Financial Stability Monitoring

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Abstract

We present a forward-looking monitoring program to identify and track the sources of systemic risk over time and to facilitate the development of preemptive policies to promote financial stability. We offer a framework that distinguishes between shocks, which are difficult to prevent, and vulnerabilities, which amplify shocks. Building on substantial research, we focus on leverage, maturity transformation, interconnectedness, complexity, and the pricing of risk as the primary vulnerabilities in the financial system. The monitoring program tracks these vulnerabilities in four areas: the banking sector, shadow banking, asset markets, and the nonfinancial sector. The framework also highlights the policy trade-off between reducing systemic risk and raising the cost of financial intermediation by taking preemptive actions to reduce vulnerabilities.

1. INTRODUCTION

We define systemic risk as the potential for widespread financial externalities—whether arising from corrections in asset valuations, asset fire sales, or other forms of contagion—to amplify financial shocks and, in extreme cases, to disrupt financial intermediation. Potential financial externalities may have cyclical causes. For example, in an economic expansion, leverage might proliferate throughout the financial sector, which in turn could increase the potential for asset fire sales. Potential financial externalities may also have structural roots, as with money market mutual funds (MMFs), which in their current form are susceptible to runs by their own investors, and thus tend to create the potential for asset fire sales and other forms of contagion.

Financial externalities differ from textbook production externalities such as pollution in that they manifest in only some states of the world. For instance, when liquidity is ample and economic conditions are benign, the insolvency of a financial institution may have few or no knock-on effects at other financial institutions. However, in less benign periods, the same insolvency could trigger runs and deleveraging at other institutions. Therefore, we define systemic risk as the potential for financial externalities.

Importantly, potential financial externalities, like production externalities, imply inefficient economic allocations. For instance, when deciding whether to increase leverage, a financial institution might weigh its higher expected bankruptcy costs (the private marginal cost) against the tax and cost advantages of funding more with debt finance (the private marginal benefit). However, the public marginal cost of the additional leverage exceeds the private marginal cost, as it also includes any associated increases in expected bankruptcy costs at other institutions that might be caused by, say, the increased risk of fire sales or other forms of contagion. As a result, leverage of financial institutions, absent any government policies, is likely to be higher than is socially optimal, particularly during an economic expansion, when a financial intermediary's tolerance for risk is likely to be high.

To address systemic risk, the government could tax or directly reduce financial vulnerabilities, which are defined as the collection of factors that contribute to the potential for widespread financial externalities. Vulnerabilities include leverage, maturity transformation without government insurance, compressed pricing of risk, interconnectedness, and complexity. One alternative, to directly measure and tax financial externalities, such as fire sales, broad asset price corrections, and panic, seems on its face impossible, given that financial externalities are observed in only some states of the world and are difficult to measure and to link ex post to particular entities. Another alternative is to forecast and preemptively act against shocks, but shocks are, by definition, inherently difficult to predict.

An additional motivation for focusing on vulnerabilities is provided by the emerging literature on the incorporation of financial stability concerns into optimal monetary policy. Stein (2014) shows that monetary policy, when governed by the dual mandate for stable prices and maximum employment, penalizes variance in inflation and employment. As a result, if a high level of financial vulnerabilities increases the variance of output or inflation, and if monetary policy affects the growth of vulnerabilities, then optimal monetary policy should depend on the current level of financial vulnerabilities. In this case, as with the externality model discussed above, the measurement of financial vulnerabilities is a necessary input into the policy process, even though the impact of vulnerabilities occurs through the creation of macroeconomic volatility, another type of externality. Woodford (2011) and Kiley & Sim (2014) develop equilibrium models that incorporate financial stability in setting monetary policy.

This article offers a strategy for monitoring cyclical financial vulnerabilities and also discusses policy options for addressing them. To do so, our first contribution (Section 2) is to provide a framework that relates financial shocks, financial vulnerabilities, financial externalities, and the

Table 1 Monitoring vulnerabilities in different sectors

	Price of risk	Leverage	Maturity and liquidity transformation	Interconnections and complexity
Asset markets	Asset valuations in equities, rates, credit, real estate	Investor leverage	Carry trades Mutual funds ETFs Dealer-based finance	Derivatives and counterparties
Banking	Risk taking in credit and rates Underwriting standards SLOOS	Regulatory capital ratios; banks and broker-dealers Market measures of risk Stress test capital	Financial firm liabilities and maturities Secured and unsecured	Systemic risk measures Intrafinancial assets and liabilities
Nonbanks, shadow banks, and financial markets	Securities issuance Underwriting standards SCOOS	Securitization tranches New financial products Regulatory capital arbitrage Hedge funds	Agency real estate investment trusts ABCP conduits Repo markets Sec lending MMFs Short-term investment funds	CCPs
Nonfinancial sector	Underwriting standards (LTV ratios, DTI ratios)	Debt-to-GDP Households, business, and government leverage	Reliance on short-term debt	ND

Abbreviations: ABCP, asset-backed commercial paper; CCP, central counterparty; DTI, debt-to-income; ETF, exchange-traded fund; LTV, loan-to-value; MMF, money market fund; ND, not determined; SCOOS, Senior Credit Officer Opinion Survey; SLOOS, Senior Loan Officer Opinion Survey.

overall pricing of risk in the financial system. The framework builds upon the literature on leverage and maturity mismatches in order to clarify the concept of financial vulnerabilities and also to argue that policies to address vulnerabilities will likely impose costs in the form of a higher price of risk in normal times. Our second contribution (Section 3) is to offer empirical measures of cyclical financial vulnerabilities. In this section, we group vulnerabilities into four areas: the banking sector, the nonbank sector including shadow banking, asset markets, and the nonfinancial sector. We focus on cyclical rather than structural vulnerabilities to identify the vulnerabilities that require monitoring, but we acknowledge structural vulnerabilities as additional important determinants of systemic risk. We focus on financial frictions arising from asset valuations, leverage, maturity and liquidity transformation, and complexity and interconnectedness. An overview of the monitoring framework is provided in **Table 1**. Our third contribution (Section 4) is to discuss the roles of macroprudential policies, including monetary policy, in mitigating cyclical vulnerabilities.

2. CONCEPTUAL FRAMEWORK FOR FINANCIAL STABILITY

A number of recent articles model the interactions among the buildup of financial intermediary leverage, the implications for asset prices, and the evolution of systemic tail risks (Adrian & Boyarchenko 2012, Gertler & Kiyotaki 2012). The key amplification mechanism in these models arises from the time variation in the tightness of intermediary funding constraints. During expansionary booms and low measures of risk, funding constraints are looser and intermediaries can build up leverage and maturity mismatch.[1] The greater risk appetite of intermediaries in these

[1]The observation that systemic risk can build when measured risk is low is documented by Adrian & Brunnermeier (2010), and modeled by Brunnermeier & Sannikov (2011) and Adrian & Boyarchenko (2012).

times is evident in compressed pricing of risk and correspondingly higher asset price valuations. Given the potential for externalities, whether from corrections in asset valuations, asset fire sales, or other forms of contagion, intermediaries during booms will tend to take more risk in the form of higher leverage and maturity transformation than is optimal from a social welfare perspective.

In contrast, during economic contractions, the evidence suggests that lenders become highly risk-averse. For example, at broker-dealers, the key constraint for risk taking is the measured risk of securities prices [for example, as measured by the Chicago Board Options Exchange Market Volatility Index (VIX)]. The institutional constraints are risk management constraints, such as value-at-risk or capital constraints from stress scenarios, against which the institution needs to be well capitalized (Adrian & Shin 2010, 2013). Commercial banks tend to manage the risk of loan portfolios, and increase provisions, reserves, and regulatory capital as economic conditions and loan performance worsen. Interestingly, commercial bank lending standards tend to tighten as the VIX increases, indicating that the constraints on the risk taking of commercial banks tend to be similar to those for broker-dealers (Bassett et al. 2012). Other institutions, such as insurance companies, hedge funds, and other asset managers, face similar constraints that generate time-varying effective risk aversion, which in turn impacts the pricing of risk.

In our framework, when the equilibrium pricing of risk is compressed, the greater leverage and liquidity of some intermediaries make them more likely to amplify shocks and thus impose externalities on other parts of the financial system. Such adverse shocks could hit the assets or liabilities of intermediaries. On the asset side, a slowdown of real economic growth prospects can trigger an asset price adjustment, which is more likely to be disorderly if valuations are stretched. On the liability side, liquidity shocks can force intermediaries to deleverage, which is sharper if they rely heavily on short-term funding.

These equilibrium theories produce a trade-off between the overall level of systemic risk and the cost of financial intermediation, which in turn determines real activity through credit supply. The theories also highlight that the impact of an adverse shock on the broader financial system will depend on vulnerabilities of the financial intermediary sector. Depending on the strength of the financial sector, a given fundamental shock can be benign or can generate a systemic financial crisis. To the extent that adverse shocks also harm vulnerable households and businesses and cause them to contract spending, the effects on the financial sector are amplified further.

Although not explicitly modeled in the aforementioned theories, as discussed in Section 3, interconnections and complexity within the financial system are also vulnerabilities, as they too create potential externalities. Like leverage and maturity transformation, interconnectedness, whether through the sheer size of institutions or through the chains of intermediation in shadow banking, tends to lower the cost of financial intermediation when shocks are small but can also amplify large shocks through direct exposures, fire sales, or contagion. Complexity might also magnify shocks by fueling uncertainty about interconnections or inhibiting orderly liquidations.

The amplification mechanisms can be simplified to a stylized framework. For financial intermediaries, leverage is procyclical, permitting higher economic activity and lower volatility in normal times, but at the cost of a higher probability of systemic risk when shocks are large. The stylized framework has the following assumptions:

1. The price of risk, p, increases with financial shocks, s.
2. p is more sensitive to s when vulnerabilities, v, are high.
3. When s is low, p decreases with v.

These assumptions are intended to capture the following three intuitions. First, the market-wide price of risk in the financial system increases with the adverse impact of negative shocks to the system, regardless of the level of vulnerabilities. Shocks in this context are triggers such as

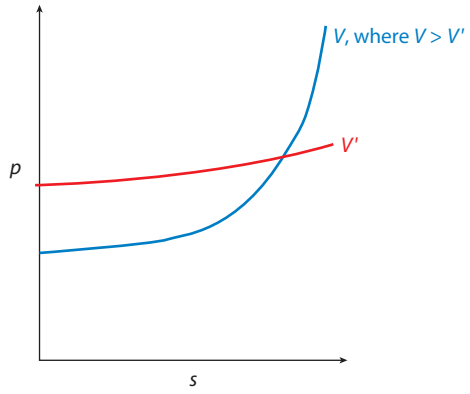

Figure 1

Financial sector vulnerability to shocks and the pricing of risk. Here, p denotes the price of risk, s the size of the shock, and V the vulnerability of the financial system. V' corresponds to a financial system with tighter regulation than V.

losses from a rogue trader, a spate of defaults on subprime mortgages, the popping of an asset price bubble, a sudden drop in domestic economic growth, or an escalation of a foreign financial crisis.[2]

Second, vulnerabilities, such as leverage, maturity transformation, and complexity, make it more likely that shocks will trigger financial externalities, which in turn may cause the market-wide price of risk to rise sharply. The distinction between shocks and vulnerabilities is subtle in some instances. For example, the popping of an asset price bubble (i.e., the sharp reversal of inflated asset valuations) would constitute a shock to the financial system. The popping of a bubble is an event that is difficult to predict, yet it can trigger a chain reaction that would ultimately impact the financial system's capacity to intermediate. The possibility of an asset price bubble therefore constitutes a vulnerability: It implies that asset prices could correct sharply downward in reaction to an adverse shock.

Third, the benefit of a more vulnerable financial system is that financial intermediation will be cheaper (i.e., the price of risk will be lower) when shocks are small (i.e., in periods of low volatility). For example, financial intermediaries were able to fund assets with short-term debt and leverage in the run-up to the financial crisis, when readings on contemporaneous volatility were low. The third assumption also captures the notion that regulations intended to reduce systemic vulnerabilities may come at the cost of a higher price of risk in periods when volatility is low.

Together, the three assumptions imply a trade-off: More vulnerable financial systems have a lower price of risk in periods of low volatility, but a higher price of risk when large adverse shocks occur. This framework is illustrated in **Figure 1**.

As already mentioned, absent government policies, one might expect that vulnerabilities would exceed socially optimal levels because vulnerabilities produce externalities. In addition, private agents could have too much leverage if they believed that they could exit before the price of risk increased. A related possibility is that an increase in vulnerabilities today could increase the expected price of risk for future market participants, who would not benefit from the lower price of risk today. Further, private agents could underestimate the likelihood of large shocks. Moreover,

[2]The distinction between triggers and vulnerabilities, as well as the benefits for economic policy of making this distinction, is discussed in Bernanke (2012).

it might be the case that one financial institution could lower funding costs by increasing reliance on wholesale short-term funding without increasing the vulnerability of the overall system, but if many financial institutions pursued aggressive funding strategies, the risks would be much greater. Therefore, vulnerabilities might arise out of an inability of financial institutions to coordinate on relatively expensive but stable funding strategies.

Policy actions could be designed to reduce the systemic risk by tamping down on vulnerabilities. In this framework, macroprudential policies should reduce the sensitivity of the price of risk to adverse shocks, so that increases in the price of risk are more moderate when adverse shocks are larger. For example, higher capital and liquidity requirements would make it more likely that financial institutions could absorb rather than amplify a sudden deterioration in domestic economic growth or the popping of an asset bubble. Higher capital and liquidity would reduce the likelihood of fire sales that could arise from the distress of a systematically important financial institution (SIFI). Similarly, policies that lean against domestic asset price increases, for example, by tightening credit underwriting standards or raising risk weights or margins, might reduce leverage-induced asset bubbles and the likelihood of a sharp fall in valuations and corresponding fire sales.

The systemic risk-return trade-off that we have outlined in this section, a recurring theme in this article, assumes that raising external equity is costly for financial institutions. Although this assumption is common in the banking literature, not all authors agree about its validity. Admati et al. (2010) and Admati & Hellwig (2013) argue that higher equity for financial institutions does not necessarily cause a higher cost of credit intermediation. As a result, some financial vulnerabilities can be lowered without raising the pricing of credit. In **Figure 1**, this would correspond to a vulnerability curve V' with a flatter slope than the initial curve V for any size of shock. Similarly, Bianchi & Mendoza (2011) study a distortionary tax aimed at investors that internalizes the social cost of overborrowing. Although such a tax on leverage does generate inefficiency due to its distortionary nature, even the investors that are taxed are better off due to the lower amount of systemic risk. The lower incidence of financial crises, in turn, has beneficial effects for growth.

3. PROGRAM FOR MONITORING FINANCIAL STABILITY

The purpose of a financial stability monitor is to provide policymakers with regular assessments of the financial system's vulnerabilities, defined as the collection of factors that contribute to the potential for widespread financial externalities [see Bernanke's (2012) speech on lessons from the crisis for financial stability monitoring]. Although the framework in Section 2 emphasizes both shocks and vulnerabilities, we focus on monitoring vulnerabilities, given that shocks are inherently difficult to predict and prevent. Such monitoring is a critical part of a broader preemptive program in the Federal Reserve System to assess and address vulnerabilities in the US financial system.

We look for financial vulnerabilities—pricing of risk, leverage, maturity and liquidity transformation, and interconnectedness and complexity—in four main areas: asset markets, banks, shadow banking, and the nonfinancial sector (see **Table 1** for an overview of the monitoring framework). Because systemic risk can arise from many sources, the monitoring program contains a broad range of metrics, and we provide only illustrative examples in each area. Also, the quantitative metrics need to be complemented by institutional knowledge of legal, accounting, and other important standards that might mask underlying risks. More importantly, metrics are not stand-alone indicators of systemic risk and so are incorporated into a broader analysis of how potential shocks could impact a number of vulnerabilities at the same time.

3.1. Asset Markets

The main goal of monitoring asset markets is to look for signs of stretched valuations that reflect compressed required returns for risk. Asset prices based on compressed pricing of risk are prone to drop, and the drop may be particularly severe and constitute a notable risk to financial intermediation and the economy if the valuations had been supported by excessive leverage, maturity and liquidity transformation, or lax underwriting standards.

Asset valuations are assessed relative to fundamentals rather than to other asset prices. Although relative asset pricing [dubbed ketchup economics by Summers (1985)] is widely used by market participants, it is not informative for financial stability purposes. For financial stability monitoring, if asset values are rich relative to fundamentals by historical standards (i.e., if the pricing of risk is compressed), asset prices are at risk of reverting abruptly, triggering the potential for financial instability.

Formal pricing models decompose asset prices into two components: the discounted future cash flow using risk-free interest rates and a risk premium that compensates investors for the riskiness of future cash flows and future rates. Changes in asset prices reflect both cash flow news due to changes in cash flow expectations and discount rate news due to changes in risk premia. A number of studies have documented that most movements in asset prices are due to changes in the discount rate, and thus reflect movements in the equilibrium compensation for risk. For example, the time variation in Treasury securities is primarily due to changes in the pricing of risk rather than to changes in expectations of future short rates (Campbell & Shiller 1984, Cochrane & Piazzesi 2005). Similarly, the majority of variation in credit spreads is due to investors' compensation for the risk of potential credit losses in the future rather than expected losses (see, e.g., Elton et al. 2001, Huang & Huang 2012). For equity prices and house prices, pricing measures such as the dividend payout or the price-to-rent ratio tend to exhibit large, persistent swings (for equity returns, see Campbell & Shiller 1988; for house prices, see Case & Shiller 2003, Campbell et al. 2009), again indicating that risk premia vary over time.

Besides assessing asset valuations using pricing models, nonprice measures of hot markets provide evidence of low pricing. Greenwood & Hanson (2013) have found that high volumes and lower-quality issuance can help predict future returns. Survey-based expectations of asset price developments cannot be taken at face value, as they are often contrarian indicators, at least in equity markets, where analysts typically expect further asset price rises at the peaks of expansions and further asset price declines at the onset of recoveries (for an empirical analysis of the cyclicality of analysts' expectations, see Amromin & Sharpe 2008). In Treasury markets, similar systematic expectation errors have been documented (Froot 1989, Piazzesi & Schneider 2011, Crump, Eusepi & Moench 2015).

The abrupt reversal of high asset valuations has caused systemic risk when accompanied by disorderly deleveraging. For example, collapsing house prices or credit valuations have often been accompanied by systemic financial episodes, as those asset classes are typically funded via highly levered balance sheets that employ substantial amounts of maturity transformation. In contrast, the decline in US equity markets in 2000 and 2001, following the tech boom of the 1990s, did not result in a systemic financial crisis, as those markets were not funded with excessive leverage and maturity transformation, although the decline contributed to an economic recession. As a result, whether or not booming asset markets represent a potential systemic risk cannot be determined by analyzing asset prices in isolation, even when those valuations are expressed in terms of fundamentals. Rather, asset valuations should be considered in conjunction with the vulnerabilities that can turn mispricing into a threat to financial stability, including investor leverage, maturity mismatch, and liquidity mismatch. Adrian, Etula & Muir (2012) and Adrian, Moench & Shin (2009) empirically

demonstrate the tight link between asset valuations and balance sheet developments across asset markets, showing that increases in prices tend to be accompanied by expanding balance sheets.

Asset market monitoring encompasses equity prices and equity price volatility, interest rates and interest rate volatility, credit markets, real estate markets, commodities, and exchange rates. Although a discussion of valuation metrics for all of these markets is beyond the scope of this article, we focus on a number of examples that appear particularly relevant for financial stability.

3.1.1. Equity securities. Risk premia have been studied extensively in equity markets. Many theories link the level of expected returns and consumption, explaining the overall level of equity risk premia using measures of consumption growth, tail risk in consumption, uncertainty about consumption growth, long-term consumption growth, or habit in consumption growth. Despite an extensive academic literature, the linkage between consumption and equity risk premia remains difficult to establish empirically. As a result, we propose a pragmatic approach to measure equity risk premia.

The most popular way to compute the equity premium is to use a present discounted value formula (essentially an elaborated version of Gordon's growth formula). A complementary way to identify equity risk premia is to exploit the insight that any predictability of equity returns must reflect the time variation of compensation for risk if markets are arbitrage-free. The predictable component of equity returns can thus be used to obtain the equity risk premium. A well-established literature has shown that variables such as dividend yield, short rate, slope of the yield curve, implied volatility, and inflation have predictive power, in particular at longer horizons (Campbell & Shiller 1988; Blanchard, Shiller & Siegel 1993; Cochrane 2011).

In addition to narrowing equity premia, rising leverage of investors is important to monitor. Holdings of equities can be compiled from various sources, including the 13F filings and other regulatory filings of the US Securities and Exchange Commission (SEC). In general, equities tend to be held by fully funded institutions such as mutual funds, insurance companies, or pension funds. Margin debt that applies primarily to retail investors appears to increase with equity prices, but with margins set at 50% (since 1977), the amount of aggregate leverage from this source is modest. Portfolio margins, such as for hedge funds, tend to be set at lower levels, but the amount of debt increases with equity prices. The emergence of levered exchange-traded funds (ETFs), which might employ portfolio insurance strategies, could add to leverage and maturity mismatch in equity markets. Notably, the 1987 crash was caused by the portfolio insurance policies of equity investors, who tended to use dynamic hedging strategies, a form of embedded leverage. Although such portfolio insurance strategies have since largely disappeared from the equity investing universe, similar strategies are employed by levered ETFs. Of course, the 1987 crash was accommodated by aggressive liquidity injections and interest rate cuts by the Federal Reserve, insulating the real economy from the crash.

Equity markets have become more complex as well, as illustrated by the increase in high-frequency trading. The Flash Crash in May 2010 illustrates the dangers associated with high-frequency trading algorithms. If a large market move is triggered by a mistake, that move could in turn trigger a chain reaction of sales from various algorithms. In the Flash Crash, the Dow Jones fell 600 points in a 5-minute interval (between 2:42 PM and 2:47 PM), before recovering nearly completely by 3:07 PM. A monitor should track the growth of new practices that could lead to a buildup of vulnerabilities arising from complexity and increased interconnectedness.

3.1.2. Treasury securities. Treasury valuations are measured by estimating dynamic term structure models that capture the time variation of risk premia in arbitrage-free settings. Campbell & Shiller (1984, 1991) and Cochrane & Piazzesi (2005) provide evidence for the time variation

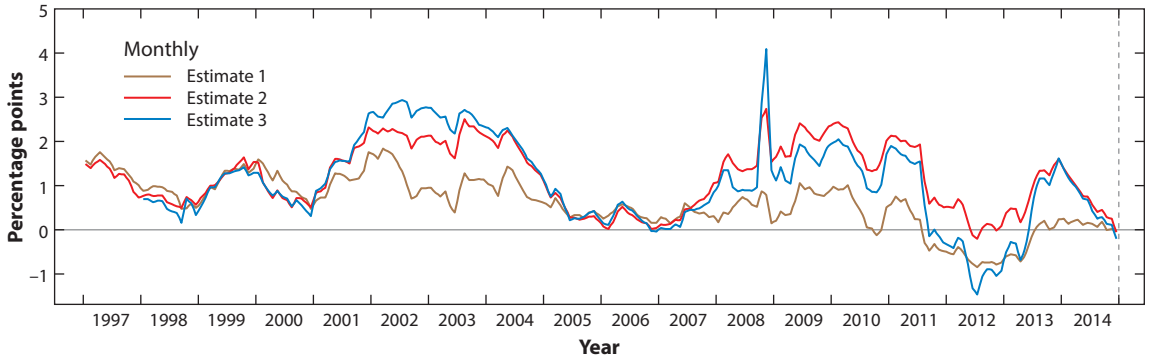

Figure 2

Ten-year nominal yields and term premium estimates. For Estimate 1 (*tan line*), term premia are estimated by a three-factor term structure model combining Treasury yields with interest rate forecasts from the Survey of Professional Forecasters (Kim & Wright 2005). For Estimate 2 (*red line*), the premia are estimated by a four-factor term structure model using only Treasury yields (Adrian, Crump & Moench 2012); for Estimate 3 (*blue line*), the premia are estimated by a three-factor model using only Treasury yields (Christensen, Diebold & Rudebusch 2011).

of risk premia in the Treasury market. There are a variety of such dynamic models of interest rates, including those proposed by Kim & Wright (2005); Adrian, Crump & Moench (2012); and Christensen, Diebold & Rudebusch (2011). All three models are affine term structure models that can be updated daily and that exploit the insight from finance theory that when markets are arbitrage-free, excess return predictability implies a risk premium. This insight identifies the risk premium as the forecastable component of Treasury returns relative to the expected returns on the strategy of rolling over investments in short-term, risk-free securities. The models vary by the number of state variables used to capture the evolution of the term structure, and the use of other data, such as survey forecasts of future short rates.

Despite differences in assumptions and estimation, the three affine term structure models produce similar estimates of term premia (**Figure 2**). The estimated 10-year Treasury term premium exhibited a pronounced compression between 2003 and 2006, in the run-up to the financial crisis; widened during the crisis from 2007 to 2009; and has since declined markedly. In particular, term premia currently are at very low levels by historical standards; such low levels have not been measured since the 1960s. These historically low term premia reflect a number of special factors, including the Federal Reserve's large-scale asset purchases.

Low Treasury risk premia, if reversed unexpectedly, could cause financial instability if interest rate exposure is high on levered balance sheets. The increase in potential systemic risk is greater if other bonds that have credit risk also reflect the low term premia on Treasury securities. One way to understand this exposure is by pointing out that the amount of leverage required to achieve a given return on equity (ROE) target has increased significantly in recent years because of lower interest rates. Even though there is anecdotal evidence of lower ROE targets since the financial crisis, the low-yield environment in recent years generates incentives to increase leverage in order to increase returns.

Mutual funds and ETFs have become larger holders of long-term Treasury securities and other debt securities in recent years, as investors have reallocated assets away from equities. Although these funds do not tend to employ financial leverage, redemption features based on closing net asset value (NAV) or on greater liquidity of funds relative to the liquidity of the underlying securities

can lead to a run dynamic similar to one arising from leverage or maturity mismatch (Feroli et al. 2014). However, any liquidity discount may be smaller than one from credit, and the degree to which it would persist would still likely depend mainly on leverage or maturity mismatch of other investors. Another source of leverage that might arise in a period of low rates is increased exposure through interest rate swaps, as investors increase the use of swaps and increase the complexity of the network of counterparties.

3.1.3. Corporate debt. A risk-averse investor in corporate bonds should require a spread to compensate for expected losses and for investing in a risky security relative to a risk-free security. One way to estimate risk-taking behavior is to measure the amount of compensation required for risk as the residual of the risk spread and the compensation for expected losses based on a model of physical expected losses. However, because the expected risk of loss can only be estimated, valuations are difficult to gauge in real time with certainty. Moreover, investors appear to underestimate the size of future losses when recent losses have been low.

Risk-taking behavior can be approximated from the term structure of corporate bond spreads. Forward spreads on corporate bonds for different periods can be evaluated. One advantage of monitoring corporate bond spreads far out in the term structure, such as between years 9 and 10, is that it allows for an assessment of changes in the price of risk without having to control for changes in the default rates and recovery rates expected by investors, under the assumption that investor expectations of credit risk far in the future are time invariant (**Figure 3**). In the plot, BBB-rated forward spreads between 9 and 10 years ahead were quite low in 1997. This suggests that the price of risk was quite low in 1997. And indeed, this is a time when some have argued ex post that corporate bonds were overvalued (Altman & Armon 2002).

Trends in nonprice terms of debt securities can be used to supplement an assessment of the market's pricing of required returns. Periods of greater issuance by lower-rated firms, accompanied by looser nonprice terms, such as rising debt multiples or fewer covenant protections for lenders, could be signs of increased investor risk taking (**Figure 4**). The rapid issuance of junk bonds and weakening deal structures in the leveraged buyout wave in the late 1980s led to reduced returns (Kaplan & Stein 1993). Corporate bond returns appear to decline following periods of

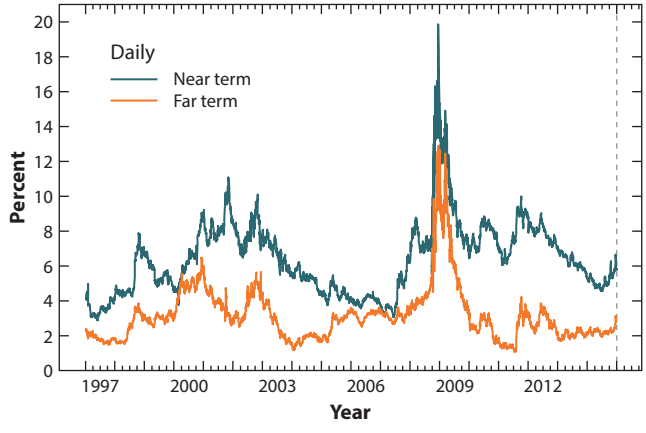

Figure 3

High-yield near- and far-term corporate bond spreads. Near-term forward spreads are between years 2 and 3, and far-term forward spreads are between years 9 and 10. Staff estimates derived from Bank of America Merrill Lynch Bond Indexes.

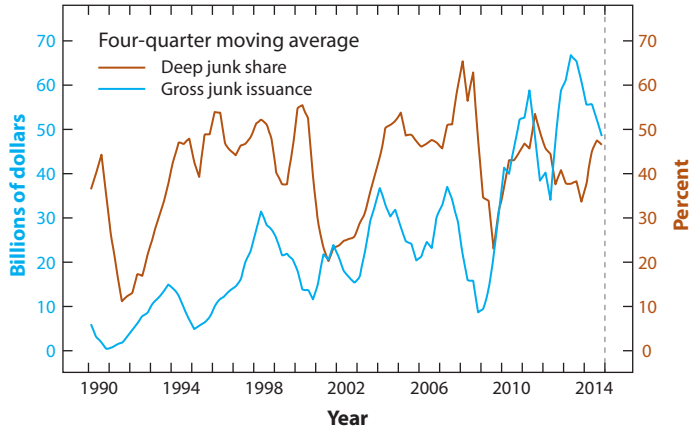

Figure 4

Gross junk issuance and share of deep issuance. Deep junk share is the fraction of bonds rated B– or lower over total nonfinancial junk issuance. Gross junk issuance includes public, 144A, euro, and medium-term note issues. Data are from Thomson Reuters SDC Platinum (downloaded on Jan. 31, 2013).

low-quality bond issuance (Greenwood & Hanson 2013), and institutional demand pressures that lead to reduced time in syndication for leveraged loans result in lower loan yields (Ivashina & Sun 2011).

Losses on credit instruments are more likely to be destabilizing to the financial system if they are held by leveraged investors. The losses on junk bonds issued in the late 1980s were amplified because leveraged savings and loans were significant investors in these bonds, a contributing factor to the recession in the 1990s. Although real money investors, such as mutual funds, insurance companies, and pension funds, are major investors in debt securities, there was also substantial demand from collateralized debt obligations (CDOs), collateralized loan obligations, and other leveraged investors in the run-up to the recent crisis. Moreover, losses could be amplified if corporate debt securities are less liquid than the investment funds that pool these securities, such as mutual funds and ETFs.

3.1.4. Residential real estate prices. The literature that assesses the valuation of housing prices usually starts with a discounting formula linking the rent-to-price ratio to the current real interest rate, a house price risk premium, and the expected future capital gain from home ownership (Campbell et al. 2009; Himmelberg, Mayer & Sinai 2005) (**Figure 5**). These articles find that all three components are important determinants of house price movements and, importantly, point to the roles of risk premia and price expectations. Whereas some observers attributed the run-up in housing prices in the early 2000s primarily to the decline in real interest rates, others pointed out that risk premia and housing expectations were particularly important [Case and Shiller (2003) were early proponents of the view that housing valuations reflected an asset price bubble]. In hindsight, too little weight placed by analysts on the likelihood of a bad tail outcome (Gerardi et al. 2008) and inflated expectations about future house price growth played an important role in the run-up to the crisis (for indirect evidence on house price expectations by Wall Street professionals, see Cheng, Raina & Xiong 2012).

A primary determinant of the pricing of risk in the housing market is the supply of credit, as the vast majority of new home purchases are financed via mortgage credit. In the run-up

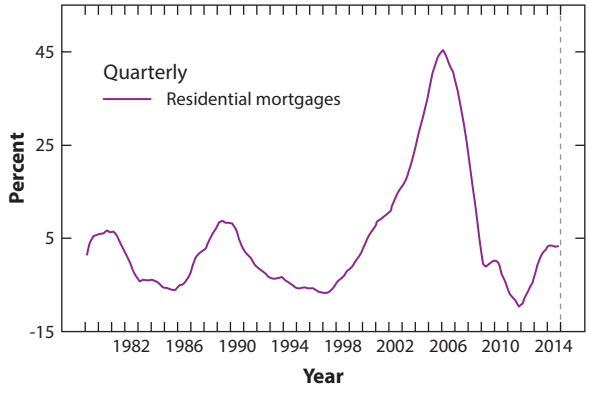

Figure 5

House price overvaluation, measured as the deviation from the long-run relationship between house prices and rents. Staff calculations are based on data provided by CoreLogic.

to the crisis, incentive problems within the largest banking institutions, in the shadow banking system, and among the thrifts, together with lax regulations, led to a deterioration of underwriting standards, although this deterioration is clearer in hindsight (**Figure 6**). As a result of easy lending standards, house prices were pushed up. In fact, cross-sectional studies show that the house price bust was more severe in areas that experienced laxer underwriting standards, had larger shares of subprime borrowers and of second liens, and experienced a bigger household leverage cycle (Mian & Sufi 2009, 2010, 2011). Also, there is evidence that the failures in underwriting standards enabled more speculative borrowing in the regions that experienced the largest boom and bust cycle (Haughwout et al. 2011). This evidence suggests again that house price valuations have to be analyzed in conjunction with underwriting conditions by financial intermediaries. The systemic impact of the house price decline was ultimately attributable to the risk-taking behavior of the financial system in the run-up to the crisis.

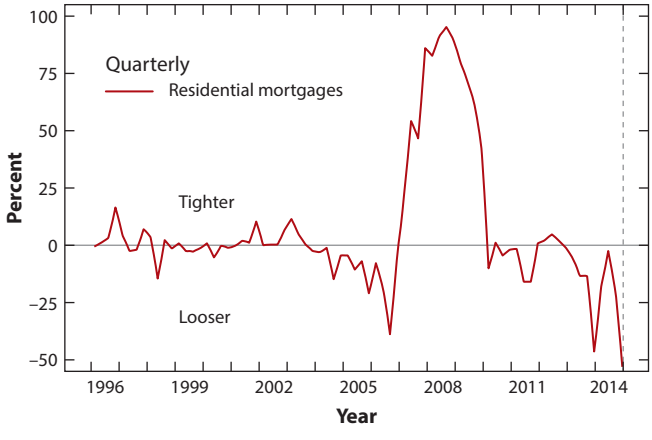

Figure 6

Loan standards, weighted by the value of outstanding loans. Net percent of banks reporting tightening standards. Data are from the Senior Loan Officer Opinion Survey on Bank Lending Practices (FRB 2014c).

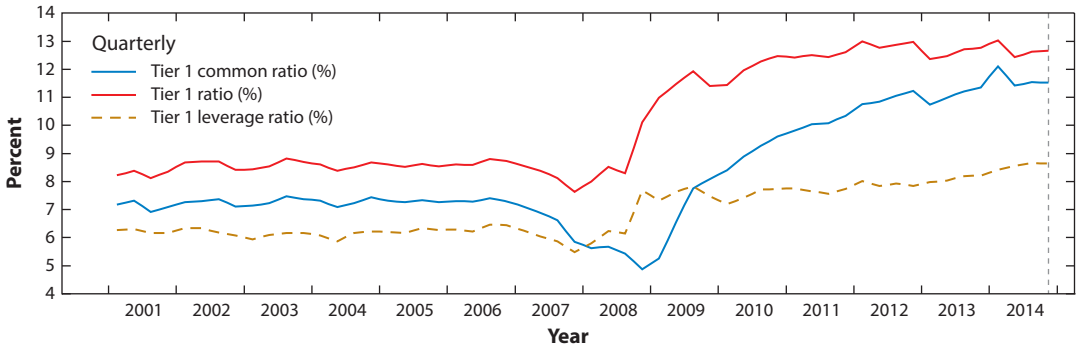

Figure 7

Capital ratios of the 19 bank holding companies (BHCs) that in May 2009 were assessed in the Federal Reserve System's Supervisory Capital Assessment Program. Goldman Sachs, Morgan Stanley, Ally Financial, and American Express are excluded prior to 2009, as they were not yet BHCs. MetLife is no longer a BHC and thus is excluded from calculations from 2012Q4 onward. Data are from Consolidated Financial Statements for Holding Companies (Y-9C forms) submitted to the Federal Reserve by the BHCs.

3.2. Banking

Systemically important banking firms are those whose distress or failure could disrupt the functioning of the broader financial system and inflict harm on the real economy.[3] They pose potential systemic risk if their decisions reflect an expectation of government support in failure and deploy excessive leverage, if they fail to internalize private-sector coordination failures associated with short-term debt and contribute to fire sales and contagion, or if they are excessively interconnected to other parts of the financial system.

Standard measures of amplification channels from banks include regulatory capital and leverage ratios, asset liquidity, and wholesale short-term funding (**Figures 7** and **8**). However, these measures are often viewed as lagging indicators of future risks. For example, regulatory capital ratios would not reflect expected losses on mortgages that might be due to an expected decline in house prices unless there were tangible indications, such as an increase in 30-day delinquencies, that losses could increase in the near future. Market indicators, such as credit default swap (CDS) premia, equity prices, and expected default probabilities based on estimates of asset volatilities and liabilities, provide market participants' contemporaneous views about institutions' riskiness, and they are an important complement to balance sheet and supervisory measures (**Figures 9** and **10**). However, these market-based indicators may be confounded by current levels of overall risk pricing and may be compressed when economic conditions are good.

Considerable research is being conducted to better measure the systemic risk of banks, and below we summarize three areas. The first area is financial market-based measures of systemic, as opposed to individual-firm, risk. The second is information from supervisory stress tests, which use confidential supervisory information to produce forward-looking measures of banks' risk. The third is network measures of interconnectedness.

[3] SIFIs can be bank or nonbank financial institutions. The Dodd-Frank Wall Street Reform and Consumer Protection Act automatically designates bank holding companies with total assets over $50 billion as SIFIs, but the Federal Reserve increases its regulatory and supervisory efforts with the systemic importance of the firms in this group. The Financial Stability Oversight Council is authorized to designate nonbank SIFIs based on a number of criteria that include the size, leverage, maturity mismatch, and potential spillovers of the institution to the broader financial system if it were distressed.

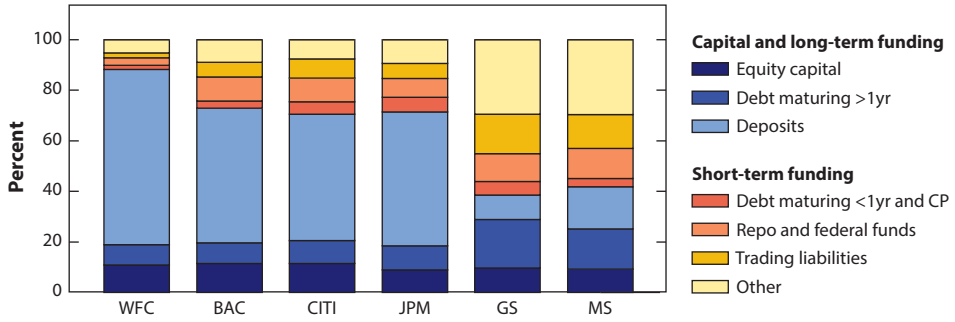

Figure 8

Liability structures of select US bank holding companies (BHCs) in 2014Q4. Data are from Consolidated Financial Statements for Holding Companies (Y-9C forms) submitted to the Federal Reserve by the BHCs. Abbreviations: BAC, Bank of America Corporation; CITI, Citigroup; CP, commercial paper; GS, Goldman Sachs; JPM, JP Morgan; MS, Morgan Stanley; WFC, Wells Fargo Corporation.

3.2.1. Financial market-based systemic risk measures. Researchers have been developing systemic risk measures for firms based on financial market indicators (**Figure 11**). Conditional value at risk is an estimate of the value at risk of the financial system conditional on a firm's distress, based on comovement of equity prices in the lower tail of the firm's and the market's return distributions (Adrian & Brunnermeier 2010). The distress insurance premium measures the cost of insuring a firm against system-wide distress, measured by losses on a portfolio of financial institutions (Huang, Zhou & Zhu 2009). This second measure is derived from CDS premia and correlations of equity returns of portfolio firms. A third measure, the systemic expected shortfall, estimates the expected decline in the market value equity of a firm given a market-wide decline in equity prices, and so it approximates the propensity to be undercapitalized coincident with the rest of the financial system (Acharya et al. 2010).

These measures attempt to uncover, through asset prices, fundamental links between distressed financial firms and the broader financial system, and as such are a direct attempt to uncover the

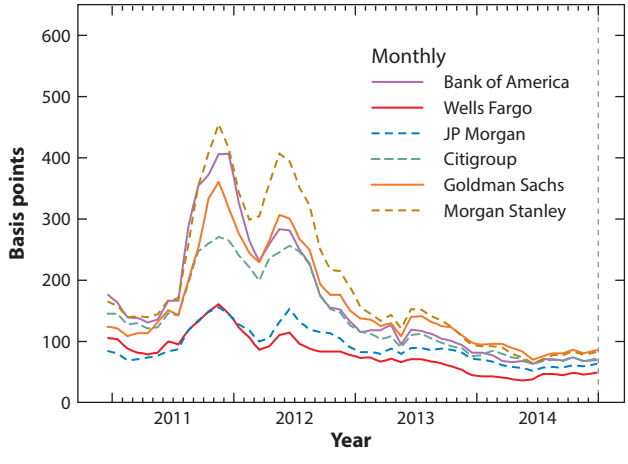

Figure 9

Five-year credit default swap premia for select US bank holding companies. Data are from Markit Group Limited: Markit Credit Default Swaps (CDS).

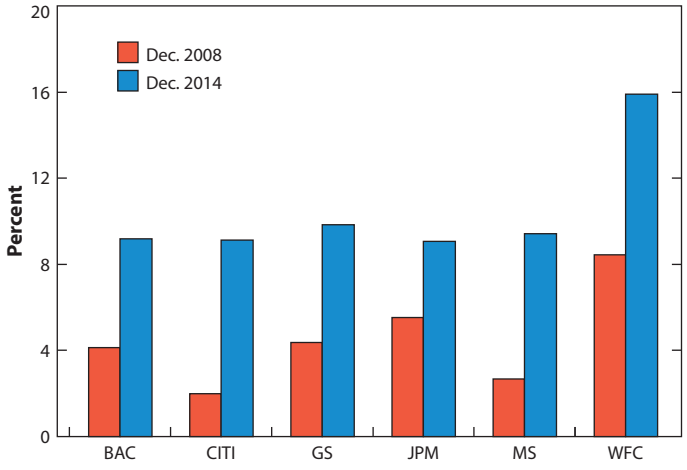

Figure 10

Market-based capital ratios for select US bank holding companies. Ratios are market value of common equity to estimated market value of assets. Staff calculations are from Bloomberg data. Abbreviations: BAC, Bank of America Corporation; CITI, Citigroup; GS, Goldman Sachs; JPM, JP Morgan; MS, Morgan Stanley; WFC, Wells Fargo Corporation.

components of v in our systemic risk framework. Such links could reflect that the failure of a large, interconnected financial institution may cause a generalized loss in confidence in the financial system, which in turn could trigger coordination failures in short-term credit markets; such links could also arise through counterparty relationships with the failing firm or from the firm's presence or roles in the functioning of certain markets. Researchers are also exploring risk measures of tail events based on options prices of SIFIs (Malz 2013, Aramonte, Rosen & Schindler 2013).

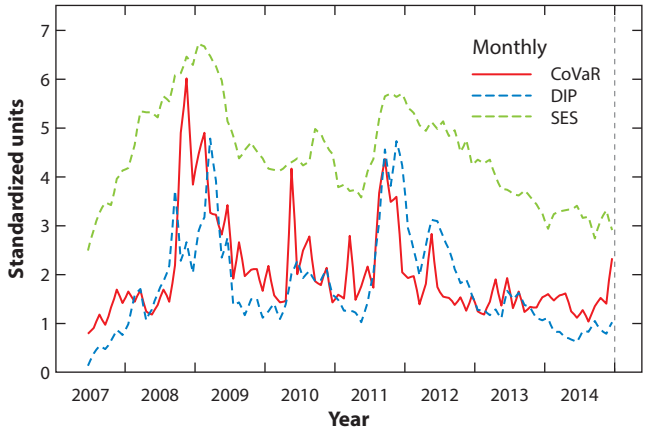

Figure 11

Systemic risk measures of portfolio firms of the Large Institution Supervision Coordinating Committee (LISCC). Each risk measure is averaged across the six largest LISCC bank holding companies (Bank of America, Citigroup, Goldman Sachs, JP Morgan, Morgan Stanley, and Wells Fargo). Each resulting time series is then rescaled by its standard deviation. Abbreviations: CoVaR, conditional value at risk; DIP, debtor-in-possession financing; SES, systemic expected shortfall.

Any market-based measure of systemic risk will not be immune to confounding effects of current levels of overall risk pricing. For example, systemic risk measures rely fundamentally on stock prices or CDS premia, which reflect the varying market price of risk. In addition, when the market price of risk is low, options-implied risk-neutral probabilities will be low, even if the physical probabilities of tail events have not decreased.

3.2.2. Supervisory stress tests. Supervisory macro stress tests conducted by the Federal Reserve project whether the largest regulated banking firms would have sufficient capital to withstand unexpectedly weak macroeconomic and financial conditions. Such tests were initiated in the United States at the height of the financial crisis in early 2009, have been repeated in the past few years, and are used to evaluate the capital planning processes of bank holding companies (BHCs).

Supervisors project losses for the firms' loans and trading assets, and revenues under a 2-year hypothetical scenario are based on detailed confidential information about the characteristics of firms' assets and business models. Stress tests are conducted for the largest firms simultaneously, which allows comparison of loans and trading assets across institutions at the same time, promotes consistency of estimated losses across the firms, and imposes a macro constraint on the performance of the largest firms in the aggregate. Also, particular features of the stress tests incorporate simultaneous stresses. For example, losses assume that precommitted liquidity and credit lines, such as those that would have supported asset-backed commercial paper (ABCP) conduits or variable rate demand obligations in 2007, would all be drawn, and projected losses for the trading book include those arising from stressed counterparties, reflecting interconnectedness among the firms.

Supervisors disclose firm-level loss rates for broad categories of assets, as well as capital ratios under stress scenarios (**Figure 12**). In past years, significant abnormal stock returns in the days following announcements of stress test results and capital distribution decisions suggest that such disclosures convey useful information to investors.

Stress test results on losses, revenues, and capital under a severe macroeconomic scenario provide a time-varying, forward-looking measure of the risk of a firm. Because the results are

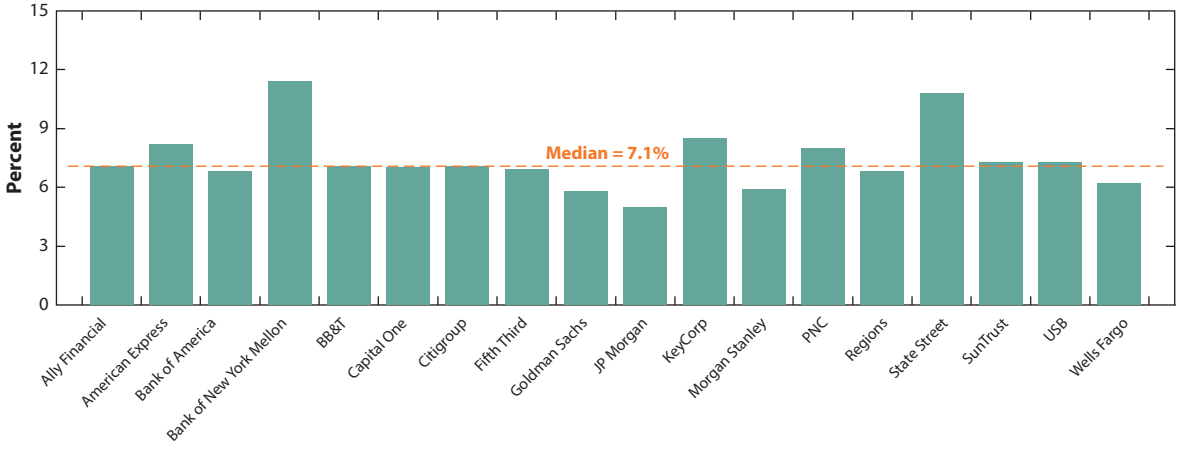

Figure 12

Post-stress tier 1 common capital ratios for bank holding companies. Data represent minimum stressed ratios with original planned capital actions for severely adverse scenarios. The chart and its median line represent 18 firms that are among the largest banks in the Comprehensive Capital Assessment Review. Data are Federal Reserve estimates (FRB 2014a).

based on physical expected losses, these measures are not subject to the concern that risk measures are affected by the market pricing of risk. However, the macroeconomic scenarios need to be designed each year so that these measures of risk are not procyclical, suggesting lower losses and higher capital adequacy when current economic conditions are strong. The Federal Reserve issued a policy statement about the design of macroeconomic scenarios, which specifies that scenarios will be based on features of past severe recessions. In addition, scenarios will be designed to avoid adding more procyclicality to the banking sector, which arises because market participants tend to require less compensation for risk after extended periods of low losses, by setting a floor on the peak unemployment rate (Liang 2013).

3.2.3. Network measures. Network measures map interlinkages between firms, help to identify key nodes or clusters, and can be used to simulate how a shock, such as the distress of a firm, could be amplified through the network. Garratt, Mahadeva & Svirydzenka (2011) provide an example applied to the international banking system and based on public data. Using a network measure, they show how the degree of interconnectedness has changed, from tight linkages among only a few countries to tight linkages among many countries following the introduction of the European Union, indicating the potential for greater contagion. Another example is based on detailed data for Brazilian banks for 2007 and 2008 (Cont, Moussa & Santos 2013). Using data on exposures, Cont, Moussa & Santos estimate the potential for systemic risk based on the expected loss to the banking network conditional on the default of a firm in a macroeconomic stress scenario, and they also provide evidence that counterparty exposures are more important than size in determining the contribution to systemic risk of an institution.

Measures of derivative market networks of central counterparties (CCPs), dealers, and firms can be derived from detailed data on positions in CDSs reported to the Depository Trust & Clearing Corporation Trade Information Warehouse (**Figure 13**). The position data allow the identification of firms that are central to the transfer of risk from buyers to sellers. Based on the snapshot of positions in 2010, Brunetti & Gordy (2012) find that CCPs are central to the network,

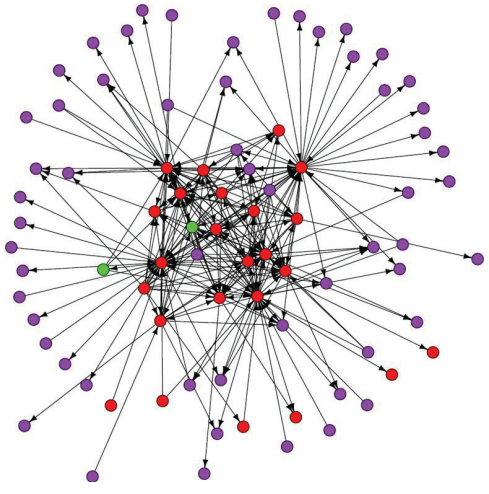

Figure 13

Interconnectedness of central counterparties, dealers, and nondealers in credit default swaps. Central counterparties are represented by green dots, dealers by red dots, and nondealers by purple dots. Adapted with permission from Brunetti & Gordy (2012).

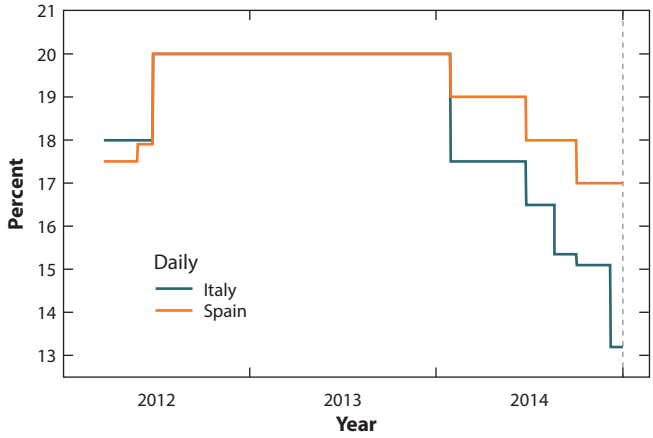

Figure 14

Margins on Italian and Spanish sovereign bonds with maturities of 15–30 years. Data are from LCH.Clearnet SA.

that dealers are interconnected among themselves, and that nondealer buy-side firms tend to trade primarily with a single dealer, rather than with multiple dealers. These types of network measures will be important for monitoring systemic risk, especially if transactions increase with economic activity.

Network stability may also be impacted by margin requirements, because an increase in margins can trigger fire sales as counterparties sell assets to meet their margin calls. Margins required by CCPs insulate them and members from falls in securities' values and from counterparty risks. But when economic conditions are strong and price volatility has been low, margins tend to fall, which indicates that volatility may increase by more in the event of a price decline. Moreover, when times are good, CCPs and counterparties in bilateral transactions may compete for business by requiring lower margins. Relevant information to monitor includes the level of margins and haircuts, which institutions hold what type of collateral with what clearing counterparty, and how margin and haircut policies might change in response to deteriorating market conditions (**Figure 14**).

3.3. Nonbank Sector and Shadow Banking

Nonbank finance and shadow banking involve financial intermediation—including credit, liquidity, and maturity transformation—without an explicit government backstop (Pozsar et al. 2010; Adrian & Ashcraft 2012a,b; Stein 2010; Sunderam 2012). The core of the shadow banking system before the crisis consisted of securitized credits, mortgages, and loans that were sold by originators to various leveraged entities, including traditional banks, ABCP programs, and CDOs, that were then funded in short-term debt markets by highly risk-averse lenders. Securities broker-dealers play a central role in many aspects of shadow banking as facilitators of this market-based intermediation. To finance their own and clients' securities holdings, they rely heavily on collateralized lending agreements, such as short-term repo, which can become fragile when the value of the collateral becomes uncertain. Shadow banking liabilities increased dramatically in absolute size (as well as relative to traditional commercial banking liabilities) in the years leading up to the financial crisis (**Figure 15**), but they plummeted during the crisis and since then have stayed at lower levels.

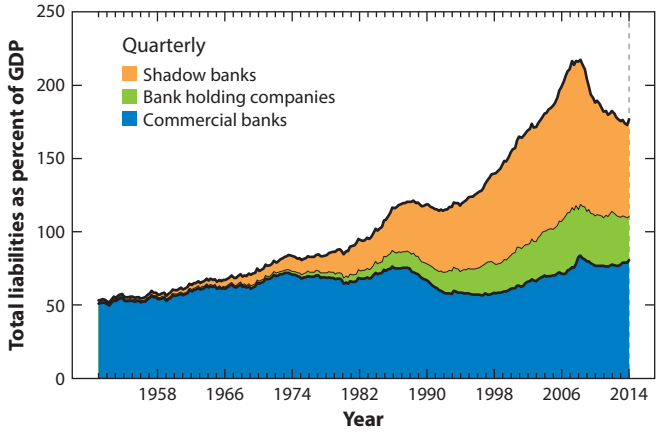

Figure 15

Financial sector liabilities. Bank holding company liabilities include those of broker-dealers. Data are from the Financial Accounts of the United States (FRB 2014b).

Shadow banking poses a greater systemic vulnerability when the leverage of dealers and investors is higher and when the degree of maturity mismatch is greater (Brunnermeier & Pedersen 2009). In addition, the potential for systemic risk increases with new financial practices that are not well understood (Gennaioli, Shleifer & Vishny 2013; see also Tarullo's (2012) speech on shadow banking after the financial crisis).

Because shadow banking comprises many different entities and activities and is ever evolving, our discussion focuses on a few areas. In particular, we discuss dealer-intermediated financing, wholesale short-term funding markets, securitizations, and other new financial products that transform risks. Nonbank entities, such as hedge funds, private equity and other funds, and asset management firms should be monitored to the extent that they engage in activities that involve significant transformations of maturity, liquidity, and credit risk. The participation of insurance companies and pension funds in activities such as securities lending and the provision of tail risk insurance in credit markets that facilitate shadow banking should also be monitored.

3.3.1. Dealer-intermediated finance. The recent crisis illustrated that a significant amount of financing is intermediated outside of the traditional banking system and, in one fashion or another, through the dealer community. Dealers act as intermediaries for the market-based system, covering trading in equities, rates, credit, derivatives, foreign exchange, and commodities.

Relative to commercial banks, broker-dealers are highly levered. In part, lower capital ratios for broker-dealers reflect that the asset side of the balance sheet is quite different for them, with a high share of assets in very liquid, relatively low-risk securities and a relatively small share of assets in loans, which are less liquid and generally more risky. Moreover, liabilities of broker-dealers are primarily wholesale short-term secured funding, which is much less reliable in times of stress than insured deposits.

The leverage of security broker-dealers tends to be procyclical, more so than for commercial banks. Data on broker-dealer subsidiaries in the United States show a dramatic decline in capital ratios in the years leading up to the financial crisis as perceived risk—often measured by the VIX or credit spreads—fell to low levels. Adrian & Shin (2010) document this procyclicality and point out that financial crises correspond to extreme outcomes in this leverage cycle.

The leverage cycle of broker-dealers is a potential amplification channel. Leverage can build when market volatility and risk management constraints are low, which tends to compress the market pricing of risk and boost asset prices, and in turn, fuels greater repo financing. However, when economic conditions turn and dealers and their clients reduce risk-taking activities, dealer balance sheets begin to deleverage. As a result, risk premia and volatility increase endogenously. Deleveraging will be sharper if the broker-dealers are more levered and perform larger maturity and liquidity transformations, which can generate fire sales, especially if the risks are opaque.

In addition, to monitor broader market conditions facilitated by dealers, in 2010 the Federal Reserve started the quarterly Senior Credit Officer Opinion Survey (SCOOS), which asks dealers about the provision of credit (Eichner & Natalucci 2010). The SCOOS is in many ways modeled on the long-established Senior Loan Officer Opinion Survey (SLOOS), which was initiated in the 1960s and asks commercial banks about their willingness to lend, their terms, and their standards. The SCOOS also allows for the qualitative tracking of conditions, as reported by dealers, in markets such as syndicated leveraged loans, prime brokerage, and derivatives trading. Also, new information from Form PF collected by the SEC on hedge funds and other private funds will provide insight into changes in the use of leverage by dealer clients. Still more data are needed to track repo and securities lending markets.

3.3.2. Wholesale short-term funding. Wholesale short-term funding markets are fragile because they permit maturity transformation without direct, explicit sources of liquidity or credit backstops. The lack of credible backstops makes such funding vulnerable to coordination failures at times, and thus is a potential mechanism for amplifying adverse shocks. Triparty repurchase agreements and ABCP are two main sources of wholesale short-term secured funding in the shadow banking system. Financial commercial paper (CP) and uninsured certificates of deposit (CDs) (wholesale CDs or brokered deposits) are a source of unsecured funds for financial firms. Other securities that provide significant amounts of maturity transformation in the shadow banking system include variable rate demand obligations and tender option bonds. Primary classes of investors in these funding instruments are 2a-7 MMFs and other cash management funds. We focus below on ABCP, triparty repo, and MMFs.

ABCP and triparty repo volumes rose sharply prior to the financial crisis and have declined significantly since then (**Figure 16**). ABCP peaked in July 2007 (corresponding to the onset of the financial crisis), whereas repo peaked in September 2008, about a year later. ABCP is a means for financial firms to fund loans, receivables, or securities through bankruptcy remote conduits. Most conduits are overcollateralized and have backup sources of liquidity from sponsoring commercial banks. However, the rapid expansion of ABCP conduits from 2004 to 2007 was accompanied by fewer protections; for example, newer conduits, such as structured investment vehicles, were marketed without backup liquidity. Investor runs in 2007 led to a 40% drop in outstanding ABCP in just a few months, and those conduits that were backstopped by weaker commercial bank sponsors or lacked liquidity lines were more likely to be run, as documented by Covitz, Liang & Suarez (2013). Although the structural flaws of ABCP have been fixed and the market is now notably smaller, incentives to reduce funding costs could lead to a weakening of standards when risk taking builds again. Measures of fragility include increased volumes, weaker forms of credit and liquidity support, and less liquid conduit assets.

The triparty repo market is the main source of funding for security broker-dealers.[4] Triparty repo refers to repo using an infrastructure provided by triparty clearing banks to manage the

[4]The importance of repo for the security broker-dealer sector was first documented by Adrian & Fleming (2005) and Adrian & Shin (2010). The mechanics of repo borrowing were described by Fleming & Garbade (2003) for general collateral finance

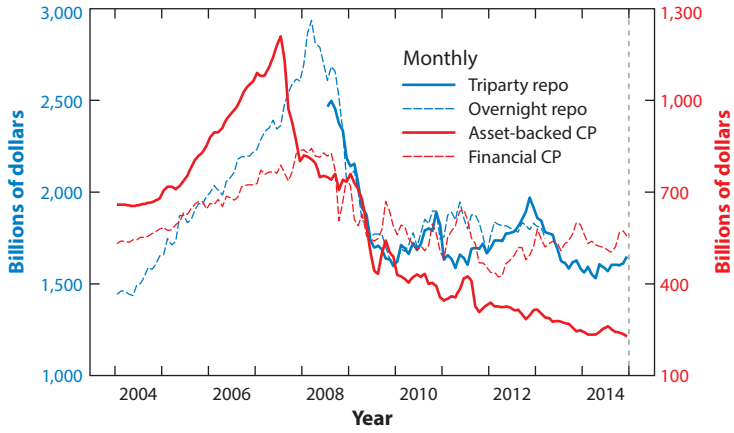

Figure 16

Commercial paper (CP) and repo financing. Data are from primary dealer statistics collected from FR2004 forms submitted to the Federal Reserve and from the Depository Trust Company. For more information, see FRB (2012).

collateral of borrowers. Because repo is a fully collateralized lending transaction, the lender is protected from borrower default. In addition, borrowers believe they are protected from lender default, as the collateral never leaves the triparty repo platform. However, this protection is primarily about the custody of the collateral; potential credit or liquidity issues arising from a default of a lender could pose significant credit and liquidity risks.[5]

Although triparty repo was traditionally secured by Treasury and agency debt as collateral, there was a marked deterioration in the quality of collateral in the run-up to the financial crisis, similar to the deterioration in ABCP conduits, with a greater share of collateral consisting of asset-backed securities (ABSs), whole loans, and equities. Whereas the share of less-liquid collateral has declined since the financial crisis, the market remains vulnerable to runs due to counterparty risks, potentially giving rise to fire sale externalities.

Part of triparty repo financing is used to fund the dealer's own securities positions, whether these are held for purposes of making markets or for other reasons. The remaining funding from triparty repo is passed on to the clients of dealers in the form of delivery versus pay (DVP) repo, and among dealers via general collateral finance (GCF) repo. The DVP repo market itself is also a source of fragility, a fact that was amply documented by Gorton & Metrick (2012). In periods of stress, haircuts are increased sharply in the DVP repo market, which forces repo borrowers to deleverage, an important risk management tool for the dealer sector. In contrast, haircuts tend to be stable in the triparty repo market, and lenders in this market instead tend to adjust quantities rather than prices by simply withdrawing funding.

(GCF) repo, by Garbade (2006) for delivery versus pay (DVP) repo, and by Copeland, Martin & Walker (2010) for triparty repo. An additional source of wholesale funding is securities lending transactions, which are described in detail by Lipson, Sabel & Keane (2012) and Adrian et al. (2013). Krishnamurthy, Nagel & Orlov (2012) report repo market measures based on MMF filings.

[5]Additional advantages of triparty repo result from the fact that the clearing banks extend daily intraday credit. This intraday credit is of large value to lenders and borrowers, as triparty repo transactions are unwound daily. Clearing banks thus extend an implicit, noncontractual guarantee to borrowers during the day, amounting to over a trillion dollars a day, some of which is against illiquid collateral. Efforts by market participants, including the clearing banks, dealers, and supervisors, have led to important reductions in intraday credit.

Although the repo market is now considerably smaller than in 2008, it remains a critical area to monitor for the potential for a deleveraging cycle. Signs of increasing vulnerabilities, based on the recent crisis, include increased volumes, less liquid collateral, lengthened maturities, narrowed haircuts, and higher counterparty risk.

The primary lenders into triparty repo are MMFs and stable-value cash-management products. The predominant one is the 2a-7 MMF. The SEC imposes tight investment restrictions on such funds to protect investors, but such restrictions have no ameliorative impact on their susceptibility to investor runs. These 2a-7 funds hold assets that entail credit and interest rate risk but still offer investors a constant net asset value, provided that actual net asset values do not fall more than half a percent below that constant value. Importantly, this rounding mechanism provides investors with an incentive to redeem shares (i.e., run) if a threat to the value of MMF portfolios emerges.

The potential damage from this flawed business model was forcefully illustrated in the aftermath of the September 2008 bankruptcy of Lehman Brothers. The Reserve Primary Fund had exposure to Lehman Brothers and could no longer maintain a stable NAV, which triggered a broad run, with nearly half a trillion dollars flowing out of prime MMFs to Treasury-only MMFs by the end of October 2008 (McCabe 2010). This run, in turn, exacerbated the fragility of short-term funding markets and generated shortages for CP and repo issuers. In response, the Federal Reserve instituted the Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility to provide a public backstop through commercial banks for ABCP issuers (Duygan-Bump et al. 2013) and the Commercial Paper Funding Facility as a public liquidity backstop for CP issuers more broadly (Adrian, Kimbrough & Marchioni 2011). Whereas these facilities supported the CP markets, runs by money market investors were addressed more directly by the public guarantee provided to MMFs by the Treasury.

Some steps have been taken since the crisis to mitigate the risks arising from MMFs, including greater reporting requirements and SEC regulations for stronger liquidity requirements to reduce maturity transformation.[6] MMFs are now required to report their asset holdings to the SEC on a monthly basis, and exposures are subsequently made public by the SEC with a two-month lag. These data allow more effective monitoring of MMFs' portfolios. For example, holdings by US prime MMFs of short-term paper (CP and CDs) issued by European financial institutions were substantial at the time reporting started in December 2010, and they declined significantly as the European sovereign and financial debt crisis intensified in 2011 (**Figure 17**). In addition, the maturities of assets at MMFs shortened (**Figure 18**). The decline in holdings and maturities is somewhat reassuring from a financial stability point of view, as MMFs fairly quickly reduced their exposures to debt that became more risky. However, the lack of any loss absorption buffer still leaves the financial system vulnerable to a break-the-buck event by an MMF. Moreover, although shorter maturities reduce the risk that an individual MMF would have to liquidate assets to meet redemptions, the shortening of asset maturities increases the rollover risk to issuers.

3.3.3. Securitizations and new financial products. Shadow banking also encompasses financial intermediation that takes place through securities backed by loans that are often originated by depository institutions. The combined quarterly volume of asset-backed security issuance in the form of CDOs, residential mortgage-backed securities (RMBSs) (including only private label

[6]The SEC's MMF reforms of July 2014 introduced (*a*) a floating NAV for prime institutional funds, (*b*) fees and gates, and (*c*) stress testing requirements. These changes are likely to mitigate the vulnerabilities of MMFs.

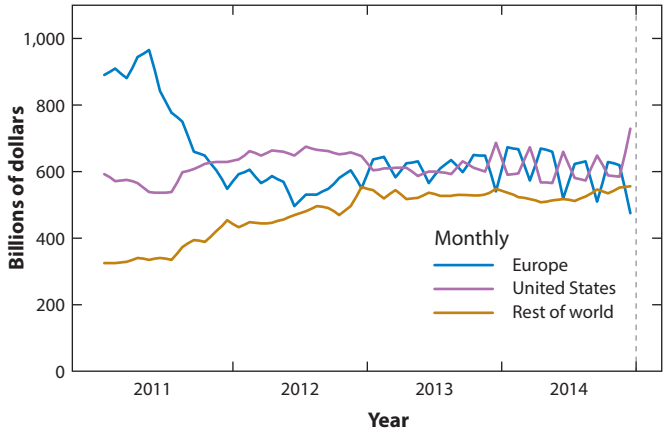

Figure 17

Prime money market mutual fund exposures. Data are from N-MFP forms filed with the Securities and Exchange Commission.

RMBSs, not mortgage-backed securities issued by government-sponsored enterprises), commercial mortgage-backed securities, and securities backed by consumer loans topped $500 billion just prior to the financial crisis, with the AAA-rated tranches being funded by ABCP and triparty repo. Volumes dropped precipitously during the crisis, and they now stand at roughly $100 billion per quarter (**Figure 19**).

Gauging the risk of structured products is difficult, given the complexity and variety of the structures and of the assets being funded. Key determinants of risk include the amount of subordination, the structuring of payment waterfalls, the nature of liquidity or credit backstops from banks and insurance companies, and the quality of the underlying collateral, though these data are often not public. Experience with the inadequate ratings provided by credit rating agencies in the run-up to the financial crisis indicates that risks embedded in structured credit products tend to be much more complex and multidimensional than risks of corporate debt. Efforts to make more data about the collateral and the structure of these products available to investors are important to reduce the potential for contagion.

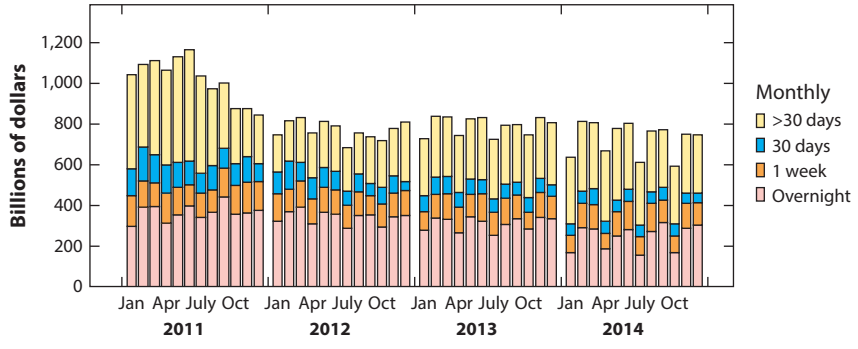

Figure 18

Maturities of prime money market mutual fund European exposures. Data are from N-MFP forms filed with the Securities and Exchange Commission.

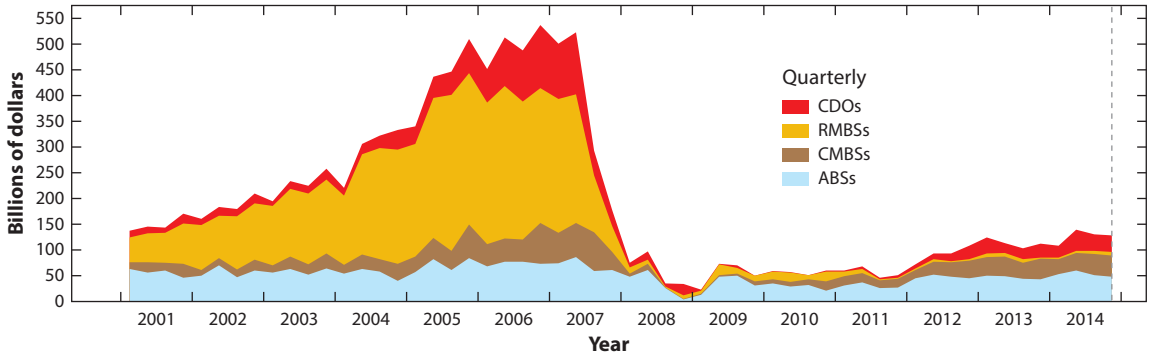

Figure 19

US securitization issuance. Here, asset-backed securities (ABSs) are securities backed by consumer loans, distinct from commercial mortgage-backed securities (CMBSs) and residential mortgage-backed securities (RMBSs). CDOs are collateralized debt obligations, defined as including securities backed by commercial loans, resecuritizations of portfolios of securitization bonds, securitizations of trust preferred-securities, and securitizations of corporate bonds. Data are from Asset-backed Alert and Commercial Mortgage Alert from Harrison Scott Publications, Inc. (downloaded April 3, 2015).

Abnormally high and increasing volumes of asset-backed security issuance may be an indication of underpriced risk, weak underwriting, or insufficient subordination. High volumes may also indicate that the financial system is relying on a funding model that proved unstable in the financial crisis.[7]

A key element of a monitoring program should track the adoption of new structures and products that provide financial intermediation and transform risks in novel ways. Some new products are intended to arbitrage new capital and liquidity regulations, such as short-term liabilities with maturities just beyond the proposed liquidity coverage ratio regulatory limits. Others may involve implicit leverage or transformation of risks in opaque ways. One example is synthetic ETFs, which have been growing in number, size, and complexity. Although the SEC recently imposed a moratorium on approval of new synthetic ETFs in the United States, they continue to grow dramatically in Europe, and there are concerns that they could transmit shocks to US markets. A synthetic ETF may replicate the returns of an index by using derivatives, rather than the underlying assets, and thus may be complex and face additional risks, such as counterparty risks. Other examples are bond and loan ETFs, which create liquidity for a basket of underlying securities that are likely less liquid than the ETF shares.

3.4. Nonfinancial Sector

Research has identified excessive credit in the private nonfinancial sector as an important indicator for the buildup of systemic risk (Borio, Drehmann & Tsatsaronis 2011; Borio, Furfine & Lowe 2001; Borio & White 2003). A first-order transmission channel for systemic financial crises to affect the real economy is via wealth effects of the household and nonfinancial business sectors. The leverage of these sectors, as well as their reliance on short-term nonbank deposits for funds, can amplify these wealth effects. As highly indebted households and nonfinancial businesses are less able to withstand negative shocks to incomes or asset values, they may have to sharply curtail

[7] Campbell et al. (2011) argue that runs in short-term credit markets in 2008 led to an evaporation of funding for highly rated tranches of asset-backed securities.

spending in ways that can reinforce the effects of the shocks. For example, in the nonfinancial business sector, leverage, debt defaults, bankruptcy, or covenant violations force firms to cut back on investment or employees, potentially amplifying the initial declines in spending if cutbacks are widespread (Opler & Titman 1994, Chava & Roberts 2008, Falato & Liang 2015, Sharpe 1994). In the household sector, highly levered households are less able to absorb, for example, the shock of a house price decline. Mian & Sufi (2009) show that a rise in household leverage, measured at the county level, is a strong predictor of recession severity.

Losses among households and businesses can also lead to mounting losses at financial institutions. When such losses impair the capital adequacy of regulated banks and shadow banks, they can restrict credit availability and further reduce aggregate demand through an adverse feedback loop in which less aggregate demand reduces the value of collateral and makes it more difficult for the nonfinancial sector to service their debt, further increasing losses to the financial sector (see, e.g., Bernanke & Gertler 1989, Gertler & Kiyotaki 2012).

Measures of vulnerability in the nonfinancial sector include such variables as leverage and debt service burdens. Excessive leverage and mispriced risks are difficult to identify, so indicators of credit availability, such as underwriting standards on new credit extensions for households and businesses, provide important additional evidence. In addition, for each sector, it is important to analyze conditions in the tails of the distributions of leverage or net worth, as households with below-prime credit scores or businesses with speculative-grade ratings are more vulnerable than segments with higher income or wealth. Moreover, as the last financial crisis illustrates, debt cycles for different sectors may not move in lockstep; whereas rapid household debt growth proved unsustainable in the run-up to the financial crisis, leverage and the credit quality of most nonfinancial businesses were at moderate levels, and the business sector was not a major vulnerability in the crisis. Of course, some nonfinancial corporations were involved in shadow banking activities through the ownership of finance companies and special-purpose vehicles for the funding of receivables. Many such companies were caught up by the funding problems during the crisis.

3.4.1. Aggregate private nonfinancial sector leverage. Nonfinancial sector debt growth and debt-to-GDP ratios are basic aggregate indicators of leverage. Excess leverage can be proxied by high growth rates in excess of GDP growth for sustained periods. Another measure, credit-to-GDP gap ratio, is the difference between the actual and trend credit-to-GDP ratios, where the trend adjustment captures that credit cycles are longer than business cycles (**Figure 20**).

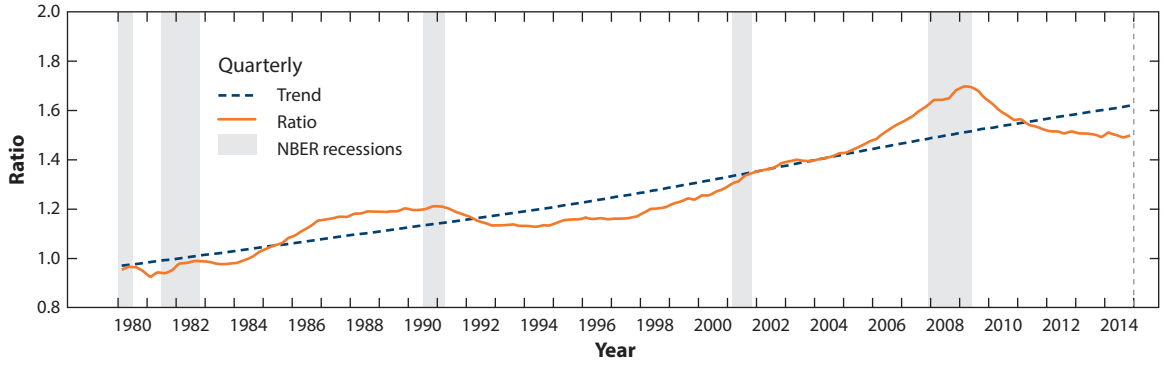

Figure 20

Private nonfinancial sector credit-to-GDP ratio, calculated using a Hodrick–Prescott filter. Abbreviation: NBER, National Bureau of Economic Research. Staff calculations based on data from the Financial Accounts of the United States (FRB 2014b) and the United States National Income and Product Accounts.

A caveat that applies to credit-to-GDP gap measures is that they are difficult to gauge in real time. Edge & Meisenzahl (2011) document estimation difficulties for the private nonfinancial sector in the United States. This difficulty of calculating unusual growth in credit-to-GDP ratio in real time comes down to the challenge of distinguishing permanent from transitory shocks from both a statistical as well as a heuristic point of view. Statistically, the challenge is a potential structural break because sometimes financial innovations occur that are accompanied by a structural shift in credit-to-GDP ratio or other leverage measures. Whereas those structural breaks can be estimated in retrospect, they are very hard to detect in real time, as one has to allocate any movement in the leverage measure as being either permanent or transitory. Heuristically, the challenge is that times of large imbalances are usually accompanied by reasonable stories of why those imbalances represent fundamental changes. For example, in the run-up to the recent financial crisis, commentators and policymakers attributed the substantial rise in household leverage to the improved ability of the financial system to distribute risk via securitization techniques and related financial innovations. In fact, the Great Moderation was cited as evidence that the economy was able to support the much greater leverage. In retrospect, those arguments proved wrong, but they were extremely convincing at the time.

3.4.2. Nonfinancial businesses. Prolonged periods of excessively loose lending standards and terms on credit may be indicators of future vulnerability of businesses. For example, in addition to narrow credit risk spreads, high debt-to-earnings multiples at origination could indicate greater risk taking by lenders and borrowers and raise the vulnerability of this sector.

Data for individual firms, as well as for the aggregate nonfinancial sector, provide valuable information about changes in the weaker parts of the sector, which could be masked by aggregate leverage or profits. For example, the debt-to-asset ratios for firms in the top decile in the early 2000s were greater than of other firms (**Figure 21**), indicating greater vulnerability among those weaker, top-decile firms to a slowdown in activity or other shock at that time.

Data for the nonfinancial business sector are available in the aggregate from sources such as FRB (2014b), and detailed data for publicly traded corporations are available from quarterly and annual reports and other financial statements. For firms that are not publicly traded, including those taken private in leveraged buyouts, which tend to have high default risk, firm-level data are

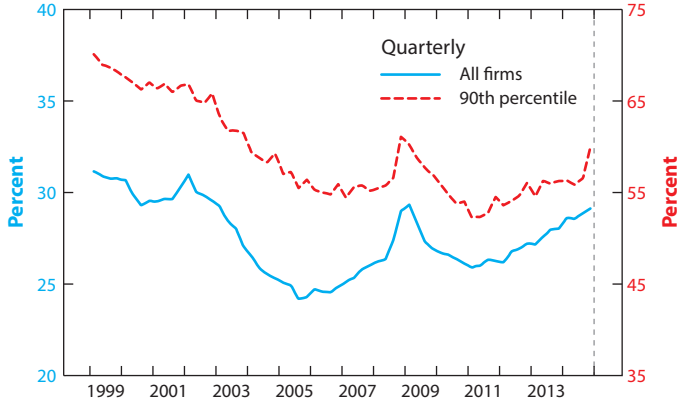

Figure 21

Debt-to-asset ratio: the ratio of the book value of total debt to total assets. The 90th percentile is calculated from a subset of the 3,000 largest firms by assets. Data are from Standard & Poor's Capital IQ: Compustat North America.

generally unavailable, and aggregate data on private firms are lagging and so provide limited value for monitoring.

3.4.3. Households. As with nonfinancial businesses, data for individual households or segments of the household sector are especially valuable for assessing increased vulnerabilities arising from the sector.

In the run-up to the financial crisis, disaggregated data show that increases in debt-to-asset ratios and debt service burdens were more pronounced for lower–credit quality borrowers, those least able to accommodate a decline in house prices or employment. Data on the geographic concentration in mortgage debt and loan-to-value (LTV) ratios show that high LTV ratios were highly concentrated in specific areas, such as Las Vegas and cities in Florida, making those areas more vulnerable to a downward spiral in the event of a negative shock to house prices.

In the past few years, as the economy and house prices have recovered, increases in net worth appear to have been concentrated among households in the upper decile of the wealth distribution, whereas households in the middle of the distribution (the 40th to 59th percentiles) have seen their net worth decline by 40% since mid-2007. The share of mortgages that are underwater has declined, but credit conditions for new residential mortgages for borrowers with weaker credit histories remain tight (**Figure 22**). These disaggregated data suggest that segments of the household sector remain quite vulnerable to shocks to income or house prices, and so could amplify such shocks through lenders. Moreover, a lack of underwriting standards for government-backed student loans could, in the future, create substantial financial burdens for some households, as well as for private financial firms with other claims on these households, as student loans have priority over other claims.

Investors and financial stability authorities can monitor underwriting standards for borrowers by credit quality and geographic area using detailed data from credit bureaus and other data vendors. Such detailed data are also important for regaining and preserving confidence in securitized products. In contrast to data for businesses, making the necessary data on households widely available raises the important challenge of including protections to maintain privacy.

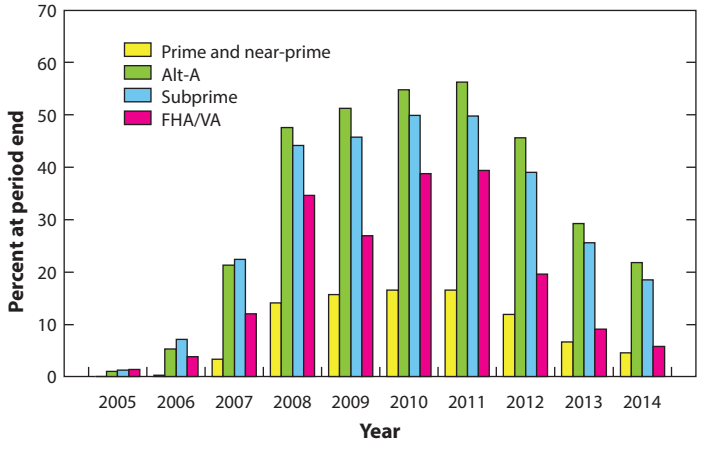

Figure 22

Underwater mortgages. Staff calculations based on data provided by CoreLogic and LPS (Lender Processing Services) Applied Analytics. Abbreviations: FHA, Federal Housing Administration; VA, Veterans Affairs.

3.4.4. Government debt. The fiscal debt situation in Europe clearly indicates that excessive sovereign debt, or tight linkages between banking and sovereign debt, can lead to systemic risk. Concerns by market participants that sovereign debt is excessive can force governments to impose fiscal austerity measures—raising taxes or cutting spending—often when GDP growth is already weak. Such measures can increase the odds of a feedback loop in which greater austerity causes growth to slow further, making it even more difficult to achieve debt reduction targets. Such a slowdown can also increase risks to the financial sector, especially if the household or business sectors are levered or otherwise vulnerable to a slowdown. In addition, if sovereign debt is held largely by the domestic banking sector, then concerns about the sovereign's ability to service its debt amplifies the risk that banking firms might also not be able to service their own debt, generating a severe adverse feedback loop.

In the United States, federal government debt has jumped since the crisis to approximately 70% of GDP, near its World War II highs, though it is elevated partly because of recent below-trend GDP growth. Although the current debt-to-GDP ratio may not indicate that the sector is especially vulnerable to a pullback from investors and a sharp rise in borrowing costs, the expected growth of entitlements if programs are left unchanged could lead to greater concerns about the ability to continue to service the debt and remain productive. Nonetheless, the sector is vulnerable if credit rating agencies were to materially downgrade the debt to reflect concerns about the ability of policymakers to make the necessary adjustments to put the country on a sustainable path.

The fiscal conditions of state and local government vary widely, with a number of large states burdened with substantially underfunded pensions (Novy-Marx & Rauh 2009). State and local pension fund assets were roughly $2.6 trillion in 2011. An estimate from the Center for Retirement Research suggests that the aggregate actuarial funded ratio of state and local plans was 75% in fiscal year 2011, based on a discount rate of 8%, and that the funded status would drop substantially to 50% if instead a risk-free rate were used to discount liabilities. The Pew Center for States estimates that unfunded pension liabilities-to-GDP averaged approximately 5% in 2010 but was as high as 12% for some states, such as Illinois. When these off–balance sheet liabilities are added to explicit on–balance sheet debt, ratios exceeded 30% for Illinois and eight other states, and they reached 28% to 30% in other large states, such as California, New York, and Ohio.

Although these large unfunded liabilities may not pose an immediate threat to financial stability, they increase the vulnerability of financial markets and of the economy to possible shocks, as state and local governments may have to increase pension contributions, make other spending cuts, or increase taxes. Such actions could exacerbate already weak local economic activity. Moreover, those municipalities unable to take these actions or restructure their obligations risk losing access to municipal credit markets, especially if their credit ratings are cut.

The scope and magnitude of this potential problem require significantly better data to facilitate analysis. Currently state and local governments are required to file only an annual statement; there is no standardized reporting system, and plans generally provide very little detail. The Governmental Accounting Standards Board (GASB) approved new accounting and reporting standards in 2012 that will increase transparency about discount rates and require that governments report their net pension liability in their financial statements. Even with these reforms, however, monitoring this sector will continue to require very detailed work to follow actions in various states.

4. PREEMPTIVE CYCLICAL MACROPRUDENTIAL POLICIES TO FOSTER FINANCIAL STABILITY

Financial stability policies are designed to change the systemic risk-return trade-off, illustrated by the vulnerability curves in **Figure 1**. In this framework, more stringent cyclical regulatory

and supervisory policies raise the costs of financial intermediation—the price of risk—in boom periods, thereby reducing the potential for systemic risk in the event of large adverse shocks in bust periods. The effect of these policies is reflected in the flatter slope of vulnerability curve V' (**Figure 1**). Monetary policy can also be a macroprudential tool because it affects asset prices, credit growth, and risk taking. In addition to leaning against the wind, some cyclical policies may also build financial sector resilience.

The trade-off between the pricing of risk and the amount of systemic risk in normal times reflects choices of market participants and institutions. As discussed above, there are many economic reasons why private actors on their own would price risk too low in most states of the world when shocks are small, with the consequence of increasing systemic tail risks beyond socially optimal levels. In particular, systemic distress typically involves externalities across actors and time. It follows that policies should attempt to reduce distortions between the systemic risk-return trade-off for the whole financial system relative to the systemic risk-return trade-off of individual market participants.

The possible tools to promote financial stability are varied. Most are microprudential tools applied to serve macroprudential objectives, and they target firms or sectors rather than the financial system as a whole. The macroprudential perspective implies that microprudential objectives might be overruled for the benefit of system-wide objectives. Most of the proposed reforms in the Dodd-Frank Wall Street Reform and Consumer Protection Act (DFA) and related international efforts are new regulations designed to address structural rather than emerging or cyclical vulnerabilities. Among the most notable regulations are higher capital and liquidity standards for SIFIs and financial market utilities, a new resolution regime, greater centralization of derivatives trades, and a consumer financial protection mandate. However, microprudential tools have largely been developed and evaluated on the basis of the safety and soundness of individual institutions, not with respect to the effects on financial stability of practices that are common to many institutions, and it will be important to continue to evaluate the effectiveness of these new regulations.

Policies intended to mitigate emerging cyclical vulnerabilities from individual participants becoming more willing to bear risk at a lower price when financial conditions are loosening are both more novel and less well understood in terms of effectiveness. Decisions to implement policies require policymakers to make difficult assessments, such as how quickly financial fragilities can build and how costly they would be to financial stability in the event of a large adverse shock. These considerations suggest a continuum for possible preemptive cyclical actions and point toward deploying lower-cost tools more frequently and before there is strong evidence of excesses, if by doing so we can reduce the odds that a vulnerability or combination of vulnerabilities with systemic consequences gets built up. Potential policies vary widely in their costs of implementation: Increased supervisory scrutiny targeting specific firms and activities and public recommendations by the Financial Stability Oversight Council (FSOC) to regulators, financial institutions, or market participants are relatively inexpensive actions. At the other end of the cost spectrum, a countercyclical capital buffer would apply to many large banking firms and could require some international cooperation, and monetary policy would affect all risk taking.

We briefly discuss some possible tools, mostly those designed to address identified emerging vulnerabilities, asking whether they can be timely and targeted, and then touch briefly on issues regarding broader policies. The imposition of stringent structural tools can reduce the need for cyclical tools, but at higher average costs. This discussion highlights that much research is needed to evaluate the efficacy of such tools. Notable recent contributions that study the macroprudential approach to regulation have been made by Angelini, Neri & Panetta (2012); Angeloni & Faia

(2013); Christensen, Meh & Moran (2011); Goodhart et al. (2012, 2013); Hanson, Kashyap & Stein (2011); Kashyap, Berner & Goodhart (2011); Kiley & Sim (2012); and Stein (2012).

4.1. Asset Markets

Building imbalances in the valuations of debt products, such as loans and mortgages, can be addressed by tightening underwriting standards on the assets to the extent that these assets are originated or distributed through firms subject to prudential regulations. These asset valuations, as well as those for equities, bonds, or other securities, may also be addressed through regulated banks and broker-dealers by tightening standards on implicit leverage through securitization or other risk transformations or by limiting the debt they provide to investors in either unsecured or secured funding markets, if the asset prices are being fueled by leverage. In principle, such actions could include tighter supervisory oversight, imposition of countercyclical capital buffers, or higher risk weights or sectoral capital buffers.

However, the efficacy of these tools to counter building imbalances is yet to be determined. In particular, the size of the additional countercyclical capital buffer needed to offset building asset bubbles might be unreasonably large when asset values are rising quickly, and thus the buffer may be more effective at building the resilience of a financial institution than at mitigating a building asset bubble. Even limits on leverage of investors may be insufficient because when asset prices are rising, leverage measures often are understated relative to measures after risk tolerance has declined and asset values have fallen. If the asset valuation problems are in limited sectors, countercyclical capital may not be sufficiently targeted to address a narrow asset. Although changing risk weights would be targeted, this likely would require rule making in the United States, which can be a lengthy process. Even then, these tools would affect lending only by regulated entities.

A number of countries have increased limits on LTV ratios on residential mortgages to mitigate rising real estate prices and to reduce household debt burdens. For example, Hong Kong has increased limits on LTV ratios on residential mortgages multiple times in recent years in a concerted effort to mitigate the house price boom, and recently they imposed stress tests on borrowers to improve resilience to rising interest rates. South Korea has imposed LTV and debt-to-income (DTI) ratio restrictions on households, which appear to have reduced mortgage loans, housing transactions, and house prices in the six months after implementation. In the United States, the new Consumer Financial Protection Bureau could impose standards for LTV or DTI ratios on mortgages or other credit for households, which could potentially be varied over time to address emerging imbalances.

4.2. Banking Policies

Since the financial crisis, domestic and international regulators have increased capital and liquidity requirements and have taken other actions to reduce the impact on the financial system if a SIFI were to fail. For example, the new international Basel III standard includes a minimum ratio of 4.5% of Tier 1 common to risk-weighted assets, a capital conservation buffer of 2.5%, and a common equity systemic surcharge of up to 2.5 percentage points, which increases based on the firm's size, complexity, interconnectedness, and other characteristics associated with a SIFI. Supervisory stress tests are now required annually for BHCs with more than $50 billion in assets and provide a forward-looking measure of capital under severe macroeconomic conditions. Still, there is much debate about whether the new requirements are sufficient to reduce the probability of default and systemic risk (Admati et al. 2010, Admati & Hellwig 2013).

The new Basel III requirements also incorporate a countercyclical capital buffer, which can be built up in boom times, when the cost of equity is relatively cheap, and deployed in downturns, when the accumulation of capital is expensive. A buildup during extended boom times would result in a higher capital buffer, leaving SIFIs better equipped to withstand large adverse shocks, such as the bursting of an asset bubble. A release of the countercyclical capital buffer in a downturn would mitigate pressures for SIFIs to deleverage, thus mitigating the potentially adverse amplification of forced deleveraging during an economic downturn.[8] In principle, the buildup and release of the buffer would be a function of the pricing of risk, whereas capital required for microprudential objectives would be a function of physical default risks. This variation raises notable challenges for the timing of the buildup and release. In particular, an early buildup of a buffer would risk imposing unnecessary increases in the costs of credit; also, firms and supervisors may be reluctant to release capital to promote credit availability when the pricing of risk is high and there is high uncertainty about the economic outlook.

Sectoral capital requirements are similar to countercyclical capital requirements but work in a more targeted fashion. They would be built and released like countercyclical buffers, but specific asset classes would be associated with higher or lower capital charges. Another similar tool is dynamic provisions, as practiced in Spain. Dynamic provisions are loan loss provisions that are built up in times of booms, when specific provisions are low, and released when specific provisions are built up. Although the implementation of dynamic provisions in the United States is not currently planned, a reform of provisioning practices to make them more forward looking has been debated for some time.

Other policy tools include supervisory guidance and stress tests, though these also suffer from the same problem of determining when to turn policies on and off.[9] However, because they involve more discretion, they may be less costly than rules. Supervisory guidance, which could be used to signal a need to improve risk management practices around potential future risks, is flexible by design. Supervisory stress tests can address emerging vulnerabilities by adjusting the severity of the macroeconomic and financial scenarios and by highlighting potential risks, such as those identified in a financial stability monitor. Supervisors are required to produce scenarios annually, and firms are required to conduct stress tests twice a year, which permits frequent adjustments. In addition, increased required disclosures from supervisors and firms provide investors with more information, which could allow markets a greater role in exerting discipline.

Excessive tightening of prudential regulations for SIFIs can be expected to push financial intermediation into the shadow banking system, especially when the pricing of risk is low. This suggests that macroprudential policies aimed at SIFIs should be complemented by prudential policies for the shadow banking system.

4.3. Nonbank and Shadow Bank Policies

Macroprudential policy tools that affect the nonbank sector and shadow banking are much less well defined and vastly more heterogeneous than banking policy tools. One important structural tool created by the DFA is the designation by the FSOC of nonbank financial firms as systemically

[8]There are no provisions for the cyclical variation of liquidity requirements in the Basel III framework, but in principle, the tightness of such liquidity requirements could be varied over the cycle, thus effectively regulating the amount of allowable maturity transformation.

[9]The DFA does not require stress tests for BHCs of less than $10 billion in assets.

important if their distress is expected to materially disrupt other financial activities and inflict substantial harm on economic growth. But designation is a deliberate and lengthy process, and it is not well suited to addressing emerging vulnerabilities that arise from a reduced price of risk by private market participants.

Much of shadow banking is not conducted in a firm, but rather is facilitated by markets. Wholesale short-term funding markets without government backstops, such as deposit insurance, still pose substantial systemic risks. Under an authority granted in Section 120 of the DFA, the FSOC proposed three alternatives to the SEC to mitigate the first-mover advantage for investors in MMFs arising from their stable NAV feature: a floating NAV, a small loss-absorbing buffer with a redemption holdback, and a larger stand-alone buffer. The SEC subsequently issued a proposal in September 2013 and finalized a rule in July 2014 (**http://www.sec.gov/rules/final/2014/33-9616.pdf**). In addition, the Financial Stability Board, as directed by the G20 leaders in 2008 to commit to fundamental reforms of the financial system, has been developing policy recommendations to strengthen the oversight and regulation of the shadow banking sector. This set of proposals attempts to: (*a*) limit the spillover of shadow banking risks to the banking sector, (*b*) reduce or eliminate the first-mover advantage in US MMFs that makes them vulnerable to runs, (*c*) assess and mitigate risks of other shadow banking entities, (*d*) assess and align the incentives in securitization, and (*e*) dampen risks and the procyclical incentives in secured financing.

The first four proposals focus primarily on structural reforms, whereas some elements of the fifth set are tied more directly to addressing the emerging imbalances that would be identified in this systemic risk monitoring framework. In particular, to address procyclical incentives in secured funding markets, such as repo and sec lending, they propose minimum standards for haircut practices to limit the extent to which haircuts would be reduced in benign markets. Other elements of this proposal include considering the use of central clearing for sec lending and repo markets; limiting liquidity risks associated with cash collateral reinvestment; addressing risks associated with rehypothecation of client assets; strengthening collateral valuation and management practices; and improving reports, disclosures, and transparency.[10]

Another set of tools for the regulation of shadow banking activities that has not been put into practice is the explicit regulation of margins and haircuts for macroprudential purposes. Margins and haircuts are set by exchanges, clearing houses, and broker-dealers, as well as in repo transactions. They effectively regulate the maximum amount of leverage that borrowers can take on. However, margins and haircuts are set from a purely microeconomic risk management perspective. Macroprudential considerations would promote higher through-the-cycle margins because they could materially reduce the ability of shadow banking participants to take on excessive leverage in expansions.

Another way forward on policies to address emerging systemic risks from shadow banking would be to improve data collection. The SCOOS is useful for providing systematic qualitative information on financing trends at dealers, but substantially more could be done. For example, whereas BHCs play a large role in facilitating shadow banking, regulatory reports provide little information on risks from these activities. Reports could be expanded to include types of collateral and maturity of repo transactions. In addition, efforts could be made to reduce fragmentation in the data that different regulators can access. Data for all US broker-dealers, which are at the heart of shadow banking, are available only to the SEC, and data for broker-dealers that are part of BHCs are also available to the Federal Reserve. But neither the SEC nor the Federal Reserve has data on the activities of both broker-dealers and BHCs. Another area for improved data collection

[10]Hypothecation is the practice of intermediaries using client collateral as collateral in their own borrowing transactions.

and dissemination is the repo market (triparty, DVP, and GCF). No regulator has the authority to collect transaction data in all of the segments, and thus none can develop a robust system-wide perspective on that activity.

4.4. Nonfinancial Sector

Tools to address emerging imbalances in asset valuations would likely also address building vulnerabilities in the nonfinancial sector. For example, restricting LTV or DTI ratios on mortgages, which could reduce a leverage-induced rise in prices, could also limit an increase in exposures of households and businesses to a collapse in prices, thereby bolstering their resilience. For example, authorities in South Korea, Canada, and Norway have employed a mix of LTV and DTI ratio restrictions to restrain a buildup in household leverage. An important structural reform for the government sector would be to address accounting standards that obscure costs or variability of costs. For example, accounting standards that have permitted state and local governments to discount pension liabilities by a long-run expected return have masked the variability in underfunding, which allowed problems to build and go unaddressed for long periods. The current attention to this problem has raised the cost of credit for some states and municipalities, which has increased their vulnerability to new possible risks. The new GASB pension accounting reforms are important steps, but many pension funds still operate with target returns that do not adjust commensurately with changes in current conditions.

4.5. Broader Policies

The policies discussed above are designed to target specific identified vulnerabilities on an ex ante basis. A broader tool that could be applied is monetary policy. In general, the degree of monetary accommodation has a direct impact on the risk taking of financial institutions (for an overview of the risk-taking channel of monetary policy, see Dell'Ariccia & Marquez 2014, Adrian & Liang 2014; for a classic reference on liquidity injections, see Holmström & Tirole 1998). Monetary policy acts on the pricing of risk via the risk-taking behavior of financial institutions. Monetary policy would also affect the rates for all financial institutions, even the ones in the shadow banking system that cannot be targeted via typical supervisory or regulatory actions.

Although it is beyond the scope of this article to comprehensively address the interactions between monetary policy and financial stability, it is worth noting that it is possible, in principle, to subsume financial stability into the dual mandate that legally governs monetary policy in the United States. The dual mandate, defined in the Federal Reserve Act, requires that monetary policy be conducted to achieve maximum employment and price stability. Monetary policy thus does not have an explicit financial stability objective. However, to the extent that assessments of tail risks change the expected outlook for inflation or real activity, financial stability considerations could indirectly enter into monetary policy decisions. This has been observed more formally within the context of a macroeconomic setting by Stein (2012), and also by Woodford (2011). In Stein's setting, financial intermediation activity is distorted due to fire sales during a financial crisis, which affects monetary policy decisions in equilibrium. Woodford embeds Stein's mechanism within a traditional new Keynesian model of monetary policy. These models effectively introduce a risk-taking channel of monetary policy into a macroeconomic setting. Empirical support for the risk-taking channel is provided by Adrian & Shin (2008), Jiménez et al. (2012), and Paligorova & Santos (2012).

In practice, however, it may be difficult to aggregate risks to financial stability by embedding them into a dual mandate framework. To do so would require monetary policymakers not only to assess expected output and inflation, but to make determinations about the tails of the outcome

distributions (for an example, see Clouse 2013). In addition, policymakers would need to be able to evaluate which distributions are optimal. For example, they would need to assess whether higher expected employment and higher downside risk would be preferred to lower expected employment and lower downside risk. In addition, the blunt nature of monetary policy may make it a poor tool for targeting tail outcomes, whereas regulatory and supervisory tools may be able to more directly address some financial vulnerabilities, particularly when vulnerabilities emanate from specific markets or institutions. The counterargument to this, made by Stein (2013), is that supervisory and regulatory tools, due to their narrow focus, may simply end up pushing vulnerabilities into other parts of the financial system where only monetary policy could reach. Still, the question of the effectiveness of monetary policy relative to more targeted policies remains.

A discussion of policies toward financial stability should also consider the broader question of whether ex ante policy tools are adequate to mitigate systemic risks or whether new government backstops would be more efficient. That is, are the new regulations in the DFA and other proposed reforms, along with available supervisory and monetary policy tools, sufficient to reduce systemic risks? Bank deposit runs of past decades were addressed with government deposit insurance and, given the consequent moral hazard, necessary supervision and regulation. But now more credit intermediation and maturity transformation is conducted through nonbank financial institutions and securities-based markets without government backstops. For example, Gorton & Metrick (2010) and Ricks (2010) propose alternatives to bring securitization and repo funding, or other short-term IOUs, under a regulatory umbrella that includes regulations on asset holdings and insurance for short-term liabilities. These types of proposals differ from the more targeted policies discussed above and would involve an expansion of government backstops from the current system in order to bring shadow banking into the regulated sector.

New government backstops to address the risks arising from shadow banking can be costly, of course. First, an expansion along these lines would require a new regulatory structure to prevent moral hazard, which can be expensive and difficult to implement effectively. Second, an expansion of regulations does not reduce the incentives for regulatory arbitrage but just pushes them beyond the existing perimeter. Third, there is a limited understanding of the impact that such a fundamental change would have on the efficiency and dynamism of the financial system. At the same time, it seems clear that policies that promote only greater disclosure would not be sufficient to effectively limit the buildup of systemic risk; for example, the incentive for investors in low-risk debt to shorten the maturities of their investments as macroeconomic uncertainty increases is an externality that can lead to systemic risk, one that would be only partially mitigated by disclosure. Even with full disclosure, absent the implementation of effective macroprudential policies, the level of vulnerabilities from systemically important institutions, maturity transformation without backstops, asset bubbles, and leverage would likely, at some point, become too high from a social welfare perspective.

Given these considerations, we argue that at this juncture, with current authorities under the DFA, the best path forward for promoting financial stability is a program for monitoring systemic risks, based on improved data collection and enhanced disclosure, and the implementation of meaningful preemptive regulatory and supervisory policies to address specific risks. When excesses appear to be broad, monetary policy may also be appropriate. As noted, however, much additional research is needed to evaluate the efficacy of tools in terms of timeliness, effectiveness, and scope for arbitrage.

5. CONCLUSION

In this article, we document a program for monitoring emerging sources of risk to financial stability and briefly discuss some cyclical policies. The program is motivated by a substantive body

of research on (*a*) the pricing of risk, (*b*) leverage, (*c*) maturity and liquidity mismatch, and (*d*) interconnectedness; these are all channels through which distress of a firm or sector can impose greater negative externalities on other parts of the financial system through fire sales and adverse feedback loops after strong economic and credit growth. Macroprudential policies to promote financial stability generally balance the increased cost of financial intermediation against the reduced potential for systemic risk. The effectiveness of these policies can be evaluated by the degree to which they prevent the price of risk from rising dramatically when adverse shocks hit and reduce the magnitude of any crisis, at the cost of more expensive credit intermediation in normal times.

DISCLOSURE STATEMENT

The views expressed in this paper are those of the authors and do not necessarily represent the view of the Board of Governors of the Federal Reserve, the Federal Reserve Bank of New York, or the Federal Reserve System. The authors are not aware of any affiliations, memberships, funding, or financial holdings that might be perceived as affecting the objectivity of this review.

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