing the relationships among complex swap instruments (see **What are Taxonomies?**). Unique transaction identifiers are also needed, and the OFR has begun discussions with the CFTC and European regulators to implement international standards in this area.
3. **Develop other swap data standards.** The OFR is also helping the CFTC develop precise definitions of swaps-related terms, conditions,

What Are Taxonomies?

A taxonomy is a way to classify and organize elements in a hierarchy.

One well-known taxonomy is the "Tree of Life," which shows the diversity of plants, animals, and other living organisms. It organizes species by shared characteristics. The class of mammals, for example, includes only animals that have hair, give milk, and bear live young. Within the class of mammals, canines can be distinguished from felines by characteristics they do not share.

The same principle of shared characteristics can be applied to financial instruments. The choice of taxonomy can vary, depending on the purpose. For example, convertible corporate bonds — which have characteristics of both debt and equity securities — could be grouped with debt instruments for one purpose, and with equity instruments for another.

A unique product identifier is essential for each category of swaps, such as fixed-for-floating interest rate swaps, so data can be aggregated.

and relationships that can be updated as markets change in the future. Private sector groups have already been working for several years to develop such a dictionary for financial instruments, business entities, and analytic tools. Clear, agreed-upon definitions are the foundation for accurately collecting and comparing data.

5.5 Universal Loan Identifiers

We are applying the best practices learned from our LEI work to other areas, such as universal loan identifiers for the mortgage industry.

Because of the complex and fragmented nature of the U.S. mortgage system, a universal identifier for every mortgage would greatly benefit regulators and financial market participants. We published a working paper in 2013 explaining how a universal loan identifier would improve data aggregation, comparisons, and analysis about the mortgage industry (see McCormick and Calahan, 2013). The CFPB proposed a rule in July 2014 requiring a universal loan identifier for each loan or application reported under HMDA, as authorized by the Dodd-Frank Act, and the OFR continues to support this effort (see CFPB, 2014). A critical component of a universal loan identifier is that it must not include any information that could be used to directly identify the applicant or borrower, such as a Social Security number or date of birth. At the same time, each universal identifier must provide traceability of the loan through its life cycle.

A mortgage loan typically passes through multiple companies as it is originated, sold, packaged for securitization, and serviced. Issuing a universal loan identifier when a mortgage is originated would help protect a borrower's personal information during the life of the loan because the personal information would be isolated from other loan data. A universal loan identifier code would travel with the loan as it is sold and resold.

Expanding Mortgage Standards

The Mortgage Industry Standards Maintenance Organization (MISMO), a nonprofit subsidiary of the Mortgage Bankers Association, is leading efforts to apply its voluntary standards to mortgage origination, underwriting, service administration, and other events in a loan's life cycle. Unlike many data standards, the MISMO standards are exchange standards that not only match data terms with their definitions, but also facilitate mapping an organization's internal data structures to a consensus standard for mortgage businesses and mortgage participants. Use of the MISMO standards has increased since the financial crisis, largely because of the work of the FHFA, which regulates Fannie Mae, Freddie Mac, and the 12 Federal Home Loan Banks.

The OFR is working with the CFPB, FHFA, and MISMO to advance data-sharing standards. These include the CFPB's Loan Estimate and Closing Disclosure and National Servicing Rule, FHFA's scorecard initiatives for mortgage servicing and securities issuance, and loan-level disclosures for both guaranteed and nonguaranteed securities issuance. The OFR also helped relaunch the MISMO Government Forum, which encourages regulators and industry to share information on mortgage data standards.

MISMO has begun several long-term projects to encourage the adoption of standard industry practices in loan origination and servicing. MISMO also supports mortgage research and publication on subjects from universal identifiers to data reporting templates. MISMO workgroups have published papers calling for regulators and industry to collaborate in developing universal identifiers for loans and parcels of property, as well as a universal document identifier. The OFR has worked with MISMO so that its standard includes the capability to use the LEI to identify each financial firm involved in the origination and servicing of loans. Embedding this information brings the industry a step closer to market transparency and the ability to track mortgage information through the loan lifecycle.

5.6 Reference Databases

The Dodd-Frank Act requires the OFR to prepare and publish reference databases for financial entities and financial instruments. Neither database may contain any confidential data. The Global LEI Foundation plans to create an entity database and offer it to the public for free. The OFR will create an instruments database for the public by using open-source components.

In financial markets, the term "reference data" often refers to the data describing instruments and entities. Some reference data rarely change, such as a company's stock symbol and headquarters location. Other reference data may change frequently, such as daily opening and closing stock prices. Still other data change periodically because of corporate actions or events.

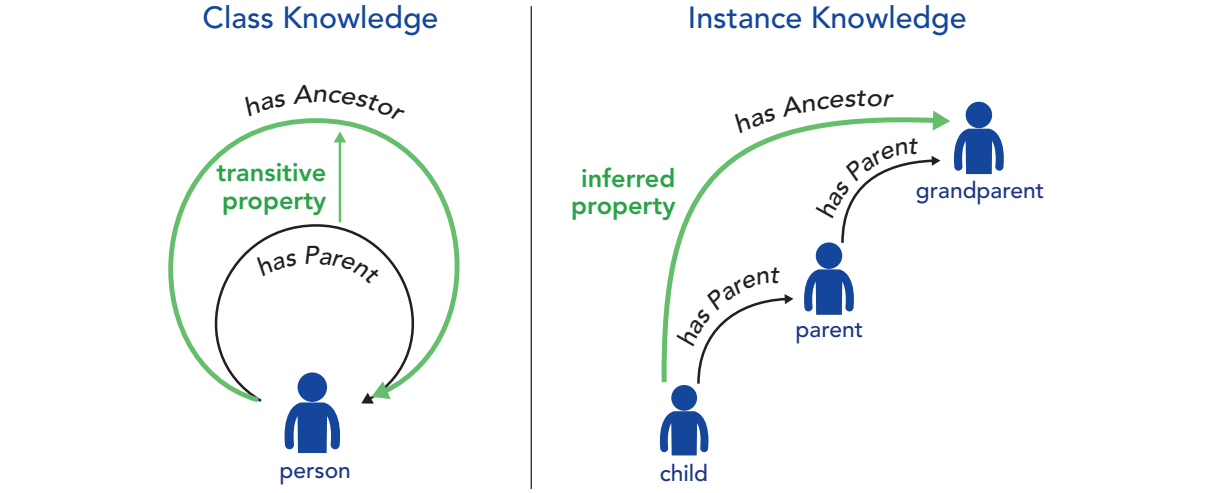
What Is an Ontology?

An ontology can be thought of as a combined dictionary and thesaurus to precisely describe data concepts, their roles, and their relationships. It is a powerful tool to use with datasets because it also contains rules of inference to make logical deductions based on definitions and characteristics entered into the ontology. This inference ability adds more knowledge to the ontology and greatly expands its usefulness.

Unlike a taxonomy, which simply lists or classifies elements within a hierarchy, an ontology can express multiple kinds of roles and relationships at the same time.

Figure 5-6 shows how an ontology can describe a simple family tree. On the left is the ontology's class knowledge, showing classes of data in the ontology, the relationships a person can have, and what kind of logical rules can be applied. On the right is specific knowledge inferred about a particular child's ancestors based on the ontology's logical rules.

Figure 5-6. Ontologies Capture Different Kinds of Knowledge
Class knowledge, for example, can create new instance knowledge



Source: OFR analysis

To fulfill the OFR's statutory requirement to establish a reference database of financial industry legal entities, the global LEI system will help by providing data on companies that have acquired an LEI. These data will embody the globally-accepted standards to precisely identify parties to financial transactions around the world.

The OFR has been exploring how to create a reference database for all financial instruments with the greatest benefit and lowest cost to the public and private sectors. Creating this database is a challenging project because so many tradable instruments exist — stocks, sovereign bonds, corporate bonds, commodities, asset-backed securities, loans, exchange-traded funds, foreign currencies, commercial paper, options, futures, swaps, and other structured products.

It is impractical for the OFR to assign a financial identifier and metadata to every known financial instrument. The private sector has established successful proprietary identifiers for some financial products, and those identifiers are already deeply embedded in market operations. In addition, maintaining a new government database would require frequent and expensive updates to keep up with new products and could potentially compete with private vendors that already sell reference data. Finally, much of the data that would be needed for a new government database are available only from primary or proprietary sources. As a result, regulators

would have to begin collecting extensive data from industry at significant cost to the industry and the government.

In consideration of the law and in light of feedback from, among others, our advisory committee, the OFR prefers a more efficient and less costly approach that fulfills the societal need. Through various channels, we have invited the industry to suggest open-source or free-to-use components or to contribute components for building a reference database for financial instruments. Regulators, the financial industry, academics, and the public could use the database to calculate the value of an instrument, compare a group of instruments, or link instruments to other datasets that use the same instrument identification.

Our approach recognizes three essential components to create a financial instrument reference database:

1. **Ontology**. An ontology precisely defines terms, conditions, characteristics, and relationships of each instrument in a database. In addition to providing a common language for all users, an ontology also creates a conceptual framework for organizing data (see **What is an Ontology?**).
2. **Identifiers and Metadata.** Identifier systems and comprehensive descriptive data, or metadata, form for each financial instrument a unique identifier that can be mapped to proprietary identifiers widely used in the market.
3. **Valuation and Analytical Tools.** Analytical software will allow users to query, browse, compare, and model financial instrument data. For example, mathematical algorithms could be created to accurately represent each instrument in the database. An algorithm is a process or procedure a computer follows to solve problems or complete calculations. Each algorithm would link daily changes in an instrument's credit risk, market risk, and other risk factors to the instrument's cash flow obligations.

Private sector initiatives are already under way in each of the three component categories. Those initiatives will help the OFR identify the standards — and open-source intellectual property components — useful for constructing a financial instrument reference database. The OFR has begun outlining the acceptance criteria for the components needed to publish a financial instrument reference database. Our objective is to set general criteria, not to preselect or endorse any particular contributor's solution.

We are still in the early planning stages, and expect to develop specific criteria for each category of component. However, we expect that there will be broad criteria that will apply to all components and to the way that components are expected to work together. We expect contributors to agree to provide web access and a high level of availability, so that information will be accessible to the public. We would expect access to be free of charge, at some defined service level. And, we would expect the contributor to use standard interfaces, which the OFR would specify, to allow the components to share data. These, and other criteria to be determined, would drive the acceptance process.

The OFR plans to hold a workshop to share our proposed approach with industry stakeholders and gather feedback. We believe that setting acceptance criteria for each of these three content categories and publishing use cases to validate interoperability is the most direct approach to creating an important public good.

A significant hole in both existing open source and proprietary identifiers is instrument identification for innovative new instruments. Our approach to a reference database would accommodate financial instruments at the leading edge of market innovation. These bespoke or exotic instruments have unique, highly customized contract terms. An ontology can ensure a common understanding of the metadata that describe the instrument. For example, if a bespoke instrument description refers to a coupon, the ontology can be consulted for the precise meaning of that word in relation to the instrument.

Instruments in the reference database could also be defined by their functions. For example, a swap is the exchange of cash flows by two parties to transfer maturities or risks. Common functions and cash flows can be used to organize instruments into groups for analyzing the properties of instruments within and across different groups.

ADDRESSING DATA GAPS

6

Policymakers and market participants have far more detailed, high-quality financial data available to them than before the financial crisis began in 2007. But significant gaps remain, and the OFR has a mandate to fill them. This chapter reviews our progress in 2014 in fulfilling that mandate. We are making it a high priority to fill data gaps in secured funding markets and asset management. More broadly, the chapter discusses how we and financial regulators work to identify, analyze, and fill data gaps that impede financial stability analysis and monitoring.

6.1 Data Gaps Agenda

Improving the quality and scope of financial data on behalf of the regulatory community and the public is the OFR's signature mandate. Those data must be comprehensive, timely, sufficiently detailed, suited for their intended purpose, and available to support in-depth analysis. To implement our data gaps agenda, we seek to: (1) understand the data needed for financial stability analysis, (2) analyze available data and determine where gaps exist, (3) identify the causes of gaps and how those gaps might be filled, and (4) prioritize the needs and determine the feasibility of obtaining the needed data.

Our job is to identify, prioritize, and fill data gaps. As this is an ongoing and iterative process, we work to address the underlying issues that cause gaps in data (see **Figure 6-1**). Our work also includes promoting more efficient data collections through the greater use of standardized protocols, enhancing collaboration and sharing among regulators, and promoting use of data standards, as discussed in Chapter 5.

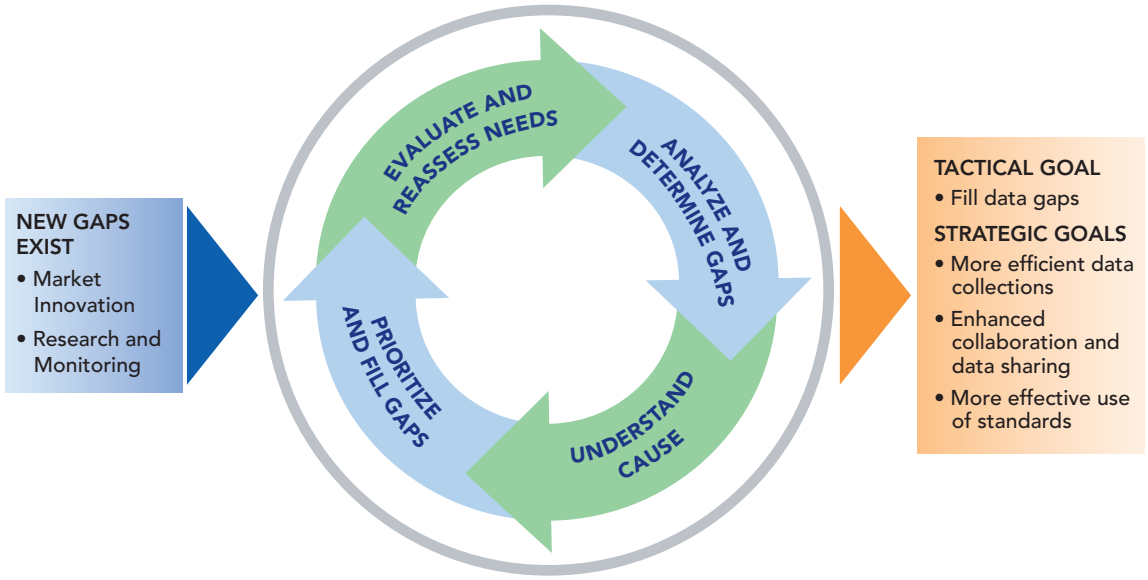
Data gaps occur for many reasons. As we develop new tools of financial stability analysis, we realize the need for more and better financial data.

Data gaps occur for many reasons. As we develop new tools of financial stability analysis, we realize the need for more and better financial data. Some data might exist but may not be collected systematically by regulators. Other data might be collected, but security needs or laws might restrict sharing. Still others might be difficult to link, to compare with other data, or to aggregate. Existing data may also be unusable if they are not electronically accessible, lack standards, or have had standards inconsistently applied. In addition, financial innovation and regulatory arbitrage (exploiting regulatory loopholes) constantly create needs for new analysis and new data. Consequently, filling data gaps will always be a moving target.

This chapter describes:

Data Gaps Initiatives. Data available to regulators are not currently sufficient to evaluate many of the key risks and policy issues discussed in Chapters 2 and 3.

Figure 6-1. How the OFR Addresses Data Gaps



Source: OFR analysis

Filling data gaps in secured funding markets is a high priority (see **Section 6.2**). The OFR, working with the Federal Reserve Board of Governors and the Federal Reserve Bank of New York, is planning a joint pilot data collection to improve our understanding of bilateral repurchase agreement (repo) activities. The OFR also participates in the Financial Stability Board (FSB) shadow banking workstream on securities lending and repo that is working to address data gaps in these markets across international borders. We highlighted these activities and their risks in past annual reports, and they remain a key focus of our research and analysis.

In addition to these initiatives, the OFR will continue to explore data gaps in areas such as captive reinsurers, mortgage and other markets, and activities engaged in by the asset management industry.

Regulatory Collections. In Section 6.3, we describe new and enhanced data collections by member agencies of the Council and other domestic and international regulators that have already improved our ability to conduct financial stability analysis. We highlight data collections about hedge fund and other private fund activities, systemic risk indicators for large bank holding companies, home mortgage data from banks, and trading activity in off-exchange markets and derivatives markets. We also illustrate how data from the new Form PF can be used to analyze hedge fund leverage across investment strategies.

Collaboration and Sharing Initiatives. Many financial markets and major financial institutions are global. For a clear view of interconnections and exposures, financial supervisors and regulators often need data representing activity beyond their jurisdiction. Data collections are driven by initial business and regulatory needs, but greater domestic and cross-border collaboration and secure data sharing would help meet the need for regulators to develop a global view and minimize reporting burdens. The OFR collaborates broadly when possible to share data.

Although obstacles remain to sharing data, the OFR has initiatives underway, as described in Section 6.4, to promote more extensive collaboration and secure sharing among financial regulatory agencies. During 2014, the OFR and FDIC co-chaired a working group of the Council's Data Committee to enhance the Interagency Data Inventory, which lists data that Council member agencies collect from industry or purchase from vendors.

The inventory, first released in 2013 and described in our 2013 annual report, facilitated several initiatives, including a project to link datasets by connecting (or "mapping") unique identifiers in those datasets. Another OFR pilot project uses the inventory to explore potential overlaps in regulatory reporting to gain insights on the nature and extent of reporting burdens.

The data inventory and related projects are key ingredients in our efforts to meet the Dodd-Frank Act mandate to provide the public with useful data to help increase market

transparency and facilitate research on financial stability. We expect the inventory will be useful for identifying data gaps and for establishing more effective data sharing arrangements among Council member agencies to support financial stability analysis.

6.2 Data Gaps Initiatives

The OFR identifies and prioritizes data gaps through our research and monitoring of financial markets and through collaboration with the Council and its member agencies. Addressing data gaps in the repo and securities lending markets is a top priority for the OFR. This section describes these activities and also describes gaps in data related to other secured funding markets, asset management activities, and emerging areas such as captive reinsurance.

Repo and Securities Lending

Availability of data about repo and securities lending activities has improved since the crisis. But much of the available data is not collected in a consistent manner, which would allow for comparison and aggregation, and most is not available to the public. In addition, there are still segments of these markets not covered by existing data collections.

In 2012, the FSB published a consultative document recommending improvements in market transparency in securities lending and repos (see FSB, 2012b). As part of this effort, the FSB set up a data experts group to develop proposed standards and processes for data collection and aggregation at the global level and to ensure consistent data collection by national authorities. The OFR participates in this effort, bringing expertise based on our research on data gaps in short-term funding markets and ideas based on our agenda for improvements in data collections and effective use of standards.

As part of the domestic efforts on this front, the OFR, the Federal Reserve Board of Governors, and the Federal Reserve Bank of New York are planning a joint pilot data collection based on these templates to improve our understanding of bilateral repo activities. These agencies have solicited voluntary participation and feedback on a proposed template from firms that are large participants in the repo market, with an aim to finalize this data template by the end of 2014. We anticipate a voluntary data collection focused on bilateral repo activity will begin in the first half of 2015. These data will also be shared with the SEC. Further work will be done on a securities lending data collection in 2015.

Certain trade and settlement-level data are necessary for analyzing risks in the repo and securities lending markets (see **Figure 6-2**). Trade-level data show the dependence of individual repo market participants on short-term funding, counterparty exposure for repo and securities lending market participants, and interconnections among participants. Settlement-level data show types, loan maturities, haircuts (percentage discounts on collateral value), and quality

Figure 6-2. Critical Elements to Close Data Gaps in Repo and Securities Lending Markets

Level	Bilateral Repo	Securities Lending
Trade	• Identity of dealer and counterparty • Clearing entity • Trade and settlement date • Principal and currency • Type of collateral • Transaction term • Interest rate	• Identity of dealer, securities owner, and lending agent • Clearing entity • Trade and settlement date • Principal and currency • Type of collateral (cash or securities) • Transaction term
Settlement	• Allocated collateral security • Haircut	• For cash collateral: • Description of reinvestment by quality and maturity • Reinvestment income and rebate rate • Haircut
		• For securities collateral: • Allocated collateral security • Lending rate • Haircut

Source: OFR analysis

of the securities used as collateral, as well as exposures of market participants to specific types of securities, market sectors, and geographies.

The OFR plans to publish a working paper in the near future that will serve as a primer on securities financing markets — describing how these markets function, the vulnerabilities and data gaps, and measures that would increase transparency.

REPO MARKETS

The degree of transparency about repo transactions and positions from a market-wide perspective depends on whether trades are settled centrally (triparty) or bilaterally. The triparty market is the most transparent part of the market. These trades are settled using the triparty repo settlement platforms at the clearing banks. Currently only two banks — Bank of New York Mellon Corp. and JPMorgan Chase & Co.. — provide triparty repo services.

The Federal Reserve Bank of New York collects data about trading activities in triparty repo markets from the two clearing banks, identifying the dealers, investors, and collateral by asset class. The Federal Reserve Bank uses this information for its own monitoring and analysis and publishes monthly triparty repo summary statistics on its website (see Federal Reserve Bank of New York, 2014a).

The General Collateral Finance (GCF) market is an anonymous wholesale market that is centrally cleared and netted by Depository Trust & Clearing Corporation's (DTCC) Fixed Income Clearing Corporation with almost exclusively dealer-to-dealer transactions. Trades are settled on the books of the triparty clearing banks. The GCF Repo Service enables dealers, who are required to be netting members of Fixed Income Clearing Corporation, to trade general collateral repos based on rate, term, and collateral type throughout the day.

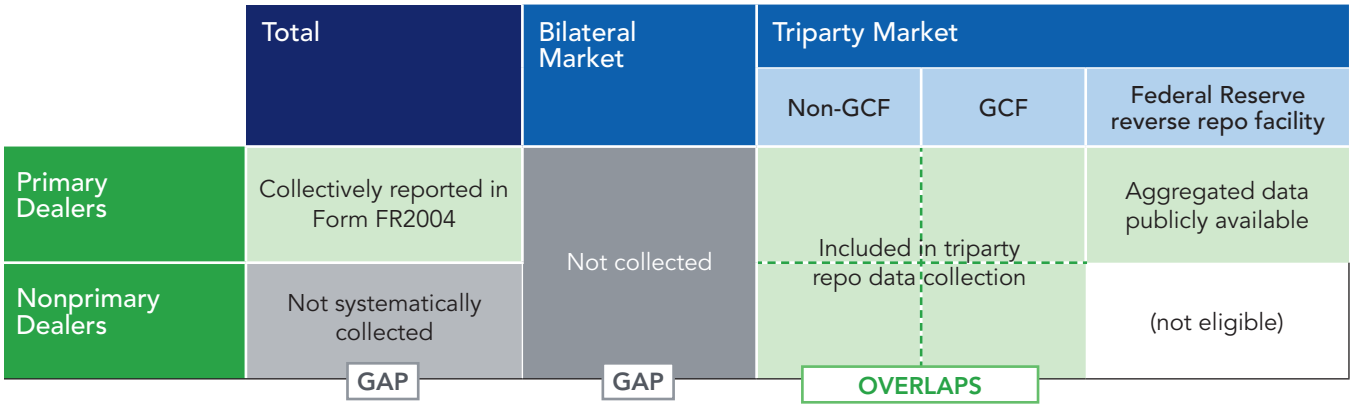
The Federal Reserve Bank of New York publishes summary information about outstanding repo transactions in the GCF repo market for one day each month (see Federal Reserve Bank of New York, 2014b). In addition, DTCC publishes a repo index, the DTCC GCF Repo Service Index, which reflects daily funding costs for dealers in the GCF repo market.

By contrast, there are limited market data available about repo trades that dealers settle bilaterally outside the triparty clearing banks. Anecdotal and survey evidence indicates this repo market suffered distress during the financial crisis.

The 22 U.S. primary dealers that serve as trading counterparties to the Federal Reserve Bank of New York account for most trading in the U.S. repo market (see Federal Reserve Bank of New York, 2014c). These dealers confidentially report their market activities weekly to the Federal Reserve on Form FR 2004. This form collects information including position, transaction, financing, and fails data in U.S. government securities and other selected fixed-income securities. The Federal Reserve Bank of New York publishes on its website every week consolidated information about primary dealer positions based on Form FR 2004 data.

However, Form FR 2004 does not cover activities of broker-dealers that are not U.S. primary dealers, and it does not differentiate triparty from bilateral trades. In addition, the form does not include important information such as

Figure 6-3. Data Collection Gaps and Overlaps in Repo Markets



GCF = General Collateral Finance

Source: OFR analysis

haircuts, rates, and the identity of the counterparty, and the information it does contain is highly aggregated. As a result, significant data gaps exist at the transaction level of these trades, particularly in the repo activities of dealers who are not primary dealers and the repo activities that are not settled on the clearing banks' triparty settlement platforms (see **Figure 6-3**). We can only produce rough estimates of the size of the bilateral repo market based on these data (see Federal Reserve Bank of New York, 2014d).

Transaction-level data would not only offer insights into the dispersion of pricing across counterparties and asset classes, but with proper identifiers, such as the Legal Entity Identifier (LEI), transaction data can be consolidated with other data sources. This detail is critical for fundamental research projects that attempt to measure the market impact of a large liquidity shock and assess subsequent fire sales, such as our agent-based models described in Section 4.2. More information on repo transactions would also be valuable for our financial stability monitoring and analysis so we can better understand how the markets function, how they interact with one another, and how risks can build and shift in these markets.

SECURITIES LENDING MARKETS

Securities lenders, including mutual funds, exchange-traded funds, insurance companies, and other investors, lend securities in their portfolios to earn additional income. Securities borrowers, mainly broker-dealers, generally relend the securities to their clients for short selling and other permitted purposes.

A substantial amount of data is available about securities lending markets, but those data belong to private vendors. For example, the two largest securities lending data vendors have accumulated substantial databases covering more than $13 trillion of global securities and millions of single-day transactions involving more than 45,000 securities lenders. Industry practitioners, including custodians, prime brokers, asset managers, and hedge funds, provided the information.

However, these data collections are voluntary and do not include essential data elements about counterparties or collateral management. No systematic, targeted data collection is conducted for the benefit of regulators or the investing public. For that reason, these data are not necessarily complete or comparable for analysis. Section 984(b) of the Dodd-Frank Act mandates that the SEC adopt rules to increase the transparency of information available to brokers, dealers, and investors about securities lending. The SEC is still accepting comments and has not yet issued a proposal in this area (see SEC, 2014a).

Enhanced Financial Accounts

The OFR has begun to assist the Federal Reserve Board in its long-term project to enhance the Financial Accounts of the United States, formerly known as the Flow of Funds Accounts (see Gallin and Smith, 2014).

The Federal Reserve has long used the Financial Accounts to measure credit growth and wealth dynamics in the economy and in parts of the financial system. But the recent financial crisis illustrated that policymakers need much more detailed information about such activity in financial markets and about risk-taking — who is borrowing and lending, how financial market participants are changing the aggregate risk profile of the system through derivatives and other products, and where risk concentrations are emerging.

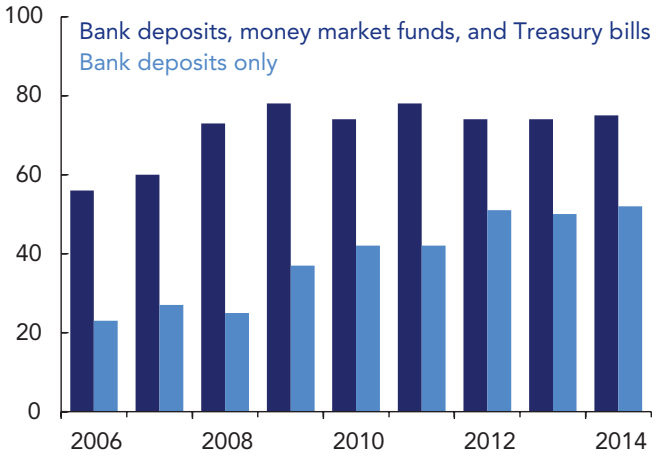
The objectives of the project are to: (1) link the quarterly, highly aggregated data to more detailed (granular) and frequent source data, where available; (2) increase the coverage of financial activity represented in the accounts to include off-balance-sheet and noncash activity; and (3) explore new measures of the flow of collateral and the flow of risks across the financial system.

A number of datasets could be helpful for this project. Those include derivatives data available through swap data repositories and the new data filed by hedge funds and other private funds on Form PF.

A recent OFR working paper suggested the need for additional information similar to that envisioned by the Enhanced Financial Accounts project, and proposed an accounting framework as a first step (see Pozsar, 2014). A key next step will be to document the data gaps identified by the project. We can use that knowledge to help inform our future data collection efforts. The ultimate goal will be to use the information for financial stability monitoring and analysis. That will be possible only when the pilot accounts are established, populated with data, and any remaining gaps identified.

Figure 6-4. Current Percentage of Short-Term Portfolio Allocated to Specific Investment Vehicles

Approximately 52 percent of corporate cash is invested in bank deposits



Source: 2014 Association for Financial Professionals Liquidity Survey

Regulators have limited information about how nonfinancial corporations invest their cash. This represents an important gap in our ability to understand what drives growth and risk in short-term wholesale funding markets. Specifically, we need data to help us analyze the sources and uses of funds in these markets.

Asset Management

SEPARATELY MANAGED ACCOUNTS

Separately managed accounts (or separate accounts) are a type of customized investment product that asset management firms offer to large institutional investors under terms defined in an investment management agreement. The OFR's *2013 Annual Report* pointed out the lack of publicly available and standardized information on separate accounts, and those data gaps prevent regulators from gauging how much risk separate accounts may represent in financial markets.

In response to the identified data gaps, the Securities Industry and Financial Markets Association (SIFMA) conducted a voluntary survey of its members in early 2014 on the separate accounts they manage (see SIFMA, 2014a). The survey provided valuable information and confirmed there is a need to improve transparency on separate accounts.

Nine firms with $11.2 trillion in total assets under management and about $4 trillion in separate accounts responded to the survey. The survey found the majority of separate accounts (97 percent) are long-only portfolios. The firms said they invest in securities such as stocks and bonds — not derivatives — and they do not sell securities short. Only 1.7 percent of the separate accounts surveyed said they use leverage. Separately managed accounts that invest only in short-term assets collectively have about $330 billion under management in 347 accounts, according to the survey. None was involved in securities lending.

Without access to market-level data, regulators cannot evaluate shifts in activities and their impacts on broader markets. For example, a potential shift of cash management away from money market funds in response to regulatory reform could accelerate the growth of separately managed cash accounts. Separate cash accounts could also become significant investors in certain types of securities and accumulate large exposures to certain entities or regions. These market developments cannot be effectively understood and monitored so long as gaps remain.

CORPORATE CASH INVESTMENT ACTIVITIES

Nonfinancial corporations had about $1.8 trillion in cash at the end of the first quarter of 2014, a record according to available data. But regulators have limited information about how nonfinancial corporations invest their cash. This represents an important gap in our ability to understand what

drives growth and risk in short-term wholesale funding markets. Specifically, we need data to help us analyze both the sources and uses of funds in these markets, as discussed in the OFR's *2013 Annual Report* and in a recent OFR working paper (see OFR, 2013a, and Pozsar, 2014).

In a recent survey by the Association for Financial Professionals, 81 percent said they expect their cash and short-term investment balances to grow or remain at the current level (see AFP, 2014). Corporations keep cash balances for a variety of reasons, including operating costs, dividend payments, share buybacks, and acquisitions. Interruptions in market access during the financial crisis may also have led some corporate treasurers to keep more liquidity available.

The substantial cash balances have made nonfinancial corporations important investors in banks and the short-term markets (see **Figure 6-4**).

Such surveys are currently the only available data source of corporate cash investments. No complete standardized dataset on corporate investments of financial assets is available to aid regulators and policymakers in monitoring any potential shifts in corporate investment preferences.

Captive Reinsurers

Regulators and market participants need better information about captive reinsurance to evaluate the financial solvency of captive reinsurers and the potential risks to holding companies (see **Section 2.3**). Captive reinsurers are licensed insurance companies created to assume insurance risk transferred from a corporate affiliate.

Captive reinsurance transactions must be approved by state regulators. Captive reinsurers do not always have the same filing requirements as traditional insurance companies, which submit large amounts of data to regulators and the public. Financial statements are publicly available for traditional insurance companies, but not for captives.

In a 2013 report, the New York State Department of Financial Services criticized the disclosure practices of some life insurance companies and their affiliates regarding captives. The state found that New York insurance companies and affiliates outside New York did not disclose in their SEC filings nearly 80 percent of captive reinsurance companies' reserve collateral secured by parental guarantees. Only 10 of the 17 insurers in the survey disclosed any information about guarantees, and the department considered only half of those disclosures sufficient (see NYSDFS, 2013).

The Federal Insurance Office recommended in 2013 that states adopt consistent disclosures and oversight standards for captives, including public disclosure of financial statements (see FIO, 2013). The National Association of Insurance Commissioners (NAIC) is considering broadening its definition of a multistate insurer, which would subject captive reinsurers to the same oversight and transparency requirements as other insurance companies.

Last year, the NAIC adopted requirements for insurance companies to report in their required annual statements the amount of reinsurance transferred to affiliated captives and to offshore affiliated captives. These requirements will provide greater insight into the level and growth of captive reinsurance activities by U.S. insurance companies. However, these changes still may not give regulators a complete picture of the level of captive reinsurance.

Any filing requirements for captive reinsurers would not extend to offshore affiliated captives. If overseas jurisdictions show more leniency than U.S. jurisdictions on either filing or substantive requirements, insurance companies might respond by increasing their use of offshore captives instead of domestic captives.

Mortgage Servicing Information

The most comprehensive information about mortgages is available from servicers. Mortgage servicers have extensive information about mortgages because they handle borrowers' payments and provide services over the life of the loan. However, it is difficult to get a comprehensive view of the mortgage industry from servicers because they are subject to different regulatory frameworks.

For example, the OCC collects mortgage data from large national bank servicers and uses that data to generate the quarterly Mortgage Metrics Report. However, mortgage servicing activities are migrating to nonbank companies not subject to OCC oversight (see **Section 2.3**). Although some nonbank mortgage servicers are publicly traded and fall under the oversight of the SEC, their financial statements do not contain detailed data about the mortgages they service.

To address these issues, the Conference of State Bank Supervisors introduced the quarterly Mortgage Call Report in 2011 to standardize the collection of data on financial condition and mortgage origination through its Nationwide Mortgage Licensing System. The Mortgage Call Report collects and aggregates data from state-licensed mortgage companies and nonbanks that use state-licensed mortgage originators. However, these data provide only high-level information for a subset of states and territories.

Industry participants have attempted to standardize mortgage data by establishing the Mortgage Industry Standards Maintenance Organization reference model, which allows adopters to more readily transmit servicing data between entities using an open-source, XML architecture (a markup language that provides a flexible way to create and share information and format). However, adoption is voluntary and, for some companies, cost prohibitive.

Analysis of potential threats to financial stability would be better supported by a standardized collection of mortgage data from bank and nonbank servicers, reported consistently over time as mortgages are transferred and sold. Such a collection could improve data quality and mapping and help identify risks building in areas with little or no regulatory oversight.

Historical Data Gaps Analysis

It is essential for the OFR to understand past financial crises as we analyze potential policies to reduce systemic risk because the next crisis may not be the same as the most recent one. There have been 17 major banking crises in the United States over the past two centuries (see Reinhart and Rogoff, 2011). It makes sense to take advantage of information about these crises to identify patterns. A broad historical focus also permits researchers to respond to available data.

For some periods and circumstances, data on interbank connections are better and more informative than data available today. For example, in the 19th century, regulators frequently checked details on interbank deposits — deposits that banks held with correspondent banks — in order to verify that banks were meeting reserve requirements.

But historical data are often locked in static, paper forms and not available for electronic analysis. If made available, historical resources — such as bank directories and bank examination reports from an earlier era — could allow us to map in unprecedented detail the interconnections of those historical interbank networks, which banks rely on for liquidity. Although banks in the same location may have faced common shocks, the degree of distress differed depending on the location and financial condition of the banks to which they were connected. However, to benefit from this information, we would need to convert the data into electronic formats.

Several researchers at the OFR are collecting detailed data on interbank connections. The first project is to create a map of interbank relationships for banks in Pennsylvania from 1870 to 1897. The second project is to create a dataset on state chartered banks and trust companies in Illinois to gain insight into the strength of interbank relationships and the effects on bank panics, using detailed information on the amount of deposits at each connected bank. These states were selected because of the availability of data.

Our researchers also are creating a dataset on debit and credit payments of the New York Clearing House and haircuts applied to banks during banking panics to help us understand the flow of liquidity during financial crises.

These projects will broaden our understanding of systematic shocks during financial crises of the past — and possibly of the future.

6.3 Regulatory Collections to Address Data Gaps

Since the financial crisis, regulators have collected new data from previously less-regulated areas of financial markets and expanded existing collections to include more detailed information on financial market activity. Regulators are also using technology and data standards to improve the quality and timeliness of collected data. This section highlights some new and enhanced data for financial stability analysis.

New and Updated U.S. Regulatory Data Collections

PRIVATE FUND DATA: FORM PF

The SEC issued a rule in July 2014 with amendments to the liquidity fund section of Form PF, the primary form for collecting data about private funds (see SEC, 2014b). These amendments align the reporting about liquidity funds in Form PF with the information that money market funds report on the SEC's Form N-MFP and which banks report

about their short-term investment funds to the OCC. This realignment will improve the comparability of data collected through the forms, permitting the SEC, OFR, and others to simultaneously evaluate risks in money market funds and private liquidity funds. Firms must comply with the new requirements by April 14, 2016 (see **Hedge Fund Leverage and Strategy**).

MONEY MARKET FUND DATA: N-MFP AND N-CR

The SEC's new rule on money market funds, adopted in July, seeks to reduce the risk of runs on money market funds and includes significant updates to requirements related to disclosure and data collection (see **Section 3.4**). Starting in April 2016, the 60-day lag on public availability of information filed on Form N-MFP will be eliminated. Money market funds will be required to disclose detailed information on their websites daily, including net asset values rounded to the fourth decimal place, daily liquid assets, weekly liquid assets, net inflows and outflows, imposition of fees and gates, and any use of affiliate sponsor support. In addition, the SEC will introduce a new form, Form N-CR, for reporting material fund events.

SYSTEMIC RISK INDICATOR DATA: FR Y-15

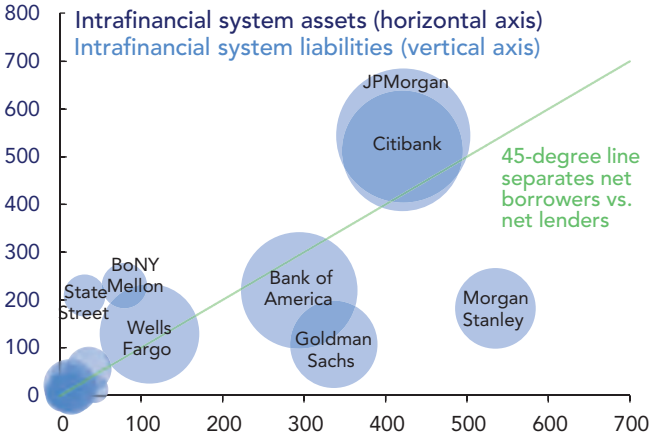
This year, for the first time, data from the Federal Reserve's FR Y-15 data collection on 33 bank holding companies is publicly available, except certain line items and data related to the liquidity coverage ratio. This collection, which began with data as of December 31, 2012, provides insight into the structure of financial networks and the interconnectedness of large financial institutions. Over the past year, minor revisions have been made, including revisions to align the FR Y-15 more closely with the assessment methodology of the Basel Committee on Banking Supervision for global systemically important banks, or G-SIBs.

The FR Y-15 collects information on the Basel Committee's systemic importance categories of size, interconnectedness, cross-jurisdictional activities, substitutability, and complexity from bank holding companies with assets of more than $50 billion. The data are used to help monitor financial stability risks posed by bank holding companies subject to enhanced prudential standards and to determine capital surcharges for G-SIBs.

A forthcoming OFR Brief will present the data used in determining U.S. bank holding companies' systemic importance scores and apply an OFR financial connectivity index to the data (see Allahrakha, Glasserman, and Young,

Figure 6-5. U.S. G-SIBs Vary in Use and Provision of Funding

Companies below the line are net lenders to other financial institutions



Note: Bubble size shows total exposures in billions.

Source: Federal Reserve Form Y-15

The FR Y-15 collects information on the Basel Committee's systemic importance categories of size, interconnectedness, cross-jurisdictional activities, substitutability, and complexity from bank holding companies with assets of more than $50 billion. The data are used to help monitor financial stability risks posed by bank holding companies subject to enhanced prudential standards and to determine capital surcharges for G-SIBs.

Hedge Fund Leverage and Strategy

In 2012, the SEC began collecting confidential data on hedge funds on Form PF, the primary form for collecting data about private funds. This analysis considers leverage levels across different hedge fund strategies. Hedge funds with higher leverage or debt are typically more vulnerable to adverse events, if all other factors are equal.

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 still new, caution is important in interpreting the information collected.

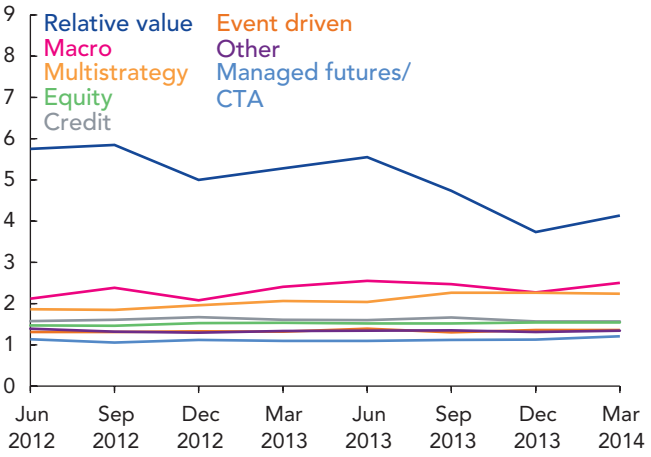
As of May 2014, about 7,800 hedge funds report data through Form PF. Of these, approximately 1,300 are qualifying funds, or funds with net assets of at least $500 million. These funds, which manage more than 80 percent of hedge fund assets, are required to file data quarterly through Form PF.

The analysis presented here is based on data from qualifying hedge funds, which report more detailed information about borrowing and derivative exposures than other funds. Although there are various ways to calculate fund leverage, a commonly used metric is the ratio of gross assets (assets under management based on the current market value of assets and uncalled commitments) to net assets (gross assets under management minus outstanding indebtedness or other accrued but unpaid liabilities).

Figure 6-6 shows this ratio for qualifying hedge funds by strategy type from the beginning of Form PF reporting in June 2012 through March 31, 2014. The figure shows that this ratio has been higher in relative-value funds than in other funds but has been declining since 2012. During the period, leverage levels in macro funds and multistrategy

Figure 6-6. Qualified Hedge Fund Gross/Net Asset Ratios

Relative value funds have reduced leverage



* CTA = Commodities Trading Advisory
Note: All filings within a reporting period are aggregated on the period end date. Funds with 70 percent or more of their strategy allocation in one strategy are labeled with that strategy.

Sources: SEC Form PF, OFR analysis

funds have increased slightly. Gross assets were $4.2 trillion and net assets were $2.1 trillion for all qualifying hedge funds as of March 31, 2014.

Funds typically build leverage through borrowing or use of derivatives. Figure 6-7 shows fund borrowing by strategy type. Borrowing decreased notably in funds after June 2013. Borrowing increased steadily for multistrategy and equity funds between 2012 and 2014.

Figure 6-8 shows that most fund borrowing is obtained through prime brokers, followed by repos and other secured borrowing. Very little hedge fund borrowing is unsecured.

Gross notional exposure is another common measure of leverage. Gross notional exposure represents the sum of the values of long and short positions in a portfolio, including notional values (face values) of derivatives. (The dollar value of interest rate derivatives are based on 10-year bond equivalent value). Multistrategy funds and macro funds managed roughly 60 percent of the gross notional exposures of qualifying hedge funds, on March 31, 2014, largely due to the use of derivatives. The notional values of derivatives represented more than half of the gross notional exposure of qualifying hedge funds. Gross notional exposure for all qualifying hedge funds was more than $14 trillion.

Hedge fund strategies can change rapidly in response to market factors. Leverage levels, even within hedge fund strategy types, can vary significantly over time, depending on individual funds' investment decisions. Monitoring ways hedge funds combine borrowing and derivatives to obtain leverage is essential to identifying potential risks in asset markets.

Figure 6-7. Qualified Hedge Fund Borrowing by Strategy Type ($ billions)

Multistrategy and equity funds borrow the most

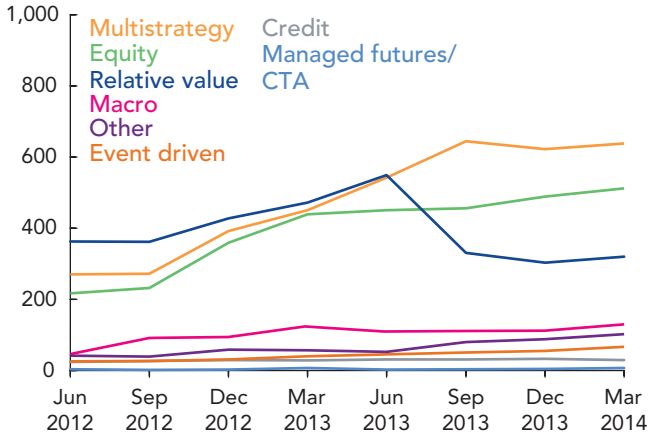
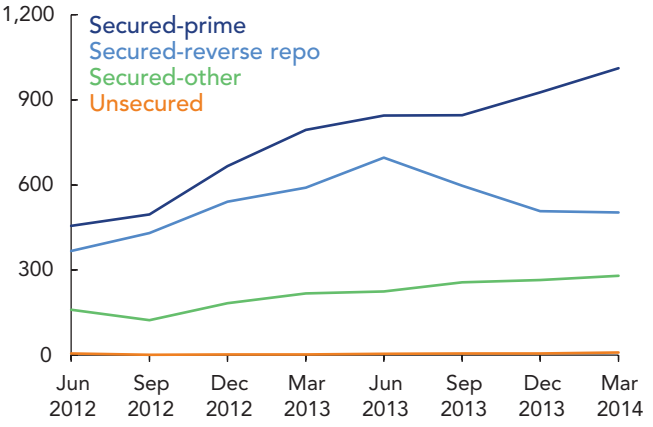


Figure 6-8. Qualified Hedge Fund Borrowing by Source ($ billions)

Most borrowing is secured, with the largest percentage sourced from prime brokers



* CTA = Commodities Trading Advisory
Note: All filings within a reporting period are aggregated on the period end date. Funds with 70 percent or more of their strategy allocation in one strategy are labeled with that strategy.

Sources: SEC Form PF, OFR analysis

forthcoming). For example, two of the interconnectedness indicators — intrafinancial system assets and intrafinancial system liabilities — attempt to measure the amount U.S. bank holding companies lend to and borrow from other financial institutions. As Figure 6-5 shows, companies above the 45 degree line have intrafinancial liabilities greater than intrafinancial assets; these banks use the financial system as a source of funding. In the figure, the size of each company in terms of total exposures is reflected by the area of each circle. The data indicate that size alone does not determine the connectivity of a bank holding company with other financial institution. Data about the interconnectedness of these institutions can help identify potential knock-on effects if one of these companies were to fail.

The FSB and Basel Committee use FR Y-15 data to update the list of firms identified as G-SIBs. In the future, the Federal Reserve may use the data to identify domestic systemically important banks.

RESOLUTION PLAN DATA

The Federal Reserve Board and FDIC continue to receive resolution plans, informally called "living wills," from all bank holding companies and foreign banking organizations with global assets in excess of $50 billion, as well as other institutions the Council has designated for supervision by the Federal Reserve Board (see **Section 3.2**). Pursuant to the Dodd-Frank Act, resolution plans are contingency plans for orderly resolution in the event of a failure. Currently, more than 120 institutions submit plans each year.

The current form of these documents (often more than 1,000 pages in length) is unwieldy, reflecting the complexity and unique nature of the information companies provide. The plans are not reported in a consistent format and data are presented in an unstructured fashion. Although this approach supports supervisors' evaluation of the plans for resolving business operations, greater standardization of this data collection in areas of commonality between the filers could make it easier for regulators to use the information for financial stability analysis.

Some of the information in resolution plans could be useful for monitoring and analyzing threats to financial stability, especially during crises. For example, resolution plans include:

- a map of a bank's ownership structure under its holding company;
- a list of cross-guarantees and major counterparties, as well as the attribution of collateral to those counterparties;
- a list of international operations;
- an explanation of the potential liquidity needs of various unwinding strategies; and
- perspective on the filers' strategies for managing technology, collateral, capitalization, and liquidity.

However, the data would need to be more structured to support macroprudential analysis. Structured data may include standardized formats and metadata tagging and might also incorporate additional detailed forms to capture data consistently.

HMDA DATA

The CFPB is implementing the Dodd-Frank Act changes to the Home Mortgage Disclosure Act (HMDA) and has proposed to change the information banks must provide about home mortgages under Regulation C to include a range of new data variables, including the length of the loan, total points and fees, the length of any teaser or introductory interest rates, and the applicant's or borrower's age and credit score.

In addition, the CFPB is considering expanding disclosures about interest rates, total origination charges, and total discount points for each loan. These changes will help public officials distribute public sector investment, determine whether financial institutions are serving the housing needs of their communities, and identify possible discriminatory lending patterns and enforce antidiscrimination statutes. They also will improve our understanding of threats to financial stability from housing finance because HMDA data are a powerful tool for understanding applications and completed mortgage loans. As these public data become available, they can reach many more researchers than proprietary products from private vendors.

FINRA DATA COLLECTION PROGRAMS

More than 35 percent of the volume of stock trades occurs outside of traditional exchanges. A portion of this off-exchange trading volume occurs in "dark pools," which are a type of alternative trading system. Dark pools comprise approximately 16 percent of overall trade volume (see Schack, Kemmsies, and Upward, 2014). Relatively opaque alternative trading systems raise concerns about the transparency of pricing and the impact of high frequency trading.

To better understand trading taking place in these systems, the SEC and the Financial Industry Regulatory Authority (FINRA) have launched several initiatives, and with these initiatives have demonstrated a shift towards more automated, frequent, detailed (account-level), and structured data collections. These new programs use formats and standards for better timeliness, clarity, and machine readability of the data. The data collected will create opportunities for research on systemic issues, such as market liquidity, concentration, and interconnectedness.

FINRA Rule 4552 requires SEC-registered alternative trading systems to report aggregated transaction data on volume and number of trades for each traded equity security on a weekly basis. For data integration, FINRA requires each alternative trading system to use a unique market participant identifier. FINRA began collecting the data in May 2014 and posts the data on its website after a wait period of several weeks.

FINRA is also developing the Comprehensive Automated Risk Data System (CARDS). In addition, self-regulatory organizations are working to implement the SEC's Rule 613, Consolidated Audit Trail (CAT). CARDS will automate the collection of business conduct information with data on account activity (balance, margin, for example) and customer investment profiles from all supervised institutions. CAT will allow regulators to track stock trading at the account level for forensic purposes.

Combined, CARDS and CAT will provide an almost complete and continuous account-level picture of market activity and status. FINRA has announced plans to have CARDS and CAT online in 2015.

TRADING EXCHANGE DATA: MIDAS

The SEC's Market Information Data Analytics System (MIDAS) provides staff at the SEC with an analytics and data platform geared towards research on equity and equity options market structure. MIDAS joins data feeds from the 11 domestic stock exchanges, as well as the consolidated tapes for equities and options, to report information for exchange-based posted orders, modifications, cancellations, and off-exchange executions.

MIDAS is available to the SEC in near real-time through cloud computing. The SEC uses this information to inform research on equity and equity options market structure and also publicly provides quarterly data metrics and analysis on its website.

Although MIDAS is not a regulatory data collection — it draws exclusively from commercial sources — it demonstrates the use of technology and standards to make existing data more useful and closer to real-time, closing data gaps that impede timely analysis and monitoring.

SWAP DATA REPOSITORY DATA

Swap data are now available through swap data repositories (SDRs) to the public and to regulators, principally the CFTC. However, SDRs have different system architectures, and the data are reported differently to each SDR. The lack of reporting standards across SDRs has created significant data gaps.

The CFTC has begun to address these issues on many levels by, among other things, requesting comments related to swap data reporting. The OFR has also been assisting the CFTC to improve the quality of SDR data (see **Section 5.4**). The SEC has proposed swap reporting rules but they have yet to be adopted. In the meantime, the OFR has access to credit default swap data from the Depository Trust & Clearing Corporation, which is a market utility supervised by the SEC (see **Section 4.4**).

CYBERSECURITY

Concerns over cybersecurity have grown over the past decade because large-scale data breaches have become more common, reflecting the growing volume of data stored electronically and the increasing technical sophistication of cyberattackers. The increased frequency of cyber-attacks has prompted attention from regulators and raises concerns about potential financial stability risks.

The SEC requires public companies to disclose cybersecurity breaches, and many firms note breaches in their public regulatory filings. However, there remains a significant data gap, because firms are reluctant to provide details about the size or impact of cybersecurity breaches due to concerns over potential damage to the confidence of clients and business partners.

Separately, this year the Federal Financial Institutions Examination Council (FFIEC) announced a pilot program to assess the management of cybersecurity risks by community financial institutions. It is undertaking other initiatives to raise awareness of those risks across the financial sector.

International Data Collection Efforts

The global nature of the financial crisis underscored that data gaps, problems in data quality, and a lack of data standards were international problems, not just issues of domestic concern. To resolve cross-border issues, regulators collaborate through international financial forums such as the Financial Stability Board and the Basel Committee on Banking Supervision.

International data-sharing is essential to afford regulators a complete view of financial risks. The OFR recognizes that security concerns can be an obstacle to data sharing, but appropriately constructed and shared security frameworks can lessen those concerns (see **Section 6.4**).

Over the past year, the G-20 Data Gaps Initiative has made progress in expanding data collection on concentration risk and interconnections among G-SIBs, to include data on G-SIB funding dependencies. (The G-20, or Group of 20, is a forum of the world's largest advanced and emerging economies.)

The initiative will continue work during the next year to collect G-SIBs' consolidated balance-sheet data broken down by risk exposures such as sector, instrument, and maturity. These data collections will be valuable for financial stability analysis because they provide an unprecedented set of comparable, detailed data about some of the largest and most complex financial institutions.

The G-20 uses a data hub to pool collected data and provide secure sharing arrangements for analytical reports based on the data. This is an example of how international regulators can cooperate to pool highly confidential cross-jurisdictional data and link and aggregate those data for financial stability analysis.

The Basel Committee on Banking Supervision continues to review issues that surface as jurisdictions implement Basel III. This year, the committee focused on the Basel III leverage ratio to ensure comparability and accuracy of the data (see BCBS, 2014a). Although Basel III was finalized in 2010, problems that emerged during implementation highlight the ongoing regulatory challenge, particularly for internationally agreed standards of data definitions, quality, and comparability in data collections.

Another challenge for international data efforts is the divergence of market infrastructure and its institutional design across jurisdictions. For example, the repo market in Europe is substantially different from the U.S. repo market. The majority of European repos are conducted in the electronic, anonymous interbank market, which relies on a central counterparty. All European repo market participants have access to the European Central Bank's refinancing facilities, which substantially reduces the risk of asset fire sales due to counterparty default. Because of bank participation in the repo market, the European Central Bank has collected a substantial database of repo and reverse repo activities, among other data elements related to monetary statistics and bank operations. Aggregated data are publicly available on the European Central Bank's Statistical Data Warehouse website.

The OFR is closely following developments in Europe's Common Reporting (COREP) and Financial Reporting (FINREP) regimes. These are reporting frameworks mandated by the European Banking Authority to harmonize supervisory reporting standards across Europe. FINREP provides templates for detailed data about income statements, balance sheets, and other areas to improve consistency of scope, granularity, and definition of data elements. This standardized data collection effort leverages new technologies and promises to provide regulators data that can be easily compared, analyzed, and aggregated in a timely manner.

OFR INTERNATIONAL PARTICIPATION

The OFR participates in international efforts because cross-border cooperation is essential for us to serve the Council, promote data standards, fill data gaps, and promote secure international data sharing.

In 2014, we participated in the FSB's *Feasibility Study on Approaches to Aggregate OTC Derivatives Data,* published in September, which studied issues and options for harmonizing derivatives data reporting across jurisdictions (see FSB, 2014a). During the crisis, the complexity and lack of transparency in derivatives trading and markets were debilitating for firms and impaired regulators' ability to understand interconnections and the spread of the crisis.

The OFR also participates in the FSB Workstream on Securities Lending and Repos. We focused on efforts to identify data gaps and develop protocols and standards for collecting data for cross-jurisdictional comparability and aggregation. We provided expertise from user and data management perspectives drawing on our research and monitoring priorities on short-term funding markets and our data policy agenda for more efficient data collections and use of

data standards. We hope these data can be more readily and securely shared across borders. Domestic efforts to fill data gaps in repo and securities lending are linked to this work (see **Section 6.2**).

6.4 Collaboration and Data Sharing Initiatives

Sharing information is essential to make the best use of data for effective and comprehensive financial stability analysis, as no regulator has access to all of the data that might help monitor risks across the financial system. It can also help minimize regulatory burden on financial entities whose activities we seek to understand. Of course, sharing information must be done in a secure manner to protect the confidentiality and security of the data being shared.

Because of our mandate to support the Council in its analysis of threats to financial stability, we work to improve data sharing among Council member organizations. We also sponsor research and undertake projects related to collaboration and sharing. This section describes three: the Interagency Data Inventory, sponsored by the Council's Data Committee, a project the OFR has begun to learn about reporting overlaps in new data collections, and a project that the OFR has begun to connect datasets that use different identifiers. It also describes our framework for protecting data that others share and entrust with us.

Data Inventory

The Council's Data Committee sponsored an initiative to develop a catalog of datasets that Council member agencies have available through industry filings or commercially purchased data.

This Interagency Data Inventory does not hold the actual datasets, but rather is a list of the metadata, or information, about the datasets. The metadata include a brief description of each dataset and categorizes the dataset as financial, supervisory, application, complaints, structure, or other (see OFR, 2013a). Basic information, including the collecting agency, name of the form used to collect the data, and form number, are also included.

Over the past year, the OFR and Council member agencies began to transform the inventory from a preliminary catalog into a more searchable, accessible, and information-rich resource, in the following ways:

- We are exploring adding new information, for example, by the legislation or regulation that required the collection, and the dates the data collection began and ended. Other information being considered includes the financial market subsector or instrument of primary focus, based on a classification system we are developing.
- We reconciled inventory records with the Office of Management and Budget's public record of data collections. This marked an important step in improving the accuracy and comprehensiveness of the inventory.
- We developed a visualization tool for use by Council member agencies for easy search and analysis by one or more criteria.

The Data Committee and the OFR will review the inventory on an ongoing basis to evaluate its usefulness and identify ways it can be used and improved for Council member agencies and the public. The public portion of the inventory is on the OFR website (see OFR, 2014).

Reporting Burden and Efficiency Project

Before the crisis, financial activity had grown substantially in less transparent or less regulated markets. In response, Congress has expanded regulatory jurisdictions, and Congress and the agencies have increased data reporting requirements, domestically and internationally. As the depth and type of data collected have expanded, so has the potential for overlapping requests among agencies and their reporting forms.

The OFR has begun a project to better understand potential data reporting overlaps. The experience gained will provide insights for the ongoing dialogue between regulators and market participants concerning reporting efficiency and burden.

For the initial project, we focused on a proposed new collection because the largest expense for firms and regulators in data collection is during startup. We looked for overlaps in the second portion of the FSB's new international collection of data from G-SIBs. Phase 1 of the collection started in 2013 and focused on companies' counterparty exposures and other major risk dimensions. Phase 2 in 2014 added information about institution-to-institution liabilities, large bank and nonbank funding providers, and their sources of funding. Phase 3 will include more detailed balance-sheet data (see FSB, 2014b).

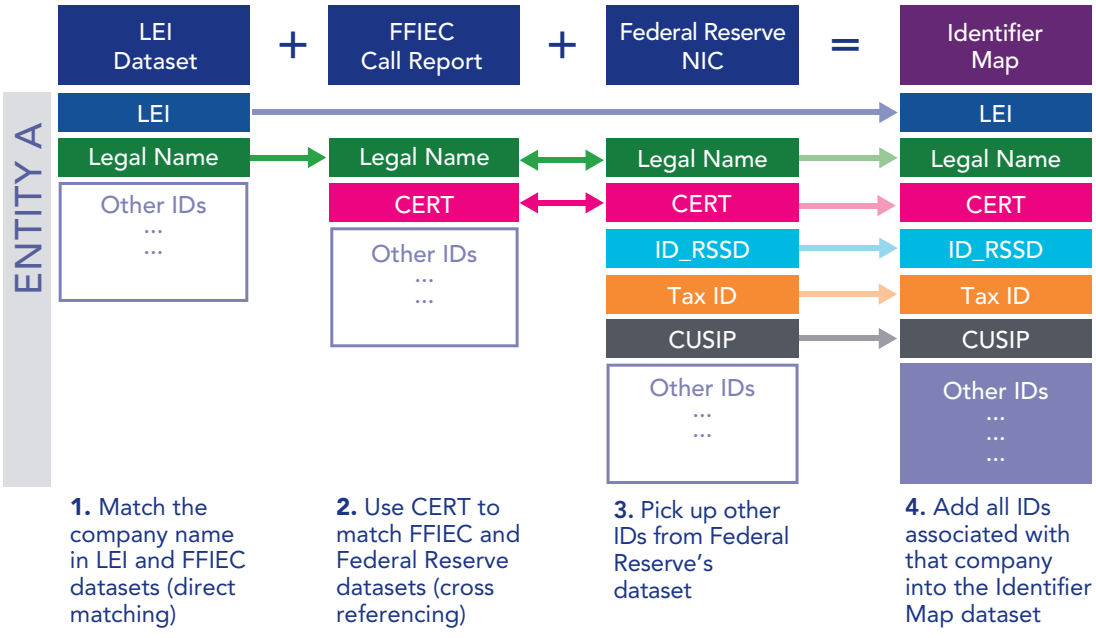
We began our analysis by reviewing the Interagency Data Inventory to identify reports that might have areas of overlap with the FSB Phase 2 data collection template. An overlap occurs if some companies have been asked to report the same type of data in multiple forms. We compared the purposes, scope, organizational frameworks, data definitions, line items, and data fields of the Phase 2 template and existing reports. We also considered whether a filer could have fulfilled a data request in Phase 2 with an existing report, either an exact match or through a small modification of an existing data field. Such modifications could include adding subfields for more detail or minor alterations in data definitions.

This FSB data collection on G-SIBs will form an unprecedented set of detailed and comparable data about some of the largest and most complex financial institutions in the world — an invaluable resource for financial stability analysis. For this and most new collections, exploring for and understanding potential overlaps in regulatory datasets and addressing reporting burden are complex tasks. We continue to work through our findings, but have identified the following general issues:

- **Variations in Data Definitions and Concepts.** Even a simple concept can have complex dimensions. For example, the Federal Reserve's Form Y-9 collects information on deposits broken down into two categories: interest-bearing and noninterest-bearing. The FSB project's Phase 2 template requests data on nonmaturity deposits. These categories are different.
- **Challenges of Disaggregation and Reaggregation.** Reporting forms may rely on the same definitions, but differ in their requests for detail. For example, Phase 2 requests data on bond holdings. But there is no such item on the Y-9, which instead includes bond holdings in more than one line item, including "Line 2. Securities" and "Line 5. Trading Assets" on Schedule HC, on the Consolidated Balance Sheet. To compare the two forms, an analyst would have to disaggregate, or separate, these and other line items to identify the bond subcomponents (not currently possible with Y-9 data), and then reaggregate them to calculate a total comparable to the Phase 2 data entry.
- **Variations in Collection Frequency.** Collection schedules can be expensive to change for regulators and companies because of the cost of systems and processes. The Y-9 is reported quarterly, but the Phase 2 data are to be reported monthly, with a lag of five working days. The goal is to report Phase 2 data weekly with a lag of three working days.

Standardization of data definitions and formats can address many of these differences (see **Chapter 5**). Another way to promote reporting efficiency is to collect

Figure 6-9. Matching a Firm Across Datasets



Source: OFR analysis

data, not forms — or in other words, to transmit data using existing standard transmission protocols such as SDMX, XBRL, and ISO 2022, which provide definitions for the transmission and meaning of the data.

Working together, regulators should be able to collect the information they need and minimize the burden for reporting firms. Regulators that identify a need for a new collection could determine first whether the needed information already lies in existing collections that can be accessed through regulatory collaboration and data sharing, or modest reworking of the standards or definitions in existing collections.

Identifier Mapping

Analysts need connected sets of information about companies, industries, and markets to conduct financial stability analysis and monitoring.

Datasets from regulatory and commercial sources frequently use proprietary unique identifiers to identify firms, so matching firms to compare or link information about them across datasets can be difficult or even impossible. The Legal Entity Identifier (LEI), a unique identifier for firms in financial transactions, offers a solution to this problem, but companies and regulators need time to adopt and implement it fully (see **Section 5.3**). Until then, matching firms across datasets is a time- and resource-intensive undertaking.

To address this need, the OFR is creating an "identifier map" to enable research and analysis that may not otherwise be feasible. We intend to make it publicly available once complete. The identifier map will match firms and link their identifiers across regulatory and private vendor datasets, so the same firm in one dataset can be definitively identified in other datasets. It will enable information about a firm to be combined across multiple sources of data, allowing insights not possible by looking at each dataset in isolation.

The map is an example of a project made possible by the Interagency Data Inventory, showing how valuable collaboration among Council member agencies can be.

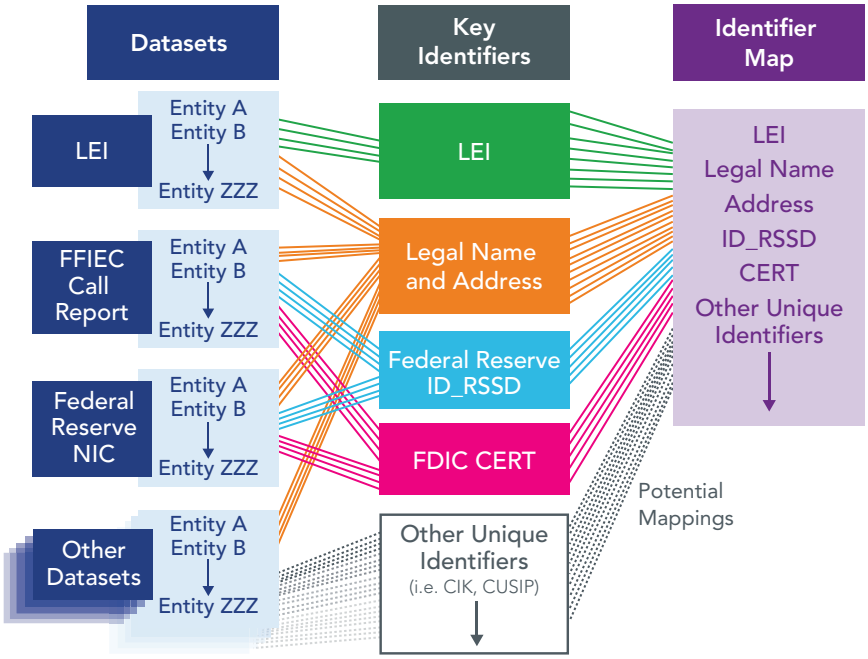
IDENTIFIER MAPPING PILOT

In 2014, the OFR's pilot project mapped the LEI with: 1) the FDIC's entity identifier, the certificate number (CERT), used in the FFIEC Consolidated Reports of Condition and Income (commonly known as the commercial bank Call Report), and 2) the Federal Reserve's entity identifier (ID_RSSD), used in its National Information Center (NIC) database.

The pilot used two techniques:

1. **Direct matching** seeks an exact match of one or more fields between datasets. If any variation exists in the fields to be matched, it is not considered a match. We found matches between the "Legal

Figure 6-10. Complexities of Creating an Identifier Map



Source: OFR analysis

Name" fields of the LEI dataset and the call report. Matches between the "Legal Name" fields allowed for company matches between the two datasets and mapping of their identifiers (LEI and CERT).

2. **Cross-referencing** verifies the results of the direct match and adds commonly shared identifiers to the final merged identifier map. The FDIC's certificate number is in the FFIEC's call report and the NIC database. We used the certificate number for further verification of the firms mapped through the "Legal Name" fields. The cross referencing also allowed us to add identifiers from the NIC database, such as the Federal Reserve's entity identifier (ID_RSSD), the tax ID number (an entity identifier used by the Internal Revenue Service), and the CUSIP (a widely used entity identifier used in financial transactions), making the identifier map a more information-rich resource.

Figure 6-10 shows the connections between the datasets we mapped and the complexity of the process and relationships.

Figure 6-9 shows the process for matching a single company across the LEI, FFIEC call report, and NIC database, and creation of the identifier map. The pilot showed us that, although algorithms exist to aid the mapping process, mapping identifiers is still a heavily manual process.

We believe the identifier mapping project will prove valuable to the OFR, the Council, other researchers, and the public. We intend to expand the scope of the project and release results as they develop.

Once the LEI has been fully adopted and embedded in industry and regulatory datasets, it will allow datasets that contain LEIs to be merged based on the company LEI, minimizing the need for time-intensive, manual entity resolution and identifier mapping.

Securing Data for Collaboration and Sharing

Data on a broad range of activities and markets across the financial system must be available and easily accessible for monitoring and analysis. However, no single regulator has all needed data, and it is critical to not duplicate data collections. Consequently, it is imperative that the OFR and Council member agencies collaborate and share data for financial stability analysis.

The benefits of sharing data are largely understood. Still, there are obstacles to doing so appropriately. Regulatory agencies must maintain the security of confidential data, financial institutions need strong comfort on the appropriate regulatory sharing of their data, and regulatory agencies receiving shared data must provide assurances that the data will be appropriately interpreted. The OFR collaborates with Council member agencies to overcome these obstacles. We also collaborate with researchers and research organizations in analysis and monitoring.

INTERAGENCY FRAMEWORK FOR INFORMATION SECURITY CATEGORIZATION

In 2013, OFR co-chaired a working group of the Council Data Committee that recommended a common information security categorization framework for communicating and ensuring the security of shared data among Council member agencies. The goal is to ease data sharing and ensure the receiver of shared data keeps them at least as secure as the data provider does.

The framework sets out principles for data sharing and responsibilities between agencies. It also establishes procedures that emphasize joint communication and control and required documentation of the data request process. The framework leverages existing information security guidance issued by the National Institute of Standards and Technology (NIST) for federal agencies.

The framework is voluntary and agencies may choose whether or not to adopt it. We believe, if adopted, it will improve secure information sharing. The OFR follows this framework for information sharing.

OFR'S SECURING DATA FOR COLLABORATION

To appropriately protect data that others share and entrust with us, the OFR takes legal and technical steps to secure the data and protect its confidentiality. For example, we and Council member agencies have signed a memorandum of understanding (MOU) governing the treatment of nonpublic data. We continue to enter into other nondisclosure agreements and additional MOUs as necessary to protect and preserve data confidentiality and outline the responsibilities of data users. We also work to ensure the proper handling of data through education and training, written policies, securing files at rest and in transit, encrypting files for transmission, and signed confidentiality agreements.

The OFR purchases data from commercial vendors and is bound by licensing agreements. These licenses provide

access to data and restrict some types of data sharing. However, OFR can often use such data to create work products which can subsequently be shared. In other cases, the OFR establishes agreements with noncommercial providers, such as financial market utilities, for use of their data for our research and analysis.

OFR INFORMATION SECURITY PROGRAM

Our information security program employs a variety of technologies to safeguard data security through transmission, storage, access control, and dissemination or publication.

Transmission. Our data sharing agreements set standards for handling highly sensitive data, using the information security categorization framework as a minimum standard. The OFR also enters into interconnection security agreements, which go a step beyond MOUs to outline expected behaviors for incident handling and notification procedures. The agreements are developed in accordance with NIST Special Publication (SP) 800-47, *Security Guide for Interconnecting Information Technology Systems* (see NIST, 2002).

When the OFR requests data, we work closely with the data provider to address any unique security requirements. Once we receive the data, we continuously monitor for any anomalous activities and potential signatures that may indicate a cyberattack or an unauthorized access attempt.

Storage and Access Control. To protect data stored and accessed by OFR employees, we constructed a new analytic environment and adopted a continuous monitoring approach, with proactive security measures to prevent, detect, and respond to potential attacks and attempts to gain unauthorized access. We completed an independent security assessment and authorization of the analytic environment in accordance with standards from NIST SP 800-53 Revision 4, *Security and Privacy Controls for Federal Information Systems and Organizations* (see NIST, 2013). We also completed an external penetration test conducted by an independent third party. The analytic environment achieved full accreditation, which verifies that an information technology system has passed a host of rigorous security checks based on NIST guidelines.

To guard against potential access by unauthorized individuals, we conduct routine access reviews and security posture assessments, and require multiple levels of approval before granting staff members access to data. We developed an access control and management application and employ a role-based access control model that incorporates physical access controls, technical controls over network connections, and frequent internal audits. The access control model also allows security groups and policies to be applied at a detailed level, ensuring a high degree of oversight and control.

Dissemination and Publication. The OFR is also evaluating technologies to promote collaboration and dissemination of data, while ensuring that data remain secure. One technology uses virtual computing platforms that allow users (such as researchers working outside our offices) to work collaboratively without affecting the overall security of the environment.

Another collaboration mechanism uses secure peer-to-peer technologies that meet the security requirements of FIPS 140-2, *Security Requirements for Cryptographic Modules* (see NIST, 2001) and allows secure file sharing among federal agencies.

OFR RESEARCH ON SHARING AND SECURITY

In 2014, our researchers continued to explore a cryptographic method called "noise addition," which is related to common data anonymization and masking techniques. Noise addition adds statistical noise to a dataset, so no information is initially available. Over time, the variance of the added noise is reduced, gradually revealing more information. This technique might allow us to secure data to collaborate with other regulators and appropriately share data with agencies, researchers, and potentially the public while protecting confidentiality.

OFR researchers also continue to explore other cryptographic methods that could help with safe and effective sharing of data, as described in a 2013 OFR working paper (see Flood and others, 2013). The purpose of this work is to improve access to data that would otherwise be confidential, closing data gaps for market participants and the public. Tension exists between making data available and protecting those data, and this research focuses on easing that tension.

OUTREACH, COLLABORATION, AND INFRASTRUCTURE

7

Collaboration is central to the mission of the OFR and includes outreach to Congress, Council member agencies, international financial regulators, academic researchers, industry groups, and the public. Since 2010, we have assembled a virtual research community of global financial stability experts and, at the same time, built a highly skilled OFR workforce and cost-effective operational systems.

7.1 Collaboration and Outreach Drive the OFR's Work

In FY 2014, the OFR partnered with the CFTC to help improve how swap data repositories collect and standardize data about derivatives trades. The OFR also collaborated with other regulators and industry internationally and in the United States as the Office played a key role in developing, launching, and rolling out the global Legal Entity Identifier (LEI) system to help map connections in the financial system that will cut industry costs for cleaning, combining (aggregating), and reporting data.

The OFR regularly reaches out to academic and financial industry groups for input about emerging issues in financial stability and financial data standards. In FY 2014, we cosponsored two conferences that featured leading experts on monitoring and measuring risks to the financial system.

We collaborate with others to maximize our resources, support financial stability research, and promote standards that will help produce reliable, high-quality data about the financial system.

- In January 2014, the OFR and the Council cosponsored their third joint conference. The event, entitled "Mapping and Monitoring the Financial System: Liquidity, Funding, and Plumbing," explored the interconnectedness among firms and markets as well as other vulnerabilities in the financial system.
- In June 2014, we joined the Consortium for Systemic Risk Analytics and the Massachusetts Institute of Technology's Laboratory for Financial Engineering in sponsoring the "Conference on Systemic Risk" in Cambridge, Massachusetts. The event explored four broad aspects of the measurement of financial stability: risk data, stress testing, market-based measures, and measurement of financial networks.

We also chaired the interagency planning committee of the annual Regulatory Data Workshop in August 2014. More than 300 employees of Council member agencies and regional Federal Reserve banks attended to share potential solutions to common financial data-related problems. The government-only event discussed ways to improve financial data standards and governance, strategies to visually represent data for analysis, techniques to securely collect and store data, and protocols to safely share data with other regulators.

OFR Responsibilities Under the Dodd-Frank Act

The Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010 established the OFR and its Data Center and Research and Analysis Center. The law requires the OFR to support the Financial Stability Oversight Council and to carry out the following responsibilities:

DATA CENTER

- Collect data on behalf of the Council and the public;
- Assist Council member agencies in determining the types and formats of data authorized by the Act to be collected;
- Standardize the types and formats of data reported and collected;
- Prepare and publish a financial company reference database and a financial instrument reference database; and,
- Perform other related services.

RESEARCH AND ANALYSIS CENTER

- Develop and maintain metrics and reporting systems for risks to U.S. financial stability;
- Monitor, investigate, and report on changes in systemwide risk to the Council and to Congress;
- Conduct, coordinate, and sponsor research to improve regulation of financial entities and markets;
- Evaluate and report on stress tests or other stability-related evaluations of financial entities overseen by Council member agencies;
- Maintain the expertise necessary to support specific requests for assistance from financial regulators;
- Investigate disruptions and failures in the financial markets, report findings, and make recommendations to the Council;
- Conduct studies and provide advice on the impact of policies related to systemic risk; and
- Promote best practices for financial risk management.

Our director and senior managers also speak frequently at industry and academic events to explain the OFR's projects and discuss potential threats to financial stability. The following speeches during the 2014 fiscal year are published on our website:

- Director Richard Berner, at the Money Marketeers of New York University, "Financial Stability: Progress and Challenges," October 16, 2014;
- Director Berner at the Joint Conference of the Center for Financial Policy at the Robert H. Smith School of Business at the University of Maryland and The Clearing House, "The Financial Industry in a Post-Crisis World Symposium," July 10, 2014;
- Chief Data Officer Linda Powell at the Object Management Group Technical Meeting, March 26, 2014;
- Chief Data Officer Powell at the GS1 Global Forum 2014, February 18, 2014; and,
- Director Berner at the Exchequer Club of Washington, October 16, 2013.

We welcome groups or companies that want to share information with the OFR on issues related to financial stability or data standards. Because of the international nature of financial markets, we are building relationships with authorities in other countries to discuss research and analysis and promote information sharing and the use of data standards around the world.

Financial Research Advisory Committee

Our work is enhanced by the insights and expertise of the OFR's Financial Research Advisory Committee, a group of 31 distinguished professionals in economics, data management, risk management, information technology, and other fields. The committee, established in November 2012, meets approximately twice each year. It has three subcommittees that meet more frequently and are focused on research; data and technology; and financial services and risk management.

In 2014, the committee welcomed 11 new members to replace members whose terms expired. Current members include a former vice chairman of the Board of Governors of the Federal Reserve, a former chief economist of the Securities and Exchange Commission, and senior data and risk management executives at major financial services companies.

At the committee's most recent meeting in July 2014, members addressed two discussion topics suggested by the OFR: 1) the impact of reduced liquidity on financial markets during stress events, and 2) the metrics regulators need to analyze and aggregate data about the swap market. The committee also adopted and presented to the OFR a recommendation for the Office to begin a project to evaluate how standardized definitions (known collectively as ontologies) could help the CFTC and OFR improve data quality in swap data repositories.

Working Papers, Grants, and Seminars

The OFR Working Paper Series is an important tool for disseminating OFR research and informing the process of assessing, measuring, monitoring, and mitigating threats to financial stability. The series is also a significant collaboration tool because papers are frequently coauthored by OFR staff researchers with outside experts from academia, industry, and other federal agencies. At the end of November 2014, the OFR had published a total of 21 working papers on subjects ranging from risk management to stress tests to shadow banking.

The OFR launched a new research product in FY 2014, the OFR Staff Discussion Paper Series, for our staff researchers to share more of their work with the academic community and the public. Three discussion papers were published as part of the new series that contributes to our understanding of financial markets, financial data, and financial institution risks. In the coming year, the OFR will continue fine-tuning and improving our Financial Stability Monitor to keep the public informed about vulnerabilities. The monitor, initially released in our 2013 annual report and updated in this report, tracks financial distress based on a mix of economic indicators, market indexes, and measurements calculated by the OFR.

To supplement the work of our staff members in the OFR's Research and Analysis Center, we brought outside experts on board for fellowships and other temporary employment. We also awarded three grants in FY 2014 to promote financial stability research. A University of Maryland researcher received a grant of approximately $300,000 over two years to research whether information in companies' 10-K annual filings with the SEC can be extracted, aggregated, and interpreted to help identify emerging risks to financial stability. Another grant of the same size went to a University of South Florida researcher to explore whether detailed information collected from financial contracts can be used to determine economic risk exposures. A third grant of $250,000 over two years went to a University of Michigan researcher to study the stability of dynamic credit networks by applying recent developments in economics and computer science to risk analysis.

Throughout the year, we invited experts from financial regulatory agencies, universities, and industry who are exploring new financial stability theories to discuss their work with our staff in a collaborative forum where ideas can be tested and expanded. This series of in-house research seminars is just one of the ways the OFR leverages the expertise of staff members and promotes the continuing exploration of issues related to financial stability.

Public Transparency

The OFR is committed to sharing nonconfidential financial stability information with the public on our website.

In FY 2014, we posted the public portion of the Interagency Data Inventory, which catalogs the data that Council member agencies buy from vendors, collect from industry, or derive from other data. This portion of the inventory included more than 300 items that U.S. regulators collect from industry, typically on a monthly, quarterly, or annual basis.

OFR's financial stability conferences and advisory committee meetings are also accessible to the public through webcasts. Although much of the OFR's work products cannot be made public because of confidential and market-sensitive data, we strive to be transparent whenever possible. Traffic has steadily increased on the OFR's website and total visitors rose more than 35 percent in FY 2014 from the previous year. When we post significant content on our website, we send an alert to website subscribers. At the end of FY 2014, we had nearly 6,000 subscribers signed up to receive e-mail alerts, more than double from the end of the previous year.

OFR speeches, Congressional testimony, press releases, and information about public conferences and events are posted online at www.treasury.gov/ofr.

Congressional Affairs

We meet frequently with Members of Congress and their staffs to keep lawmakers informed of our work and to discuss financial stability issues. OFR Director Berner testified

OFR's Vision, Mission, and Goals for FY 2015-19

Vision: A transparent, efficient, and stable financial system.

The OFR's mission is to promote financial stability by delivering high-quality financial data, standards, and analysis for the Council and the public.

Goal: The OFR is an essential source of data and analysis for monitoring threats to financial stability.

- The OFR's monitoring tools and analyses are widely used and critical to assessing financial stability.
- Data used to monitor financial stability are comprehensive, reliable, and accessible to policy makers and the public through the OFR.
- Data providers and the public recognize that OFR data are protected and secure.

Goal: Standards that improve the quality and utility of financial data are identified and adopted.

- Industry and policy makers recognize the need for standards.
- The OFR is the source of expert knowledge needed to develop and implement types and formats of data reported and collected.
- Financial data standards that create efficiencies and facilitate analysis are widely used.

Goal: Leading edge research improves financial stability monitoring and the scope and quality of financial data, and informs policy and risk management.

- The OFR is the recognized center for objective, innovative research on financial stability.
- OFR research is widely cited and used to improve policy making, risk management, financial stability, and the scope and quality of financial data collections.

in January 2014 before the Senate Banking Subcommittee on Economic Policy and in February 2014 before the House Financial Services Subcommittee on Oversight and Investigations.

At both hearings, the Director described the Office's accomplishments, priorities, and efforts to enhance transparency and accountability. In addition, the Director gave a presentation on Capitol Hill for Congressional staff members in April 2014 for the Capital Markets 101 Distinguished Speakers Series. During the presentation, the Director discussed the OFR's mission and highlighted some of the Office's significant work.

7.2 OFR Vision, Mission, and Operations

The OFR's mission is to promote financial stability by delivering high-quality financial data, standards, and analysis for the Council and the public. Our strategic plan will guide our goals and objectives in fiscal years 2015-19. Through our work, we aim to move toward the vision of a "transparent, efficient, and stable financial system."

Strategic Plan for FY 2015-19

The statutory mandates in the Dodd-Frank Act and the OFR's strategic plan are the foundation for our mission, vision, goals, objectives, and strategies. The FY 2015-19 plan builds upon the strategic framework covering FY 2012-14, and guides our next stage of development. The new plan sets three strategic goals, each with specific objectives and strategies, to fulfill our Congressional mandate and produce value for stakeholders (see **OFR's Vision, Mission, and Goals for FY 2015-19**). The strategic plan, which will be released shortly, also serves as a guide for us in setting priorities and allocating resources over the next five years.

The financial system will continue to change over the life of this strategic plan and will require the OFR to continually review its strategies for effectiveness in achieving the organization's goals and objectives to deliver on its mission. As a result, strategies and tactics may change related to data management, financial data standards, research that the organization pursues, and initiatives aimed at building institutional capabilities. All these efforts will focus on delivering ever-increasing value for our stakeholders.

Performance

The OFR established initial performance measures in 2012 tied to its then-current strategic goals. The measures were designed to track our performance in achieving the OFR's goals and objectives. The measures are continually reviewed for effectiveness in assessing the performance of the organization, and changes are implemented as appropriate. These measures are shared annually with the public in the President's Budget.

Tracking performance measures is only one way to manage performance. We will also use qualitative information to assess our performance, and we will continue to use comprehensive performance reviews to check progress and make appropriate course adjustments.

Budget

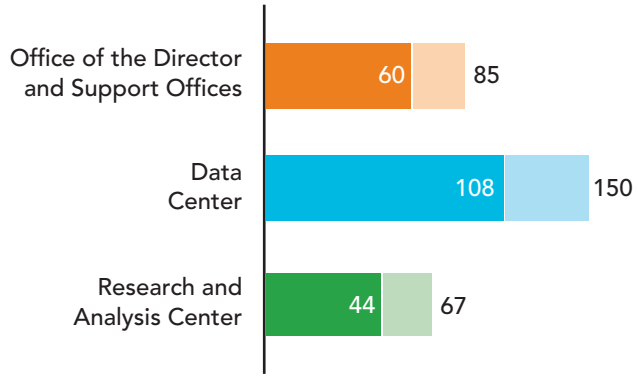
The Dodd-Frank Act directed the Department of the Treasury to establish a schedule to collect assessments to pay the expenses of the Office, the Council, and certain expenses for the implementation of the FDIC's orderly liquidation authority.

Treasury finalized a rule in 2012 that enabled the Office to collect semiannual assessments from bank holding companies with total consolidated assets of $50 billion or greater and nonbank financial companies supervised by the Board of Governors of the Federal Reserve. 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. The semiannual fee rate has since declined to about $3,000 per $1 billion of assets held by the assessed companies.

In FY 2014, the OFR spent about $82.7 million. Our estimated budget for FY 2015 is $99.5 million. Details are provided annually in the President's Budget.

Our budgets are developed following the Office of Management and Budget's Budget Circular A-11 guidance. The OFR's financial management process follows Treasury policies, and our financial activities and controls are reviewed as part of the Department's consolidated audit. To strengthen our stewardship of the funds entrusted with us, we have also developed additional rigorous internal controls, project review mechanisms, and decision-making protocols to monitor spending effectively. Treasury's Office of the Inspector General and the Government Accountability Office periodically audit OFR governance, processes, procedures, and activities.

Figure 7-1. Current and Target Workforce



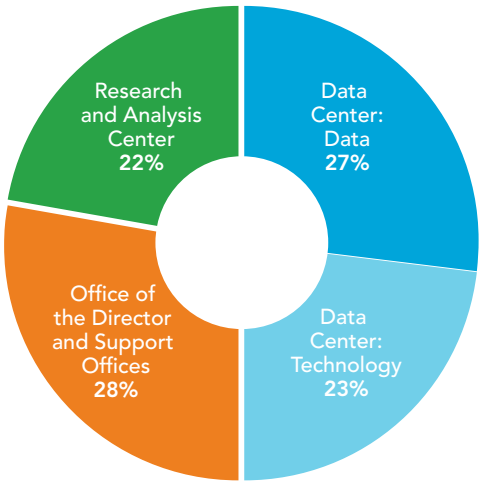
Source: OFR analysis

Because of the international nature of financial markets, we are building relationships with authorities in other countries to discuss research and analysis and promote information sharing and the use of data standards around the world.

Information Technology

The Dodd-Frank Act requires the OFR to maintain adequate information technology systems for data acquisition, management, analysis, and dissemination, applying strict rules for security and data sharing. In FY 2014, we completed the installation of a robust, long-term analytical environment for storing and handling large amounts of data to support complex financial models, computations, and analysis. The Office has continued to install a wide range of security tools and components to strengthen its already high security protections.

Figure 7-2. Planned Workforce Distribution



Source: OFR analysis

Through our work, we aim to move toward the vision of a "transparent, efficient, and stable financial system."

7.3 OFR Organization and Workforce

The OFR continues to hire specialized and highly qualified employees for our Research and Analysis Center, Data Center, and other operations.

The Dodd-Frank Act requires that a Director lead the OFR and oversee its two major components: the Data Center and the Research and Analysis Center. One of our priorities is to recruit and hire specialized and highly trained employees to fulfill our mission. We continue to build an organization and culture of trust, accountability, and urgency to attract and retain talented individuals.

The OFR staff has increased from 30 in FY 2011 to 224 at the end of FY 2014. Our target for FY 2015 is to reach a total workforce of approximately 300, including permanent, reimbursable, and detailed staff members (see **Figure 7-1**).

When fully staffed, the OFR will have about 50 percent of its workforce in the Data Center. The Research and Analysis Center will constitute about 22 percent of the OFR's staff, complemented by a broad network of resources through work arrangements with outside researchers and collaboration with other Council members. The Director's office and support functions (Counsel, External Affairs, and Operations) will constitute the remaining 28 percent of the OFR workforce (see **Figure 7-2**).

Most of our staff members are located at the OFR's Washington, D.C., headquarters. We maintain a small office in New York City to support our research and data initiatives and to facilitate regular contact with regulators, data providers, academics, and financial market participants. The OFR also has a small number of work arrangements with contributors outside Washington, D.C., and New York to support research collaboration with academics.

During FY 2014, the OFR focused on developing a high-caliber workforce and producing research and data products. We recruited to fill vacant positions, aligned functions and resources within the Office to meet stakeholder and staff needs, and developed current staff members to address critical skills gaps.

In FY 2015, we will continue to review, refine, and expand our human capital strategies, while ensuring alignment with the OFR's FY 2015-19 strategic plan.

AGENDA AHEAD 8

We will soon publish a detailed, five-year strategic plan about our strategic goals and their implications for our direction in coming years. The three goals in the plan will also drive the OFR's research and data agenda for 2015, as follows:

- We will provide critical data and analysis for monitoring threats to financial stability. A top priority is our joint project with the Federal Reserve to collect repo data from firms on a voluntary basis. We will also improve our Financial Stability Monitor, publish a Financial Markets Monitor, and expand the suite of dashboards, monitors, metrics, and other tools that we offer the Council.
- We will help develop and promote standards that improve the quality and utility of financial data. We will work to further integrate the Legal Entity Identifier (LEI) in regulatory reporting and business practices, collaborate with the CFTC to promote standards in derivatives markets, and create prototype entity and instrument reference databases to promote market transparency.
- We will conduct and publish leading edge research to improve financial stability monitoring and inform policy and risk management. Key projects will focus on macroprudential policy, stress tests, agent-based models, and innovative tools that can promote financial stability analysis. We will also conduct and publish research related to short-term wholesale funding, credit default swaps, hedge funds, and other important financial activities.

Research Priorities

Our research activities encompass financial stability monitoring, macroprudential policy evaluation and analysis, and basic research to contribute to our understanding of vulnerabilities in the financial system.

We will broaden our monitoring framework tools in 2015. When possible, we will make our analysis available to the public, using appropriate techniques to ensure the security and confidentiality of non-public data. In the near term, we plan to share with the public a version of our monthly Financial Markets Monitor, which we currently present to the Council. We will develop additional monitoring products focused on money market funds, hedge funds, and credit default swap markets. We will also publish working papers describing in greater detail how we produce our Financial Stability Monitor and our Financial Stress Index, as well as a series of shorter, less technical papers on emerging threats to financial stability.

We will expand our contribution to the analysis and debate about the macroprudential policy toolkit in the coming year. The Office has an important mandate under the Dodd-Frank Act to conduct studies and research on regulation, conduct studies and provide advice on the impact of financial stability policy, and evaluate and report on stress tests and best practices in risk management. We are in a position to objectively evaluate and study such policies because we do not make policy. Our contribution may include research on what tools are available, how they work, and how they complement or conflict with other policy goals. We continue to build our policy analysis team to broaden our expertise across financial institutions and markets, with a focus on banking, insurance, and asset management. A key debate for 2015 will revolve around the

current cyclical excesses in some markets and the effectiveness of the tools that policymakers now have to address them (see **Chapter 3**).

The OFR's basic research supports our monitoring and policy analysis work. We will publish several papers in 2015 resulting from the three research streams described in Chapter 4 — visualization, agent-based modeling, and the analysis of credit derivatives markets. Our research program on agent-based modeling has resulted in two working papers so far. In this annual report, we described a preliminary use of the tool to analyze the risk of contagion in a specific market segment (see **Assessing the Vulnerability of Agency mREITs** in **Chapter 2**). More research on agent-based models will come in 2015. We will also publish several papers on short-term wholesale funding markets, including a reference guide on repurchase agreement (repo) and securities lending markets.

Data Priorities

In the coming year, we will advance two key aspects of our data agenda:

1. to develop and promote financial data standards, and
2. to identify and fill gaps in the data that analysts need to monitor and evaluate threats to financial stability.

The Legal Entity Identifier (LEI) system is now up and running and growing quickly. To realize its full benefits, it is essential that the LEI become widespread in business practices. The OFR and the Council have called on regulators to require use of the LEI in regulatory reporting, beginning with large, complex financial companies and market participants. We note in Section 5.3 several examples of regulatory reports in which agencies have already adopted or proposed the use of the LEI. The LEI system generates efficiencies for financial companies in internal reporting, risk management, and in collecting, cleaning, and aggregating data. We believe it will decrease overlap and duplication in regulatory reporting, reducing the reporting burden for companies.

Another priority is our work with the CFTC and other regulators to promote the use of data standards in trade repository reporting. Our joint project with the CFTC seeks to enhance the quality, types, and formats of data collected from registered swap data repositories. In 2015, OFR and the CFTC will make progress in establishing standards and data harmonization.

The Dodd-Frank Act mandate for the OFR to prepare and publish reference databases for financial entities and financial instruments is a top priority. The global LEI system will meet the requirement for an entity reference database. In 2015, we will build a prototype reference database for financial instruments.

The repo data collection pilot is a signature project for the OFR (see **Section 6.2**). The pilot marks the first time we are going directly to financial companies to collect data. Participation is voluntary. Companies that participate will be asked for input on what data should be collected. We expect to begin collecting data early next year. We intend to publish aggregated data from the survey to provide greater transparency into the bilateral repo market for participants and policymakers. We expect the project will be a template for future data collection efforts.

The OFR will continue to collaborate broadly to share data and to design and implement financial data standards that give U.S. supervisors and their foreign counterparts a more accurate and global picture of the financial risks assumed by the entities they oversee.

Institutional Priorities

In 2015, we plan to further align our efforts to meet the three strategic goals in our new strategic plan (see **Chapter 7**). The strategic plan will help guide our long-term investment in people, processes, and technologies, while effective strategy management will ensure we remain responsive to changes in technology, stakeholder needs, and the financial system.

In 2014, the OFR completed the installation of the secure analytic environment needed to collect, process, store, manage, administer, and analyze large and complex datasets.

In 2015, we plan to deploy the initial release of the new OFR public website. We will also build an improved intranet for the OFR staff, expand the capabilities of our virtual research community offerings, and continue automating business processes.

We will continue in 2015 to identify and fill critical staffing gaps, based on the capabilities and competencies needed to achieve OFR strategic goals and objectives through 2019 and consistent with our forthcoming FY 2015-19 strategic

plan. Recruiting and training are also essential to build the capabilities needed to analyze risks to financial stability, fill data gaps, and promote financial data standards, and we will continue to allocate resources toward these essential activities.

We will continue to build strong relationships with our stakeholders. We will work closely with the Council and its member agencies and we will engage with Congress to ensure that Congress is apprised of our activites. We will accelerate our outreach and collaboration through our network of outside researchers, academics, industry experts, and others. We continue to receive valuable recommendations from our external Financial Research Advisory Committee. We will expand the grants program, in collaboration with the National Science Foundation, and will continue to sponsor conferences and research on financial stability and related topics.

GLOSSARY

Accommodation
Expansionary monetary policy in which a central bank seeks to lower borrowing costs for businesses and households to make credit more easily available.

Agency Mortgage-Backed Securities
A mortgage-backed security issued or guaranteed by federal agencies or government-sponsored enterprises.

Advanced Approaches
Under Basel III, the standard that U.S. banks with $250 billion or more in consolidated assets, or $10 billion or more in foreign exposures, must use to calculate risk-weighted assets. The advanced approaches require models based upon a bank's experience with its internal rating grades. Smaller banks use a standardized approach that sets risk weights for asset classes.

Bank for International Settlements (BIS)
An international financial organization that serves central banks in their pursuit of monetary and financial stability, helps to foster international cooperation, and acts 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 under 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 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 recommendations for cross-border banking supervision.

Basel III
A comprehensive set of global regulatory standards for bank capital adequacy and liquidity. The reform measures, published in 2010 by the Basel Committee on Banking Supervision, introduced a leverage ratio along with two liquidity standards: the liquidity coverage ratio and the net stable funding ratio.

Call Report
A quarterly report of a bank's financial condition and income that all federally insured U.S. depository institutions must file.

Capital Requirement
The amount of capital a bank must hold to act as a cushion to absorb unanticipated losses and declines in asset values that could otherwise cause a bank to fail. U.S. banking regulators require banks to hold more high-quality, or Tier 1, capital against total risk-weighted assets under the Basel III international accord. Banks are classified as well capitalized, adequately capitalized, undercapitalized, significantly undercapitalized, or critically undercapitalized based on regulators' capital and leverage calculations.

Captive Reinsurance Company
A subsidiary 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 clearinghouse or central counterparty, which guarantees the trades. It is an alternative to bilateral or over-the-counter trading (see Over-the-Counter Derivatives).

Central Counterparty (CCP)	An entity that interposes itself between counterparties to contracts traded in one or more financial markets. A CCP becomes the buyer to every seller and the seller to every buyer to help ensure the performance of open contracts.
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.
Clearing Member	A member of, or a direct participant in, a central counterparty (CCP) that is entitled to enter into a transaction with the CCP.
Clearing	A system that facilitates the transfer of ownership of securities after they are traded.
Clearinghouse	See Central Counterparty.
Collateral	Any asset pledged by a borrower to guarantee payment of a debt.
Collateralized Loan Obligation (CLO)	Securities that hold pools of corporate loans and are sold to investors in tranches with varying levels of risk.
Commercial Paper (CP)	Short-term (maturity of up to 270 days), unsecured corporate debt.
Comprehensive Capital Analysis and Review (CCAR)	The Federal Reserve's annual exercise to ensure that the largest U.S. bank holding companies have robust, forward-looking capital planning processes that account for their unique risks and sufficient capital for times of financial and economic stress. The exercise also evaluates the banks' individual plans to make capital distributions such as dividend payments or stock repurchases.
Concentration Risk	Any single exposure or group of exposures with the potential to produce losses large enough to threaten a financial institution's ability to maintain its core operations.
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 (2011).
Correlation Risk	The risk that the value of two or more assets will move in tandem, increasing a portfolio's volatility 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 or credit cycle (see Procyclical).
Countercyclical Capital Buffer	A policy requiring banks to build capital buffers during favorable economic periods that can be used to absorb losses in unfavorable periods.
Counterparty Risk	The risk that the party on the other side of a contract, trade, or investment will default.
Covenant-lite Loans	Loans that do not include typical covenants to protect lenders, such as requiring the borrower to deliver annual reports or restricting loan-to-value ratios.
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 receives a payoff if the borrower defaults, similar to an insurance contract. The protection 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 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.
Dark Pools	Private electronic trading venues, also referred to as alternative trading systems, that allow institutional investors to anonymously buy and sell securities, primarily stocks. Unlike stock exchanges, dark pools do not publish pretrade prices for offers to buy and sell, and report transactions to regulators after a trade is executed.
Derivative	A financial contract whose value is derived from the performance of underlying assets or market factors such as interest rates, currency exchange rates, and commodity, credit, and equity prices. Derivative transactions include structured debt obligations, swaps, futures, options, caps, floors, collars and forwards.
Distressed Insurance Premium (DIP)	An indicator of a firm's vulnerability to systemic instability. DIP uses information from credit default swap spreads and equity prices to measure the implied cost of insuring a given firm against broader financial distress.
Dodd-Frank Act	Short name for the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010, the most comprehensive financial reform legislation in the United States since the Great Depression. The Dodd-Frank Act seeks to promote financial stability by improving accountability in the financial system, adding transparency about over-the-counter (OTC) derivative markets, and protecting consumers from abusive financial services practices.
Duration Risk	The risk associated with the sensitivity of the prices of bonds and other fixed-income securities to changes in the level of interest rates.
Emerging Markets (EM)	Developing countries where investments are often associated with both higher returns and higher risk. EM countries fall between developed markets such as the United States and frontier markets that are more speculative.
Eurozone	A group of 18 European Union countries that have adopted the euro as their currency.
Exchanged-Traded Fund	An investment fund whose shares are traded on an exchange. Because ETFs are exchange-traded products, their shares are continuously priced 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 banking supervision. Members include the Federal Reserve, the FDIC, the NCUA, the OCC, the CFPB, and a representative of state financial supervisors.
Financial Contagion	A scenario in which financial or economic shocks initially affect only a few financial market participants then spread to other financial sectors and countries in a manner similar to the transmission of a medical disease. Financial contagion can happen at both the international level and the domestic level.
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 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 financial system developments on behalf of the G-20 nations. The FSB was established in 2009 and is the successor to the earlier Financial Stability Forum.
Fire Sale	The disorderly liquidation of assets to meet margin requirements or other urgent cash needs. Such a sudden selloff can drive prices below their fair value. The quantities sold are large relative to the typical volume of transactions.
Fiscal Risk	Risk stemming from deviations in fiscal policy from expectations.
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 established the technical and legal details of N-MFP filings.
Form PF	A periodic report of portfolio holdings, leverage, and risk management submitted by hedge funds, private equity funds, and related entities. The report is filed with the SEC and CFTC, which keep the information confidential. The Dodd-Frank Act mandated the reporting to help the Council monitor financial stability risks.
Funding Liquidity	The availability of credit to finance the purchase of financial assets.
General Collateral Finance (GCF)	An interdealer repurchase agreement (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).
Global Systemically Important Banks (G-SIBs)	Banks annually designated by the Basel Committee on Banking Supervision for having the potential to disrupt international financial markets. The designations are based on banks' size, interconnectedness, complexity, dominance in certain businesses, and global scope.
Haircut	The discount at which an asset is pledged as collateral. For example, a $1 million bond with a 5 percent haircut would collateralize a $950,000 loan.
Hedge Fund	A pooled investment vehicle available to accredited investors such as wealthy individuals, banks, insurance companies, and trusts. Hedge funds can charge a performance fee on unrealized gains, borrow more than one half of their net asset value, short sell assets they expect to fall in value, and trade complex derivative instruments that cannot be traded by mutual funds.
Hedging	An investment strategy to offset the risk of a potential change in the value of assets, liabilities, or services. An example of hedging is buying an offsetting futures position in a stock, interest rate, or foreign currency.
High-Quality Liquid Assets (HQLA)	Assets such as central bank reserves, government bonds, and corporate debt that can be quickly and easily converted to cash during a stress period. U.S. banking regulators require large banks to hold HQLA to comply with the Liquidity Coverage Ratio.
High-Yield Bonds	Instruments rated below investment grade that pay a higher interest rate than investment-grade securities because of the perceived credit risk.
Implied Volatility	The market's estimate of the volatility of the price of an underlying asset. The current market price of an option contract can be used in a mathematical pricing model to calculate the level of volatility that market participants expect.

Initial Margin	A percentage of the total market value of securities that an investor must pay to purchase securities with borrowed funds.
Interest Rate Swap	A swap in which two parties swap interest rate cash flows, typically between a fixed rate and a floating rate (see Swap).
International Monetary Fund (IMF)	An international 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)	An industry association of over-the-counter derivative market participants. The ISDA Master Agreement standardized derivative terms for counterparties to simplify netting and reduce legal risks.
Investment-Grade Bonds	Securities that credit rating agencies determine carry less credit risk. Non-investment grade securities have lower ratings and a greater risk of default.
Legal Entity Identifier (LEI)	A unique 20-digit alphanumeric code to identify 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.
Leverage Ratio	The Tier 1 (highest quality) capital of a bank divided by its total exposure to derivatives, securities financing transactions, and on- and off-balance-sheet exposures. The Basel III bank capital standards set a minimum leverage ratio of 3 percent, but the Federal Reserve said it will require the largest U.S. banks to maintain a leverage ratio above 5 percent beginning in 2018.
Liquidity	See Funding Liquidity and Market Liquidity.
Liquidity Coverage Ratio (LCR)	A Basel III standard to ensure that a bank maintains enough high-quality liquid assets to meet its anticipated liquidity needs for a 30-day stress period. The ratio applies to banks with $250 billion or more in total consolidated assets, or $10 billion or more in on-balance-sheet foreign exposure. A less-strict ratio is required of banks with $50 billion or more in total assets (see High-Quality Liquid Assets).
Liquidity Risk	The risk that a firm will not be able to meet its current and future cash flow and collateral needs, both expected and unexpected, without materially affecting its daily operations or overall financial condition.
Living Wills	Annual resolution plans required of U.S. banks with $50 billion or more in total consolidated assets and nonbank financial companies designated by the Council for supervision by the Federal Reserve. Each living will must describe how the company could be dismantled in a rapid, orderly way in the event of failure.
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 in the financing of a mortgage.
Local Operating Unit (LOU)	Private- or public-sector group authorized by the Global Legal Entity Identifier Foundation to register and issue LEIs. LOUs also validate and maintain reference data, and protect information that must be stored locally. Some jurisdictions may have multiple LOUs.
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. In a deep market, a large number of shares or other financial instruments can be purchased with little impact on prices.
Market Liquidity	The ability of market participants to sell large positions with limited price impact and low transaction costs.
Market Microstructure	In economics, the study of the process and outcomes of exchanging assets under explicit trading rules. Microstructure theory focuses on how specific trading mechanisms affect the price formation process.
Market Risk	The risk that an asset's value will change due to unanticipated movements in market prices.
Market-Making	The process in which an individual or firm stands ready to buy and sell a particular stock, security, or other asset on a regular and continuous basis at a publicly quoted price. Market-makers usually hold inventories of the securities in which they make markets. Market-making helps to keep financial markets efficient.
Maturity Mismatch	The difference between the maturities of an investor's assets and liabilities. A mismatch affects the investor's ability to survive a period of stress that may limit its access to funding and to withstand shocks in the yield curve. For example, if a company relies on short-term funding to finance longer-term positions, it will be subject to significant refunding risk that may force it to sell assets at low market prices or potentially suffer through significant margin pressure.
Maturity Transformation	Funding long-term assets with short-term liabilities. This creates a maturity 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 Call Report	A quarterly report of mortgage activity and company information created by state regulators and administered electronically through the Nationwide Mortgage Licensing System & Registry (NMLS).
Mortgage Servicing Rights (MSRs)	The right to service and collect loan payments and fees on a mortgage.
mREITS	Real estate investment trusts that borrow short-term funds in repo markets and invest in real estate, mortgages, and mortgage-backed securities.
Mutual Fund	A pooled investment vehicle, regulated by the SEC, that can invest in stocks, bonds, money market instruments, other securities, or cash.

Net Asset Value	The value of an entity's assets minus its liabilities. For example, a mutual fund calculates its NAV daily by dividing the fund's net value by the number of outstanding shares.
Net Stable Funding Ratio (NSFR)	A Basel III standard to ensure that a bank holds sufficient available stable funding to limit its funding risk from maturity mismatches between assets and liabilities. Available stable funding is the portion of a bank's capital and liabilities expected to be reliable for at least one year.
Network	A model consisting of a set of nodes, or financial institutions, and a set of payment obligations linking them, to show how financial interconnections can amplify market movements.
Operational Risk	Risks occurring during the normal operation of a business, including, for example, failed internal processes, legal risk, and environmental risk.
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. For example, an equity call option provides the right, but not the obligation, for a fixed period to buy a block of shares at a fixed price.
Order Book	A list of bids and offers a trading venue uses to match buyers and sellers. A limit order book is a record of unexecuted limit orders (an order to buy a stock at or below a specified price, or to sell a stock at or above a specified price) that are treated equally with other orders in terms of priority of execution. A central limit order book is a centralized database for all limit orders received by specialists and market-makers for different types of securities.
Originate	To extend credit after processing a loan application. Banks, for example, originate mortgage loans and either hold them until maturity or distribute them to other financial market participants. The distribution can include a direct sale or a securitization of a portion of the credit at the time of origination or later.
Over-the-Counter (OTC) Derivatives	Deals negotiated privately between two parties rather than traded on a formal securities exchange. Unlike standard exchange-traded products, OTC derivatives can be tailored to fit specific needs, such as the effect of a foreign exchange rate or commodity price over a given period.
Parallel-Coordinates Plot	A figure used to visualize and analyze multiple financial, economic, and other variables simultaneously.
Price Discovery	The process of determining the prices of assets in the market place through the interactions of buyers and sellers.
Primary Dealer	Banks and securities broker-dealers designated by the Federal Reserve Bank of New York to serve as trading counterparties when the FRBNY is carrying out U.S. monetary policy. Among other things, primary dealers are required to participate in all auctions of U.S. government debt and to make markets for the FRBNY when it transacts on behalf of its foreign official accountholders. A primary dealer buys government securities directly and can sell them to other market participants.
Procyclical	Financial or economic indicators that tend to move in the same direction as the overall economy (see Countercyclical).
Qualified Mortgage (QM)	Under the Dodd-Frank Act, a mortgage loan that meets certain underwriting criteria set by the CFPB. The originator of a QM has certain protections from borrower lawsuits alleging the originator failed to make a good faith and reasonable determination of the borrower's ability to repay the loan.

Qualified Residential Mortgage (QRM)	Under the Dodd-Frank Act, a mortgage loan exempt from the requirement that sponsors of asset-backed securities must retain at least 5 percent of the credit risk of the assets collateralizing the securities.
Quantitative Easing (QE)	An unconventional monetary policy to stimulate growth when policy rates are close to zero by purchasing government or other securities from private institutions.
Refinancing Risk	The risk that a borrower will face liquidity problems if unable to roll over existing debt.
Reinsurance	The risk management practice of insurers to transfer some of their policy risk to other insurers. A second insurer, for example, could assume the portion of liability in return for a proportional amount of the premium income.
Repo Run	A situation in which repurchase agreement (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 similar to a collateralized loan.
Resolution Plans	See Living Wills.
Risk Management	The business and regulatory practice of identifying and measuring risks and developing strategies and procedures to limit them. Categories of risk include credit, market, liquidity, operations, model, and regulatory.
Risk Retention	Under the Dodd-Frank Act, a requirement that issuers of asset-backed securities must retain at least 5 percent of the credit risk of the assets collateralizing the securities. The regulation also prohibits a securitizer from directly or indirectly hedging the credit risk (see Qualified Residential Mortgage).
Run Risk	The risk that investors lose confidence in a market participant due to concerns about counterparties, collateral, solvency, or related issues and respond by pulling back their funding or demanding more margin or collateral.
Search for Yield (Reach for Yield)	The practice of accepting greater risks in hopes of earning higher than average returns.
Securities Financing	The transfer or lending of securities from one party to another. A borrower of securities puts up collateral in the form of shares, bonds, or cash, and is obliged to return the securities on demand. These transactions provide liquidity in the market.
Securities Lending/Borrowing	The temporary transfer of securities from one party to another for a specified fee and time period in exchange for collateral in the form of cash or securities.
Settlement	The process by which securities are transferred and settled by book entry according to a set of exchange rules. Some settlement systems can include institutional arrangements for confirmation, clearance, and settlement of securities trades and safekeeping of securities.
Shadow Banking System	Credit intermediation outside the insured depository system, involving leverage, maturity transformation, and the creation of money-like liabilities.
Short-Term Wholesale Funding	Funding instruments typically issued to institutional investors to raise large amounts of funding for short periods. Examples include large time deposits, commercial paper, and repurchase agreements.

Single-Family Rental Securitizations (SFR)	A structured security backed by mortgage loans on pools of single-family rental properties.
Spread	The difference in yields between various private debt instruments and government securities of comparable maturity. The spread can be used as one of many indicators of financial stability.
Stress Test	An exercise that shocks asset prices by a pre-specified amount, sometimes along with other financial and economic variables, to observe the effect on financial institutions or markets. Under the Dodd-Frank Act, banking regulators run annual stress tests of the biggest U.S. bank holding companies.
Supplemental Leverage Ratio	Under Basel III, the ratio of a bank's Tier 1 (high quality) capital to its total leverage exposure, which includes all on-balance-sheet assets and many off-balance-sheet exposures. U.S. regulators require a 3 percent ratio for most banks with $250 billion or more in consolidated assets or $10 billion or more in foreign exposures. The eight large U.S. banks designated as global systemically important banks by the Financial Stability Board must maintain a ratio of 5 percent.
Swap	An exchange of cash flows agreed by two parties with defined terms over a fixed period.
Swap Data Repository (SDR)	A central recordkeeping facility that collects and maintains a database of swap transaction terms, conditions, and other information. In some countries, SDRs are referred to as trade repositories.
Swap Execution Facility	Under the Dodd-Frank Act, a trading platform market participants use to execute and trade swaps by accepting bids and offers made by other participants.
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.
Tail Risk	The low-probability risk of an extreme event moving an asset price.
Tier 1 Capital Ratio and Tier 1 Common Capital Ratio	Two measurements comparing a bank's capital to its risk-weighted assets to show its ability to absorb unexpected losses. Tier 1 capital includes common stock, preferred stock, and retained earnings. Tier 1 common capital excludes preferred stock.
Triparty Repo	A repurchase agreement in which a third party, such as a clearing bank, acts as an intermediary for the exchange of cash and collateral between two counterparties. In addition to providing operational services to participants, agents in the U.S. triparty repo market extend intraday credit to facilitate settlement of triparty repos.
Volatility Risk	The risk in the value of a portfolio from unpredictable changes in the volatility of a risk factor or underlying asset.
Volcker Rule	A provision of the Dodd-Frank Act that generally prohibits a bank from certain investment activities that are not directly related to trading for customers or for market-making. The provision also limits insured depository institutions from owning or sponsoring hedge funds or private equity funds.
XBRL (eXtensible Business Reporting Language)	A common computer language for the electronic communication of business and financial data. Regulators can use XBRL as an efficient way to obtain information from companies.
XML (eXtensible Markup Language)	A common computer language that defines a set of rules for the semantic markup of documents.

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