Financial Stability Monitoring

Tobias Adrian
Daniel Covitz
Nellie Liang

FRBNY
Staff
REPORTS

Financial Stability Monitoring
Tobias Adrian, Daniel Covitz, and Nellie Liang
Federal Reserve Bank of New York Staff Reports, no. 601
February 2013; revised June 2014
JEL classification: E58, G01, G23, G28

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 pre-emptive policies to promote
financial stability. We offer a framework that distinguishes between shocks, which are
difficult to prevent, and vulnerabilities that 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 pre-emptive
actions to reduce vulnerabilities.

Key words: financial stability, systemic risk

_____

Table of Contents

1. Introduction

We define systemic risk as the potential for widespread financial externalities—whether from corrections in asset valuations, asset fire sales, or other forms of contagion—to amplify financial shocks and in extreme cases 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, which in their current form are susceptible to runs by their own investors and consequently tend to always create the potential for asset fire sales and other forms of contagion.

Financial externalities differ from textbook production externalities such as pollution because they manifest only in some states of the world. For instance, when liquidity is ample and economic conditions are benign, the insolvency of a financial institution may have little 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. As a consequence, 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 the firm's 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 includes also any associated increases in expected bankruptcy costs at other institutions that might be caused by say the increased risk of either fire sales or other forms of contagion. As a result, leverage of financial institutions, absent any government policies, will likely 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," 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 is 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 only observed in some states of the world, difficult to measure, and difficult to link ex post to particular entities. Another alternative would be to forecast and try to preemptively act against shocks, but shocks by definition are inherently difficult to predict.

An alternative or perhaps 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 usual

1

dual mandate, penalizes variance in inflation and employment. As a result, if a high level of financial vulnerabilities increases the variance of output or inflation, and 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 and Sim (2014) develop equilibrium models that incorporate financial stability in setting monetary policy.

This paper offers a strategy for monitoring cyclical financial vulnerabilities, and also discusses policy options for addressing them. To do so, we first (Section 2) provide a framework that relates financial shocks, financial vulnerabilities, financial externalities, and the 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 terms 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, 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 and monetary policies in mitigating cyclical vulnerabilities.

2. Conceptual Framework for Financial Stability

A number of recent papers model the interactions among the buildup of financial intermediary leverage, the implications for asset prices, and the evolution of systemic tail risks (see Adrian and Boyarchenko, 2012, and Gertler and 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 those 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 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 and 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, Chosak, Driscoll, Zakrajsek, 2012). Other institutions, such as insurance companies, hedge funds, or 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 makes 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 likely is 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 tradeoff 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

---

[1] The observation that systemic risk can build when measured risk is low is documented by Adrian and Brunnermeier (2008), and modeled by Brunnermeier and Sannikov (2011) and Adrian and Boyarchenko (2012).

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 the 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 the chains of intermediation in shadow banking, will tend 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 pro-cyclical, 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 is decreasing in v.

The three assumptions are intended to capture the following intuition. The first assumption reflects the idea that the market-wide price of risk in the financial system is increasing in the adverse impact of negative shocks to the system, regardless of the level of vulnerabilities. Shocks in this context are triggers such as the losses from a rogue trader, a spate of defaults on sub-prime mortgages, the popping of an asset price bubble, a sudden drop in domestic economic growth, or an escalation of a foreign financial crisis.[2]

The second assumption captures the intuition that 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

---

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

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.

The third assumption asserts that the benefit of a more vulnerable financial system is that financial intermediation will be cheaper (i.e. a lower price of risk) 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 financial crisis when readings on contemporaneous volatility were low.   This assumption also captures the notion that regulations intended to reduce system 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 there are large adverse shocks. Graphically, this framework is illustrated in Figure 1.

Figure 1: Financial Sector Vulnerability to Shocks and Pricing of Risk

Note: p denotes the price of risk, s the size of the shock, and V is the vulnerability of the financial system. V' corresponds to a financial system with tighter regulation than V.
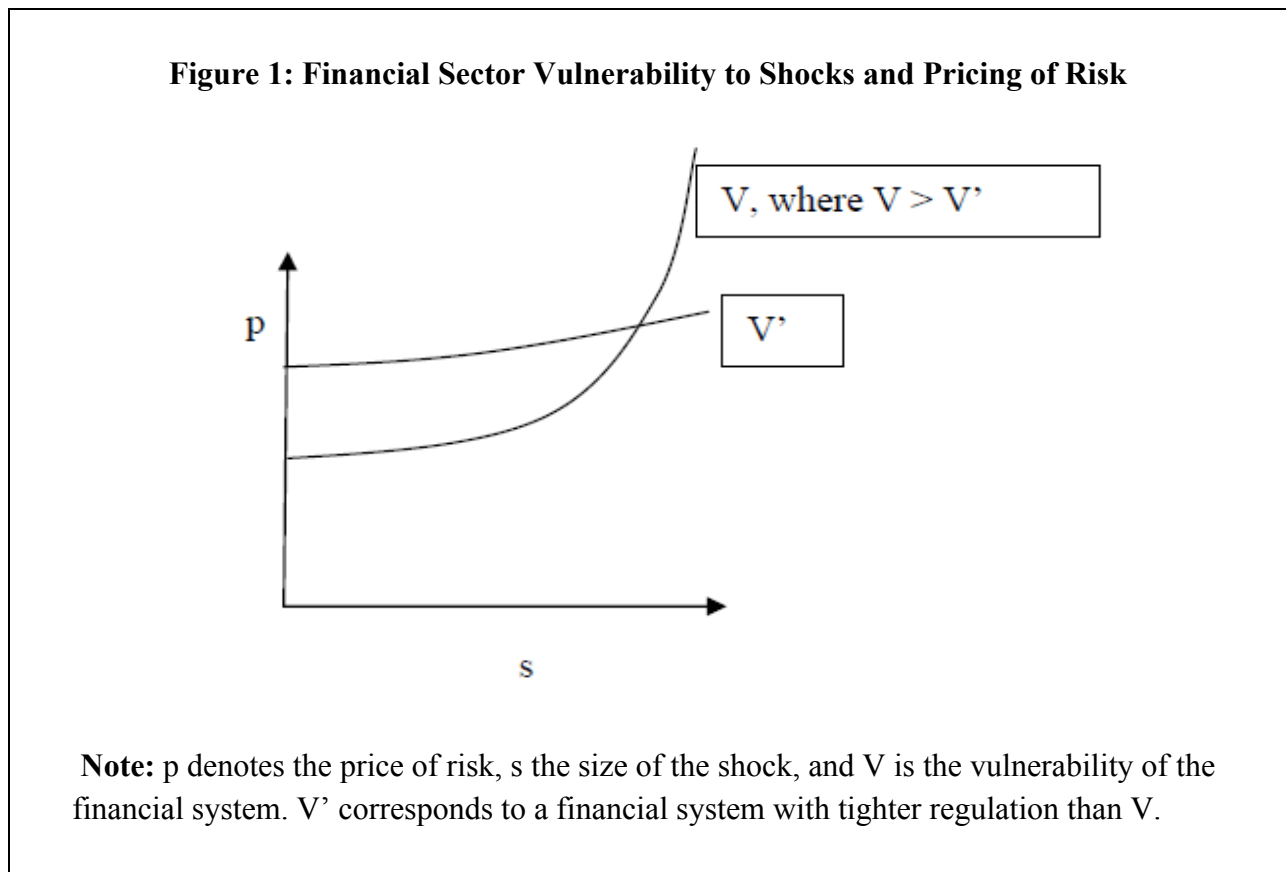
As already mentioned, absent government policies, one might expect that vulnerabilities would exceed socially optimal levels because vulnerabilities produce externalities. In addition, private agents might have too much leverage because they believe that they could exit before the price of risk increases. A related possibility is that the 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, 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. As a result, 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 a SIFI's distress. 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 tradeoff that we have outlined in this section, and that is a recurring theme throughout the remainder of the paper, assumes that raising external equity is costly for financial institutions. While this assumption is common in the banking literature, not all authors agree about its validity. Admati, DeMarzo, Hellwig, Pfleiderer (2010) and Admati and 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 shock. Similarly, Bianchi and Mendoza (2011) study a distortionary tax aimed at investors internalizing the social cost of overborrowing. Even though such a tax on leverage does generate inefficiency due to the distortionary nature of the tax, 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 inform 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.[3] While 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 pre-emptive program in the Federal Reserve System to assess and address vulnerabilities in the U.S. 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 below, we provide only illustrative examples in each area. In addition, 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.

A. 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. While 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

---

[3] See Chairman Bernanke's speech on lessons from the crisis for financial stability monitoring
http://www.federalreserve.gov/newsevents/speech/bernanke20120413a.pdf.

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 the majority of movements in asset prices is due to changes in the discount rate, and thus reflects 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 (see Campbell and Shiller, 1984 and Cochrane and 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, Gruber, Agrawal, and Mann, 2001, and Huang and 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 (see Campbell and Shiller, 1988 for equity returns, and Case and Shiller, 2003, and Campbell, Davis, Gallin, Martin, 2009 for house prices), again indicating that risk premia vary over time.

Besides assessing asset valuations using pricing models non-price measures of "hot markets" and market commentary provide evidence of low pricing. Studies have found that high volumes and lower-quality issuance can help predict future returns (Baker and Wurgler, 2013). 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 (See Amromin and Sharpe, 2008, for an empirical analysis of the cyclicality of investor expectations). In Treasury markets, similar systematic expectations errors have been documented (see Froot, 1989, Piazzesi and Schneider, 2011, Esupi and Moench, 2013).

The abrupt reversal of high asset valuations has caused systemic risk when it is accompanied by disorderly deleveraging. For example, a collapse of house prices or credit valuations have often been accompanied by systemic financial episodes, as those asset classes typically are funded via highly levered balance sheets that employ substantial amounts of maturity transformation. In contrast, the declines in U.S. equity markets in 2000 and 2001, following the tech boom of the 1990s, did not result in a systemic financial crisis, as it was not funded with excessive leverage and maturity transformation, although it 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 and Muir (2012) and Adrian, Moench and 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 volatility, interest rates and interest rate volatility, credit markets, real estate markets, commodities, as well as exchange rates. While a discussion of valuation metrics for all of these markets is beyond the scope of this paper, we will focus on a number of examples that appear particularly relevant for financial stability.

Equity Securities

Risk premia have been studied extensively in equity markets. Many theories link the level of expected returns to consumption, thus explaining the overall level of equity risk premia with measures of consumption growth, tail risk in consumption, uncertainty about consumption growth, long term consumption growth, or the "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 of computing the equity premium is by using a present discounted value formula (essentially elaborated versions of Gordon's growth formula). A complementary way to identify equity risk premia is by exploiting 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 back out the equity risk premium. A long literature has shown that variables such as the dividend yield, the short rate, the slope of the yield curve, implied volatility and macroeconomic variables such as inflation have predictive power, in particular at longer horizons (see Campbell and Shiller, 1988, Blanchard, Shiller, Siegel, 1993, and Cochrane, 2011).

In addition to narrowing equity premiums, rising leverage of investors is important to monitor. Holdings of equities can be compiled from various sources, including the SEC's 13F filings and other regulatory filings. In general, equities tend to be held by fully funded institutions such as mutual funds, insurance companies or pension funds. Margin debt primarily for retail investors appears to increase with equity prices, but with margins set at 50 percent (since 1977), the amount of aggregate leverage from this source is modest. Portfolio margining debits, such as for hedge funds tends to be fairly low, but increases with equity prices, and the emergence of levered ETFs, which might employ portfolio insurance strategies, could add more significantly 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. While such portfolio insurance strategies have since largely disappeared from the equity investing universe, similar strategies are employed by levered ETFs. Of course, the 1987 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 gets triggered by a mistake, it could 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.

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 and Shiller (1984, 1991) and Cochrane and Piazzesi (2005) provide evidence for the time variation of risk premia in the Treasury market. There are a variety of such dynamic models of interest rates, including Kim and Wright (2005), Adrian, Crump, and Moench (2012), and Christenson, Diebold and Rudebusch (2009). All three models are affine term structure models that can be updated daily and 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 premiums (chart 1). The estimated 10-year Treasury term premium exhibited a pronounced compression in the run-up to the financial crisis between 2003 and 2006, then 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 of term premia have not been measured since the 1960s. The historically low term premia reflect a number of special factors, including the Fed's large scale asset purchases.

Low Treasury risk premia, if reversed unexpectedly, could give rise to 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 to achieve a given ROE target has increased significantly in recent years given 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 longer-term Treasury and other debt securities in recent years as investors have reallocated assets away from equities. While these funds do not tend to employ financial leverage, redemption features based on closing NAV or 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 (see Feroli, Kashyap, Schoenholtz, Shin, 2014). However, any liquidity discount may be smaller than one from credit, and the degree that 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.

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 riskless 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 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 investor expected-default rates and recovery rates, under the assumption that investor expectations of credit risk far into the future are time invariant (chart 2). 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 and Armon, 2002).

Trends in non-price 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 non-price terms, such as rising debt multiples or fewer covenant protections for lenders could be signs of increased investor risk taking (chart 3). The rapid issuance of junk bonds and weakening deal structures in the LBO wave in the late 1980s led to reduced returns (Kaplan and Stein, 1993). Corporate bond returns appear to decline following periods of low-quality bond issuance (Greenwood and Hansen, 2012), and institutional demand pressures that lead to reduced time in syndication for leveraged loans result in lower loan yields (Ivashina and Sun, 2010).

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. While real money investors, such as mutual funds, insurance companies, and pension funds, are major investors in debt securities, there also was substantial demand from CDOs and CLOs 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.

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 (see Campbell, Davis, Gallin, Martin, 2009 and Himmelberg, Mayer, Sinai, 2005) (chart 4). These papers find that all three components are important determinants of house price movements, and importantly point to the role of risk premia and price expectations. While 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 (see Case and Shiller (2003) for early proponents of the view that housing valuations were reflecting an asset price bubble). With hindsight, too little weight placed by analysts on the likelihood of a bad tail outcome (Gerardi, Lehnert, Sherlund, Willen (2008)) and inflated expectations about future house price growth played an important role in the run-up to the crisis (see Cheng, Raina and Xiong (2012) for indirect evidence on house price expectations by Wall Street professionals).

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 to the crisis, incentive problems within the largest banking institutions, in the shadow banking system, and among the thrifts combined with lax regulations led to a deterioration of underwriting standards, although this deterioration is clearer in hindsight (chart 5). 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 a larger share of subprime borrowers, had a larger share of second liens, and experienced a bigger household leverage cycle (Mian and Sufi (2009, 2010, 2011)). In addition, 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, Lee, Tracy, and Van der Klaauw (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.

B. 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.[4] They pose potential systemic risk if their decisions reflect an expectation of government support in failure and deploy excessive leverage, they fail to internalize private-sector coordination failures associated with short-term debt and contribute to fire sales and contagion, or they are excessively interconnected to other parts of the financial system.

Standard measures of the amplification channels from banks include regulatory capital and leverage ratios, asset liquidity, and wholesale short-term funding (chart 6 and 7). 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 CDS premiums, equity prices, and expected default probabilities based on estimates of asset volatilities and liabilities, provide market participants' contemporaneous views about institutions' riskiness and are an important complement to balance sheet and supervisory measures (chart 8 and 9). 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.

Financial market-based systemic risk measures

Researchers have been developing systemic risk measures for firms based on financial market indicators (chart 10). Conditional Value at Risk (CoVaR) is an estimate of the value at risk of the financial system conditional on a firm's distress, based on co-movement of equity prices in the lower tail of the firm's and market return distributions (Adrian and Brunnermeier, 2008). The distress insurance premium, or DIP, measures the cost of insuring a firm against system-wide distress, measured by losses on a portfolio of financial institutions (Huang, Zhou,

---

[4] SIFIs can be bank or nonbank financial institutions. DFA automatically designates BHCs 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. FSOC 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.

and Zhu, 2009). This second measure is derived from CDS premiums and correlations of equity returns of portfolio firms. A third measure, the systemic expected shortfall, or SES, estimates the expected decline in the market value equity of a firm given a market-wide decline in equity prices, and so approximates the propensity to be undercapitalized coincident with the rest of the financial system (Acharya, Pedersen, Phillipon, and Richardson, 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 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 (see Malz, 2013, Aramonte and Schindler, 2012).

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 premiums, 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.

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 U.S. at the height of the financial crisis in early 2009 and have been repeated in the past few years, and are used to evaluate the capital planning processes of BHCs. Supervisors project losses for the firms' loans and trading assets, and revenues under a two-year hypothetical scenario based on detailed confidential information about the characteristics of firms' assets and business models. The stress tests are conducted for the largest firms simultaneously, which allow comparison of loans and trading assets across institutions at the same point in time, imposes consistency on estimated losses across the firms, and imposes a macro constraint on the performance of the largest firms in the aggregate. In addition, particular features of the stress tests incorporate simultaneous stresses. For example, losses incorporate that pre-committed liquidity and credit lines, such as those which would have supported ABCP conduits or VRDOs 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 the capital ratios under the stress scenarios (chart 11). Significant abnormal stock returns in the days following the announcements in past years 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 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 pro-cyclical, 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 pro-cyclicality 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).

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. An example applied to the international banking system based on public data can be found in Garratt, Mahadeva, and Svirydzenka (2011). 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, they 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 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 credit default swaps (CDS) reported to the DTCC Trade Information Warehouse (chart 12, from Brunetti and Gordy, 2012). 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, they find that CCPs are central to the network, dealers are interconnected among themselves, and non-dealer buy-side firms tend to trade primarily with a single dealer, rather than multiple dealers. These types of network measures will be important for monitoring systemic risk, especially if transactions increase with economic activity.

15

Network stability may also be impacted by margin requirements, since 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 counterparty risks. But when economic conditions are strong and price volatility has been low, margins tend to fall, which indicates that 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 (chart 13).

C. Shadow Banking

Shadow banking involves financial intermediation—including credit, liquidity, and maturity transformation—without an explicit government backstop (see Pozsar, Adrian, Ashcraft, Boesky, (2010) and Adrian and Ashcraft (2012a,b), Stein (2010), and Sunderam (2012)). The core of the shadow banking system before the crisis consisted of securitized credits, mortgages, and loans which were sold by originators to various leveraged entities including traditional banks, asset-backed commercial paper (ABCP) programs, and collateralized debt obligations (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 (chart 14), but they plummeted during the crisis, and since then have stayed at the lower levels.

Shadow banking poses a greater systemic vulnerability when leverage of dealers and investors is higher, and when the degree of maturity mismatch is greater. In addition, the potential for systemic risk increases with new financial practices that are not-well-understood (see Gennaioli, Shleifer, Vishny, 2013).[5]

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. Hedge funds, private equity and other funds, and asset

---

[5] See also Governor Tarullo's speech on shadow banking after the financial crisis http://www.federalreserve.gov/newsevents/speech/tarullo20120612a.htm.

management firms should be monitored to the extent that they engage in some 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.

Dealer-intermediated finance

The recent crisis illustrated that a significant amount of financing is intermediated outside of the traditional banking system and through, in one fashion or another, the dealer community. Dealers act as intermediaries for the market-based system, covering trading in equities, rates, credit, derivatives, FX, and commodities. Relative to commercial banks, broker-dealers are highly levered. In part, the lower capital ratios for the broker-dealers reflects that the asset side of the balance sheet is quite different, with a high share of assets in very liquid, relatively low-risk securities, and the share of assets in loans, which are less liquid and generally more risky, relatively small. 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 pro-cyclical, more so than for commercial banks. Data on broker-dealer subsidiaries in the U.S. 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 and Shin (2010) document this pro-cyclicality, and point out that financial crises correspond to extreme outcomes in this leverage cycle.

The leverage cycle of broker-dealer 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 boosts 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 transformation, which can generate fire sales, especially if the risks are opaque.

In addition, to monitor broader market conditions facilitated by dealers, the Federal Reserve started in 2010 a quarterly Senior Credit Officer Opinion Survey (SCOOS), which asks dealers about the provision of credit (Eichner and 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 and terms and standards. The SCOOS also allows the qualitative tracking of conditions, as reported by dealers, in markets such as syndicated leveraged loans, prime brokerage, and derivatives trading. In addition, 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 much more data are needed to track repo and securities lending markets.

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. Tri-party repurchase agreements and asset-backed commercial paper are two main sources of wholesale short-term secured funding in the shadow banking system. Financial commercial paper and uninsured certificates of deposits (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, tri-party repo, and MMFs.

ABCP and tri-party repo volumes rose sharply prior to the financial crisis, and have declined significantly since then (chart 15). ABCP peaked in July 2007 (corresponding to the onset of the financial crisis), while 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 SIVs, were marketed without backup liquidity. Investor runs in 2007 led to a 40 percent 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, and Suarez (2013).[6] While 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. Measures of fragility include increased volumes, weaker forms of credit and liquidity support, and less liquid conduit assets.

The tri-party repo market is the main source of funding for security broker-dealers.[7] Tri-party repo refers to repo using an infrastructure provided by tri-party clearing banks to manage

---

[6] Arteta, Carey, Correa, Kotter (2013) and Kacperczyk and Schnabl (2009) for additional insights on the commercial paper market.

[7] The importance of repo for the security broker-dealer sector was first documented by Adrian and Fleming (2005) and Adrian and Shin (2010). The mechanics of repo borrowing were described by Fleming and Garbade (2003) for GCF repo, and Garbade (2006) for DVP repo, and Martin, Copeland and Walker (2010) for tri-party repo. An additional source of wholesale funding consists in securities lending transactions, which are described in detail by Lipson, Sabel, and Keane (2012) and Adrian, Martin,

the 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 tri-party 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.[8]

While tri-party repo traditionally was 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 ABS, whole loans, and equities. While 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 tri-party repo financing is used to fund the dealer's own securities positions, whether these are held for purposes of making markets or other reasons. The remaining funding from tri-party repo is passed onto the clients of dealers in the form of delivery versus pay repo (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 and 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 tri-party repo market, and lenders in this market instead tend to adjust quantities rather than prices by simply withdrawing funding.

While 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, and narrowed haircuts, and higher counterparty risk.

The primary lenders into tri-party repo are money market mutual funds and stable-value cash-management products. The predominant is the 2a-7 MMMF. 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

---

Copeland, and Begalle (2013). Krishnamurthy, Nagel, Orlov (2012) report repo market measures based on money market mutual fund filings.

[8] Additional advantages of tri-party repo owe to the fact that the clearing banks extend daily intra-day credit. This intra-day credit is of large value to lenders and borrowers, as tri-party repo transactions are unwound daily. Clearing banks thus extend an implicit, non-contractual 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 intra-day credit.

actual net asset values do not fall more than a 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 Lehman bankruptcy in September 2008. The Reserve Primary Fund had exposure to Lehman 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 commercial paper and repo issuers. In response, the Federal Reserve instituted the Asset-Backed Commercial Paper Money Market Mutual Fund Facility (AMLF) to provide a public backstop through commercial banks for ABCP issuers (Duygan-Bump et al, 2013) and a Commercial Paper Funding Facility (CPFF) as a public liquidity backstop for commercial paper issuers more broadly (see Adrian, Marchioni, Kimbrough, 2011). While these facilities supported the CP markets, runs by money market investors were addressed more directly by the public guarantee provided to MMFs by the U.S. Treasury.

Some steps have been taken since the crisis to mitigate the risks arising from money funds, including SEC regulations for stronger liquidity requirements to reduce maturity transformation, and greater reporting requirements. MMFs now are 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 U.S. 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 declined significantly as the European sovereign and financial debt crisis intensified in 2011 (chart 16). In addition, the maturities of assets at MMFs shortened (chart 17). 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 a MMF. Moreover, while 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.

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 collateralized debt obligations

(CDOs), residential mortgage-backed securities (RMBS),[9] commercial mortgage-backed securities (CMBS), and securities backed by consumer loans (ABS), topped over $500 billion just prior to the financial crisis, with the "AAA-rated" tranches being funded by ABCP and tri-party repo. Volumes dropped precipitously during the crisis, and now stand at roughly $100 billion per quarter (chart 18).

Gauging the risk of structured products is difficult given the complexity and variety of the structures and the assets being funded. Key determinants of risks 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 often are not public. Experience with the inadequate ratings provided by the credit rating agencies indicate that risks embedded in structured credit products tend to be much more complex and multi-dimensional than the risks of corporate debt. Efforts to make more data about the collateral and the structure of these products to investors are important to reduce the potential for contagion.

Abnormally high and increasing volumes of asset-backed security issuance may be an indication of underpriced risk, weak underwriting, and insufficient subordination. High volumes also indicate that the financial system may be relying on a funding model that proved unstable in the financial crisis.[10]

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 LCR 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. While the SEC recently imposed a moratorium on approval of new synthetic ETFs in the U.S., they continue to grow dramatically in Europe, and there are concerns that they could transmit shocks to U.S. 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.

---

[9] RMBS refer to private label RMBS, excluding agency MBS issued by the GSEs.
[10] Covitz, Campbell, Pence, and Nelson (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.

D. Nonfinancial Sector

Research has identified excessive credit in the private nonfinancial sector as an important indicator for the buildup of systemic risk (see 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 the 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 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 and Titman, 1994; Chava and Roberts, 2008; Falato and Liang, 2013; Sharpe, 1994). In the household sector, more highly-levered households are less able to absorb, for example, the shock of a house price decline. Mian and 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 also can lead to mounting losses at financial institutions. Such losses that impair capital adequacy of regulated banks and shadow banks 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. Benanke and Gertler, 1989, Gertler and Kiyotaki, 2012).

Measures of vulnerabilities in the nonfinancial sector include variables such 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 the different sectors may not move in lock-step; while rapid household debt growth proved unsustainable in the lead-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.

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 ratio, where the trend adjustment captures that credit cycles are longer than business cycles (chart 19).

A caveat that applies to credit-to-GDP gap measures is that they are difficult to gauge in real time. Edge and Meisenzahl (2011) document estimation difficulties for the private nonfinancial sector in the U.S. This difficulty of calculating unusual growth in credit-to-GDP in real time comes down to the challenge of distinguishing permanent from transitory shocks, both from 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 or other leverage measures. While 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 with reasonable stories why such imbalances represent fundamental changes. For example, in the run-up to the recent financial crisis, commentators and policy makers 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.

Nonfinancial businesses

Prolonged periods or 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, in addition to 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, increase in the debt-to-asset ratio for the top decile firm in the early 2000s deviated from other firms (chart 20), indicating greater vulnerability among the weaker 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 the FOF, and detailed data for publicly-traded corporations are available based on 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-

23

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

Households

As with nonfinancial businesses, data for individual households or segments of the household sector are especially valuable to 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 LTVs show high LTVs 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, while households in the middle of the distribution (the 40th to 59th percentile) have seen their net worth decline by 40 percent since mid-2007. The share of mortgages that are underwater has declined, but credit conditions for new residential mortgages for borrowers with less than pristine credit scores remain tight (chart 21). 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 areas using detailed data from credit bureaus and other data vendors. Such detailed data also are important for regaining and preserving confidence in securitized products. In contrast to data for businesses, making the necessary data on households widely available raises important challenges about how to include important protections to maintain privacy.

Government Debt

The fiscal debt situation in Europe clearly indicates that excessive sovereign debt, or tight linkages of 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—raise taxes or cut 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 U.S., federal government debt has jumped since the crisis to about 70 percent of GDP, near its WWII highs, though it is elevated partly because of the recent below-trend GDP growth. While the level of the current debt-to-GDP ratio may not indicate the sector is especially vulnerable to a pullback from investors and a sharp rise in borrowing costs, the expected growth of entitlements if the 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 the 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 condition of state and local governments varies widely, with a number of large states burdened with substantially underfunded pensions (Rauh and Novy-Marx, 2010).   State and local pension fund assets were roughly $2.6 trillion in 2011. An estimate from the CRR suggests that the aggregate actuarial funded ratio of state and local plans was 75 percent in fiscal 2011, based on a discount rate of 8 percent, and the funded status would drop substantially to 50 percent if instead a risk-free rate were used to discount liabilities. The Pew Center for States estimates that unfunded pension liabilities-to-GDP averaged about 5 percent in 2010, but was a high as 12 percent for some states such as Illinois. When these off-balance sheet liabilities are added to explicit on-balance sheet debt, ratios exceeded 30 percent for Illinois and eight other states, and reached 28 to 30 percent in other large states such as California, New York, and Ohio.

While these large unfunded liabilities may not pose an immediate threat to financial stability, they increase the vulnerability of financial markets and 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 requires significantly better data to facilitate analysis. Currently state and local governments are required to file only an annual statement, and there is no standardized reporting system and plans generally provide very little detail. 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 tradeoff, illustrated by the *vulnerability* curves in Figure 1 (Section 4). 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 a flatter slope for a vulnerability curve. 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 tradeoff 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 reduce distortions between the systemic risk-return tradeoff for the financial system as a whole relative to the systemic risk-return tradeoff of individual market participants.

The possible tools to promote financial stability are varied. Most are microprudential tools applied to serve macroprudential objectives, and 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 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 FMUs, a new resolution regime, greater centralization of derivatives trades, and a consumer financial protection mandate. But 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 policy makers to make difficult assessments, such as how quickly financial fragilities can build and how costly it would be to financial stability in the event of a large adverse shock. These considerations suggest a continuum for possible pre-emptive cyclical actions, to deploy lower cost tools more frequently and before there is strong evidence of excesses, if by doing so, it can reduce the odds that a vulnerability with systemic consequences,

or a combination of them, get built up. Potential policies vary widely in their costs of implementation: Increased supervisory scrutiny targeted to specific firms and activities, or public recommendations by FSOC to regulators, financial institutions, or market participations are relatively inexpensive actions. At the other end of the cost spectrum, a countercyclical capital buffer would apply to all banking firms and may 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, and 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 may do so at higher costs of intermediation. 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 include Angelini, Neri, Panetta (2012), Angeloni and Faia (2013), Christensen, Meh, and Moran (2011), Goodhart, Kashyap, Tsomocos, and Vardoulakis (2012, 2013), Hanson, Kashyap and Stein (2011), Kashyap, Berner, and Goodhart (2011), Kiley and Sim (2012), and Stein (2012).

Asset Markets

Building imbalances in the valuations of debt products, such as loans and mortgages, can be addressed through actions to tighten underwriting standards on the assets, to the extent 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 may be more effective at building the resilience of the financial institution rather than mitigating a building asset bubble. Even limits on leverage of investors may be insufficient since 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. While changing risk weights would be targeted, this likely would require a rule-making in the U.S., which can be a lengthy process. Even then, these tools would only affect lending by regulated entities.

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

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 proposal includes a minimum ratio of 4.5 percent of Tier 1 common to risk-weighted assets, a capital conservation buffer of 2.5 percent, 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, DeMarzo, Hellwig, Pfleiderer, 2010 and Admati and 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 build-up 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.[11] In principle, the build-up 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 build-up and release. In particular, an early build-up 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

---

[11] 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.

availability when the pricing of risk is high and there is high uncertainty about the economic outlook.

A tool that is similar to countercyclical capital requirements, but that works in a more targeted fashion, is sectoral capital requirements. Sectoral capital requirements would be built and released like a countercyclical buffer, but higher or lower capital charges would be for specific asset classes. Another similar tool is dynamic provisions, as practiced in Spain. Such dynamic provisions are loan loss provisions that are built up in times of booms, when specific provisions are low, and are released when specific provisions are built up. While the implementation of dynamic provisions in the U.S. 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. [12] 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 by design, flexible. 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 will provide investors more information, which may allow a greater role for markets to also exert 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.

Shadow Bank policies

Macroprudential policy tools that affect shadow banking are much less well-defined, and vastly more heterogeneous. One important structural tool created by DFA is the designation by FSOC of nonbank financial firms as systemically 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 is not well-suited to addressing emerging vulnerabilities that arise from a reduced price of risk by private market participants.

---

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

Much of shadow banking is not conducted in a firm, but facilitated by markets. Wholesale short-term funding markets without government backstops, such as deposit insurance, still pose substantial systemic risks. The FSOC issued a proposed "Section 120" recommendation for comment that offers three alternatives to mitigate the first-mover advantage for investors in MMFs arising from its stable net asset value (NAV) feature. The three alternatives include a floating NAV, a small loss-absorbing buffer with a redemption holdback, and a larger stand-alone buffer. The SEC issued a proposal in September 2013, but has not yet finalized a rule. In addition, the Financial Stability Board, as directed by the G20 Leaders, has been developing policy recommendations to strengthen the oversight and regulation of the shadow banking sector. The set of proposals attempt to: 1) limit the spillover of shadow banking risks to the banking sector, 2) reduce or eliminate the first-mover advantage in U.S. money market mutual funds that makes them vulnerable to runs, 3) assess and mitigate risks of other shadow banking entities, 4) assess and align the incentives in securitization, and 5) dampen risks and the pro-cyclical incentives in secured financing.

The first four proposals focus primarily on structural reforms, while 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 pro-cyclical 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 consideration of the use of central clearing for sec lending and repo markets, limiting liquidity risks associated with cash collateral reinvestment, addressing risks associated with re-hypothecation of client assets, strengthening collateral valuation and management practices, and improving report, disclosures, and transparency.[13]

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, brokers-dealers, and in repo transactions. They effectively regulate the maximum amount of leverage that borrowers can take on. However, such 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 collections. The SCOOS is useful for providing systematic qualitative information on financing trends at dealers, but substantially more could be done. For example, while BHCs play a large role in facilitating shadow banking, regulatory reports provide

---

[13] Hypothecation is the practice where intermediaries use client collateral in their own borrowing transactions as collateral.

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 U.S. 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 Fed. But neither the SEC nor the Fed would have data on the activities of both broker-dealers and BHCs. Another area for improved data collections and dissemination is the repo market (tri-party, DVP, and GCF). No regulator has the authority to collect transactions data in all of the segments, and thus none can develop a robust system-wide perspective on that activity.

Nonfinancial sector

Tools to address emerging imbalances in asset valuations likely would also address building vulnerabilities in the nonfinancial sector. For example, increasing LTVs or DTIs 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 Korea, Canada, and Norway have employed a mix of LTV and DTI restrictions to restrain a build-up 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 has 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.

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 (see Dell'Ariccia and Marquez, 2012, for an overview of the "risk taking channel of monetary policy" and Holmström and Tirole, 1998, for the classic reference on liquidity injections). Monetary policy acts on the pricing of risk via the risk-taking behavior of financial institutions. Monetary policy also would 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.

While it is beyond the scope of this paper to address comprehensively 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

U.S. The dual mandate, defined in the Federal Reserve Act, requires that monetary policy should 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 Woodford (2011). In Stein's setting, financial intermediation activity is distorted due to fire sales during 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 and Shin (2008), Jiménez, Ongena, Peydró and Saurina (2012), and Paligorova and 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 policy makers to assess not only expected output and inflation, but to make determinations about the tails of the outcome distributions.[14] In addition, policy makers would need to be able to evaluate which distributions are optimal. For example, policy makers 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 in 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 towards 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 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 and Metrick (2010) and Ricks (2011) propose alternatives to bring securitization and repo funding, or other short-term IOUs under a regulatory umbrella that includes regulations on

---

[14] See Clouse (2013) for an example.

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, of course, can be costly. 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 it beyond the 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 only be 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 DFA, the best path forward for promoting financial stability is a program for monitoring systemic risks, based on improved data collections and enhanced disclosure, and the implementation of meaningful pre-emptive regulatory and supervisory policies to address specific risks. When excesses appear to be broad, monetary policy also may 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 paper, we document a program for monitoring emerging sources of risk to financial stability monitoring and briefly discuss some cyclical policies. The program is motivated by a substantive body of research on declining price of risk, increasing leverage, maturity and liquidity mismatch, and interconnectedness 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 with economic activity. 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 reducing the magnitude of any crisis, at the cost of more expensive credit intermediation in normal times.

Literature

Acharya, Viral, Douglas Gale, and Tanju Yorulmazer (2011). "Rollover Risk and Market Freezes," *Journal of Finance*, Vol. 66, 1177-1209.

Acharya, Viral, Lasse Heje Pedersen, Thomas Philippon, and Matt Richardson (2010). "Measuring Systemic Risk," Working Paper.

Acharya, Viral, Philipp Schnabl, and Gustavo Suarez (2013). "Securitization Without Risk Transfer," *Journal of Financial Economics*, Vol. 107(3), 515-536.

Admati, Anat, Martin Hellwig (2013). *The Bankers' New Clothes: What's Wrong with Banking and what to Do about it*. Princeton University Press.

Admati, Anat, Peter DeMarzo, Martin Hellwig, and Paul Pfleiderer (2010). "Fallacies, Irrelevant Facts, and Myths in the Discussion of Capital Regulation: Why bank Equity is Not Expensive." Stanford University Working Paper.

Adrian, Tobias and Adam B. Ashcraft (2012a). "Shadow Bank Regulation," *Annual Review of Financial Economics*, Vol. 4(1), 99-140.

Adrian, Tobias and Adam B. Ashcraft (2012b). "Shadow Banking: A Review of the Literature," Palgrave Dictionary of Economics.

Adrian, Tobias, Brian J. Begalle, Adam M. Copeland A, and Antoine Martin (2013). "Repo and Securities Lending," FRB of New York Staff Report No. 529.

Adrian, Tobias, and Nina Boyarchencko (2012). "Intermediary Leverage Cycles and Financial Stability," FRB of New York Staff Report No. 567.

Adrian, Tobias, Richard K. Crump, and Emanuel Moench (2012). "Pricing the Term Structure with Linear Regressions," FRB of New York Staff Report No. 340.

Adrian, Tobias, Erkko Etula, and Tyler Muir (2012). "Financial Intermediaries and the Cross-Section of Asset Returns," *Journal of Finance*, Forthcoming.

Adrian, Tobias, and Michael Fleming (2005). "What Financing Data Reveal about Dealer Leverage," *FRB of New York Current Issues Economics and Finance*, Vol. 11(3), 41281.

Adrian, Tobias, Karin J. Kimbrough, and Dina Marchioni (2011). "The Federal Reserve's Commercial Paper Funding Facility," *Economic Policy Review*, Vol. 17(1), 25-39.

Adrian, Tobias, Emanuel Moench, and Hyun Song Shin (2009). "Financial Intermediation, Asset Prices, and Macroeconomic Dynamics," FRB of New York Staff Report No. 422.

Adrian, Tobias and Hyun Song Shin. (2008) "Financial Intermediaries, Financial Stability, and Monetary Policy, " 2008 Jackson Hole Economic Symposium Proceedings, Federal Reserve Bank of Kansas City, pp. 287-334.

Adrian, Tobias, and Hyun Song Shin (2010). "Liquidity and Leverage," *Journal of Financial Intermediation*, Vol. 19(3), 418-37.

Adrian, Tobias, and Hyun Song Shin (2013). "Procyclical Leverage and Value-at-Risk," *Review of Financial Studies*, forthcoming.

Adrian, Tobias, and Markus K. Brunnermeier (2010). "CoVaR," FRB of New York Staff Reports No. 348.

Altman, Edward, and Pablo Armon (2002). "Defaults and Returns on High Yield Bonds: Analysis through 2001," *Journal of Applied Finance*, Vol. 12(1), 98-112.

Amromin, Gene, and Steven A. Sharpe (2008). "Expectations of Risk and Return among Household Investors: Are their Sharpe Ratios Countercyclical?" Finance and Economics Discussion Series 2008-17.

Angelini, Paolo, Stefano Neri, and Fabio Panetta (2012). "Monetary and Macroprudential Policies," European Central Bank Working Paper Series No. 1449.

Angeloni, Ignazio, and Ester Faia (2013). "Capital Regulation and Monetary Policy with Fragile Banks," *Journal of Monetary* Economics, Vol. 36(11), 311-324.

Arteta, Carlos, Mark Carey, Ricardo Correa, and Jason Kotter (2013). "Revenge of the Steamroller: ABCP as a Window on Risk Choices," Federal Reserve Board of Governors Working Paper.

Ashcraft, Adam, and Til Schuermann (2008). "Understanding the Securitization of Subprime Mortgage Credit," *Foundations and Trends in Finance*, Vol. 2(3), 191-309.

Baker, Malcolm, and Jeffrey Wurgler (2013). "Would Stricter Capital Requirements Raise the Cost of Capital? Bank Capital Regulation and the Low Risk Anomaly," *Harvard University working paper*.

Bassett, William, Mary Beth Chosak, John Driscoll, and Egon Zakrajsek (2012). "Changes in Bank Lending Standards and the Macroeconomy," Feds Finance and Economics Discussion Series 2012-24.

Bernanke, Ben (2012). "Reflections on the Crisis and the Policy Response," Remarks at the Russell Sage Foundation and the Century Foundation Conference on "Rethinking Finance," New York, New York.

Bernanke, Ben, and Mark Gertler (1989). "Agency Costs, Net Worth, and Business Fluctuations," *American Economic Review*, Vol. 79(1), 14-31.

Bianchi, Javier, and Enrique Mendoza (2011). "Overborrowing, Financial Crises and Macroprudential Policy," IMF Working Paper No. 11/24.

Bisias, Dimitrios, Mark Flood, Andrew W. Lo, Stavros Valavanis (2012). "A Survey of Systemic Risk Analytics," Office of Financial Research Working Paper 1.

Blanchard, Olivier J., Robert Shiller, and Jeremy J. Siegel (1993). "Movements in the Equity Premium," *Brookings Papers on Economic Activity*, 75-138.

Bookstaber, Richard (2012). "Using Agent-Based Models for Analyzing Threats to Financial Stability," Office of Financial Research Working Paper 3.

Borio, Claudio, Mathias Drehmann, and Kostas Tsatsaronis (2011). "Anchoring Countercyclical Capital Buffers: The role of Credit Aggregates," *International Journal of Central Banking*, Vol. 7(4), 189-240.

Borio, Claudio, Craig Furfine, and Philip Lowe (2001). "Procyclicality of the Financial System and Financial Stability: Issues and Policy Options," BIS papers 1.

Borio, Claudio, and William White (2003). "Whither Monetary and Financial Stability? The Implications of Evolving Policy Regimes," Proceedings of the Kansas City Fed Economic Symposium.

Brady, Steffanie, Ken Anadu, and Nathaniel Cooper (2012). "The Stability of Prime Money Market Mutual Funds: Sponsor Support from 2007 to 2011," Federal Reserve Bank of Boston Working Paper RPA 12-3.

Brunetti, Celso, and Michael Gordy (2012). "Monitoring Counterparty Credit Risk and Interconnectedness in CDS Trade Repository Data," Federal Reserve Board Working Paper.

Brunnermeier, Markus, and Martin Oehmke (2013). "The Maturity Rat Race," *Journal of Finance*, Vol. 68(2), 483-521.Brunnermeier, Markus, and Lasse Heje Pedersen (2009). "Market Liquidity and Funding Liquidity," *Review of Financial Studies*, Vol. 22(6), 2201-2238.

Brunnermeier, Markus, and Yuliy Sannikov (2012). "A Macroeconomic Model with a Financial Sector," Princeton University Working Paper.

Brunnermeier, Markus, and Yuliy Sannikov (2011). "The I Theory of Money," Princeton University Working Paper.

Campbell, John Y., and Robert J. Shiller (1984). "A Simple Account of the Behavior of Long-Term Interest Rates," *American Economic Review*, Vol. 74(2), 44-48.

Campbell, John Y., and Robert J. Shiller (1991). "Yield Spreads and Interest Rate Movements: A Bird's Eye View," *Review of Economic Studies*, Vol. 58(3), 495-514.

Campbell, John Y., and Robert J. Shiller. (1988) "The dividend-price ratio and expectations of future dividends and discount factors," *Review of Financial Studies*, Vol. 1(3), 195-228.

Campbell, Sean D., Daniel M. Covitz, William R. Nelson, and Karen Pence (2011). "Securitization Markets and Central Banking: An Evaluation of the Term Asset-Backed Securities Loan Facility," *Journal of Monetary Economics*, Vol. 58(5), 518-531.

Campbell, Sean D., Morris A. Davis, Joshua Gallin, and Robert F. Martin (2009). "What Moves Housing Markets: A Variance Decomposition of the Rent–Price Ratio," *Journal of Urban Economics*, Vol. 66(2), 90-102.

Case, Karl, and Robert J. Shiller (2003). "Is There a Bubble in the Housing Market?" *Brookings Papers on Economic Activity*, Vol. 2003(2), 299-362.

Chava, Sudheer, and Michael R. Roberts (2008). "How Does Financing Impact Investment? The Role of Debt Covenants," *Journal of Finance*, Vol. 63(5), 2083-2121.

Cheng, Ing Haw, Sahil Raina, and Wei Xiong (2012). "Wall Street and the Housing Bubble," Princeton University Working Paper.

Christensen, Jens, Francis Diebold, and Glenn Rudebusch (2010). "The Affine Arbitrage-Free Class of Nelson-Siegel Term Structure Models," *Journal of Econometrics*, Vol. 164(1), 4-20.

Christensen, Ian, Césaire Meh, and Kevin Moran (2011). "Bank Leverage Regulation and Macroeconomic Dynamics," Bank of Canada Working Paper No. 2011-32.

Clouse, James (2013). "Monetary Policy and Financial Stability Risks: An Example," *Finance and Economics Discussion Series, Federal Reserve Board*, 2013-41.

Cochrane, John (2011). "Presidential address: Discount rates," *Journal of Finance*, Vol. 66(4), 1047-1108.

Cochrane, John H., and Monika Piazzesi (2005). "Bond Risk Premia," *American Economic Review*, Vol. 90(1), 138-160.

Copeland, Adam, Antoine Martin, and Michael W. Walker (2010). "The Tri-Party Repo Market Before the 2010 Reforms," FRB of New York Staff Report 477.

Copeland, Adam, Antoine Martin, and Michael W. Walker (2011). "Repo Runs: Evidence from the Tri-Party Repo Market," FRB of New York Staff Report 506.

Cont, Rama, Amal Moussa, and Edson Bastos Santos (2013). "Network Structure and Systemic Risk in Banking Systems," in *Handbook of Systemic Risk*, J.P. Fouque and J. Langsam, Editors. Cambridge University Press.

Covitz, Daniel, Nellie Liang, and Gustavo Suarez (2013). "The Evolution of a Financial Crisis: Panic in the Asset-Backed Commercial Paper Market," *Journal of Finance*, Vol. 68(3), 815-848.

Cúrdia, Vasco, and Michael Woodford (2010). "Credit Spreads and Monetary Policy," *Journal of Money, Credit and Banking* vol. 42(1), 3-35.

Dell'Ariccia, Giovanni, and David Marquez (2012). "The Role of Real Interest Rates on Bank Leverage and Risk Taking," International Monetary Fund Working Paper.

Diamond, Douglas W., and Philip H. Dybvig (1983). "Bank Runs, Deposit Insurance and Liquidity," *Journal of Political Economy*, Vol. 93(1), 401-419.

Dudley, William (2013). Fixing Wholesale Funding to Build a More Stable Financial System. http://www.newyorkfed.org/newsevents/speeches/2013/dud130201.html

Duygan-Bump, Burcu, Patrick M. Parkinson, Eric S. Rosengren, Gustavo A. Suarez, and Paul S. Willen (2013). "How Effective were the Federal Reserve Emergency Liquidity Facilities?: Evidence from the Asset-Backed Commercial Paper Money Market Mutual Fund Liquidity Facility," *Journal of Finance*, Forthcoming.

Edge, Rochelle M., and Ralf R. Meisenzahl (2011). "The Unreliability of Credit-to-GDP Ratio Gaps in Real Time: Implications for Countercyclical Capital Buffers," *International Journal of Central Banking*, Vol. 7(4), 261-298.

Eichner, Matthew J., and Fabio M. Natalucci (2010). "Capturing the Evolution of Dealer Credit Terms Related to Securities Financing and OTC Derivatives: Some Initial Results from the New Senior Credit Officer Opinion Survey on Dealer Financing Terms," Finance and Economics Discussion Series 2010-47.

Elton, Edwin, Martin Gruber, Deepak Agrawal, and Christopher Mann (2001). "Explaining the Rate Spread on Corporate Bonds," *Journal of Finance*, Vol. 56(1), 247-278.

Eusepi, Stefano, and Emanuel Moench (2013). "Survey Implied Interest Rate Term Structures," Working Paper.

Falato, Antonio, and Nellie Liang (2013). "Do Creditor Rights Increase Employment Risk? Evidence from Loan Covenants," Working Paper.

Fleming, Michael J., and Kenneth D. Garbade (2003). "The Repurchase Agreement Refined: GCF Repo," *Federal Reserve Bank of New York Current Issues in Economics and Finance*, Vol. 9(6), 1-7.

Fostel, Ana, and John Geanakoplos (2008). "Leverage Cycles and the Anxious Economy," *American Economic Review*, Vol. 98(4), 1211-1244.

Froot, Kenneth (1989). "New Hope for the Expectations Hypothesis of the Term Structure of Interest Rates," *Journal of Finance*, Vol. 44(2), 283–305.

Garbade, Kenneth (2006). "The Evolution of Repo Contracting Conventions in the 1980s," *FRB of New York Economic Policy Review*, Vol. 12(1), 27-42.

Garratt, Rodney, Lavan Mahadeva, and Katsiaryna Svirydzenka (2011). "Mapping Systemic Risk in the International Banking Network," Bank of England Working Paper No. 413.

Geanakoplos, John (2003). "Liquidity, Default, and Crashes: Endogenous Contracts in General Equilibrium," Advances in Economics and Econometrics: Theory and Applications, Eighth World Conference, Volume II, Econometric Society Monographs.

Geanakoplos, John (2010). "The Leverage Cycle," The leverage cycle. In NBER Macroeconomics Annual 2009, ed. D Acemoglu, K Rogoff, M Woodford. Chicago: University of Chicago Press.

Gennaioli, Niccola, Andrei Shleifer, and Robert Vishny (2013). "A Model of Shadow Banking," *Journal of Finance*, Vol. 68(4).

Gerardi, Kristopher, Andreas Lehnert, Shane M. Sherlund, and Paul Willen (2008). "Making Sense of the Subprime Crisis," *Brookings Papers on Economic Activity*, Vol. 2008(2), 69-145.

Gertler, Mark, and Nobuhiro Kiyotaki (2012). "Banking, Liquidity, and Bank Runs in an Innite Horizon Economy," Princeton University Working Paper.

Gilchrist, Simon, and Egon Zakrajšek (2012). "Credit Spreads and Business Cycle Fluctuations," *American Economic Review*, Vol. 102(4), 1692-1720.

Goodhart, Charles, Anil K. Kashyap, Dimitrios P. Tsomocos, and Alexandros Vardoulakis (2013). "An Integrated Framework for Analyzing Multiple Financial Regulations," *International Journal of Central Banking*, Vol. 9(1), 109-143.

Goodhart, Charles, Anil K. Kashyap, Dimitrios P. Tsomocos, and Alexandros Vardoulakis (2012). "Financial Regulation in General Equilibrium," NBER Working Paper No. 17909.

Gorton, Gary B., and Andrew Metrick (2010). "Regulating the Shadow Banking System," *Brookings Papers on Economic Activity*, Vol. Fall, 261-297.

Gorton, Gary B., and Andrew Metrick (2012). "Securitized Banking and the Run on Repo," *Journal of Financial Economics*, Vol. 104(3), 425-451.

Greenwood, Robin, and Samuel G. Hanson (2012). "Share Issuance and Factor Timing," *Journal of Finance*, Vol. 67(2), 761-798.

Han, Song, and Geng Li (2011). "Household Borrowing After Personal Bankruptcy," *Journal of Money, Credit, and Banking*, Vol. 43(2-3), 491-517.

Hanson, Samuel G., Anil K. Kashyap, and Jeremy C. Stein (2011). "A Macroprudential Approach to Financial Regulation," *Journal of Economic Perspectives*, Vol. 25(1), 3-28.

Haughwout, Andrew, Donghoon Lee, Joseph Tracy, and Wilbert van der Klaauw (2011). "Real Estate Investors, the Leverage Cycle, and the Housing Market Crisis," FRB of New York Staff Report 514.

He, Zhiguo, and Arvind Krishnamurthy (2012a). "A Model of Capital and Crises," *Review of Economic Studies*, Vol. 79(2), 735-777.

He, Zhiguo, and Arvind Krishnamurthy (2012b). "Intermediary Asset Pricing," *American Economic Review*, Vol. 103(2), 1-42.

He, Zhiguo, and Arvind Krishnamurthy (2012c). "A Macroeconomic Framework for Quantifying Systemic Risk," Working Paper.

He, Zhiguo, and Wei Xiong (2012). "Dynamic Debt Runs," *Review of Financial Studies*, Vol. 25(6), 1799-1843.

Himmelberg, Charles, Chris Mayer, and Todd Sinai (2005). "Assessing High House Prices: Bubbles, Fundamentals, and Misperceptions," *Journal of Economic Perspectives*, Vol. 19(4), 67-92.

Holmström, Bengt, and Jean Tirole (1998). "Private and Public Supply of Liquidity," *Journal of Political Economy*, Vol. 106(1), 1-40.

Huang, Jing-zhi, and Ming Huang (2012). "How Much of the Corporate-Treasury Yield Spread is Due to Credit Risk?" *Review of Asset Pricing Studies*, Vol. 2(2), 153-202.

Huang, Xin, Hao Zhou, and Haibin Zhu (2009). "A Framework for Assessing the Systemic Risk of Major Financial Institutions," *Journal of Banking and Finance*, Vol. 33(11), 2036-2049.

Ivashina, Victoria, and Zheng Sun (2011). "Institutional Demand Pressure and the Cost of Corporate Loans," *Journal of Financial Economics*, Vol. 99(3), 500–522.

Jiménez, Gabriel, Steven Ongena, José-Luis Peydró and Jesús Saurina (2012). "Credit Supply and Monetary Policy: Identifying the Bank Balance-Sheet Channel with Loan Applications," *American Economic Review* 102(5), 2301-26.

Kacperczyk, Marcin, and Philipp Schnabl (2009). "When Safe Proved Risky: Commercial Paper During the Financial Crisis of 2007-2009," NBER Working Paper No. 15538.

Kaplan, Steven N., and Jeremy Stein (1993). "The Evolution of Buyout Pricing and Financial Structure in the 1980s," *Quarterly Journal of Economics*, Vol. 108(2), 313–357.

Kashyap, Anil, Richard Berner, and Charles Goodhart (2011). "The Macroprudential Toolkit, " IMF Economic Review 59(2), 145-161.

Kiley, Michael, and Jae Sim (2014). "Optimal Monetary and Macroprudential Policies: Gains and Pitfalls in a Model of Financial Intermediation," Working Paper.

Kiley, Michael and Jae Sim (2012). "Intermediary Leverage, Macroeconomic Dynamics, and Macroprudential Policy," Working Paper.

Kim, Don H., and Jonathan H. Wright (2005). "An Arbitrage-Free Three-Factor Term Structure Model and the Recent Behavior of Long-Term Yields and Distant-Horizon Forward Rates," Finance and Economics Discussion Series 2005-33.

Kiyotaki Nobuhiro and John Moore (1997). "Credit Cycles," *Journal of Political Economy*, Vol. 105(2), 211-248.

Krishnamurthy, Arvind, Stefan Nagel, and Dmitry Orlov (2012). "Sizing Up Repo," NBER Working Paper 17768.

Liang, Nellie (2012). "Financial Stability: Lessons Learned From the Recent Crisis and Implications for the Federal Reserve," in *The Role of Central Banks in Financial Stability: How Has It Changed?* D.Evanoff, G.Kaufman, C.Holthausen and M.Kremer, Editors. World Scientific Publishing Co. Pte. Ltd, New Jersey, Forthcoming.

Liang, Nellie (2013) "Implementing Macroprudential Policies," Conference on Financial Stability Analysis, Federal Reserve Bank of Cleveland and Office of Financial Research, May 31, 2013. http://www.treasury.gov/initiatives/ofr/news/Documents/Implementing_Macroprudential_Policies_May31-2013_final.pdf

Malz, Allen (2013). "Risk Neutral Systemic Risk Indicators," FRB of New York Staff Report No. 607.

Martin, Antoine, David Skeie, and Ernst-Ludig von Thadden (2011). "Repo Runs," FRB of New York Staff Report 444.

McCabe, Patrick E. (2010). "The Cross Section of Money Market Fund Risks and Financial Crises," Finance and Economics Discussion Series 2010-51.

Mian, Atif, and Amir Sufi (2009). "The Consequences of Mortgage Credit Expansion: Evidence from the US Mortgage Default Crisis," *The Quarterly Journal of Economics*, Vol. 124(4), 1449-1496.

Mian, Atif, and Amir Sufi (2010). "Household Leverage and the Recession of 2007–09," *IMF Economic Review*, Vol. 58(1), 74-117.

Mian, Atif, and Amir Sufi (2011). "House Prices, Home Equity-Based Borrowing, and the US Household Leverage Crisis," *American Economic Review*, Vol. 101(5), 2132-2156.

Morris, Stephen, and Hyun Song Shin (2004). "Coordination Risk and the Price of Debt," *European Economic Review*, Vol. 48(1), 133–153.

Novy-Marx, Robert, and Joshua D. Rauh (2009). "The Liabilities and Risks of State-Sponsored Pension Plans," *Journal of Economic Perspectives*, Vol. 23(4), 191-210.

Opler, Tim, and Sheridan Titman (1994). "Financial Distress and Corporate Performance," *Journal of Finance*, Vol. 49(3), 1015-1040.

Paligorova, Teodora and João Santos (2012). "Monetary Policy and Bank Risk-Taking: Evidence from the Corporate Loan Market," Federal Reserve Bank of New York Working Paper.

Piazzesi, Monika and Martin Schneider (2011). "Trend and Cycle in Bond Premia," Stanford University Working Paper.

Pozsar, Zoltan, Tobias Adrian, Adam Ashcraft, and Hayley Boesky (2010). "Shadow Banking," FRB of New York Staff Report 458.

Ricks, Morgan (2010). "Shadow Banking and Financial Regulation," Columbia Law and Economics Working Paper No. 370.

Sharpe, Steve (1994). "Financial Market Imperfections, Firm Leverage, and the Cyclicality of Employment," *American Economic Review*, Vol. 84(4), 1060-1074.

Stein, Jeremy C. (2010). "Securitization, Shadow Banking, and Financial Fragility," *Daedalus*, Vol. 139(4), 41-51.

Stein, Jeremy C. (2012). "Monetary Policy as Financial Stability Regulation," *Quarterly Journal of Economics*, Vol. 127(1), 57-95.

Stein, Jeremy (2013). "Overheating in Credit Markets: Origins, measurement, and policy responses," Federal Reserve Bank of St. Louis, St. Louis, Missouri.

Stein, Jeremy (2014). "Incorporating Financial Stability Considerations into a Monetary Policy Framework," At the International Research Forum on Monetary Policy, Washington D.C.

Summers, Lawrence (1985). "On Economics and Finance." *Journal of Finance* 40(3), 633-635.

Sunderam, Adi (2012). "Money Creation and the Shadow Banking System," Harvard Business School Working Paper.

Tarullo, Daniel (2012). "Financial Stability Regulation," Distinguished Jurist Lecture, University of Pennsylvania Law School, Oct. 10, 2012. http://www.federalreserve.gov/newsevents/speech/tarullo20121010a.htm

Wermers, Russell (2011). "Runs on Money Market Mutual Funds," University of Maryland Working Paper.

Woodford, Michael (2011). "Monetary Policy and Financial Stability," Columbia University Working Paper presented at the 2011 NBER Summer Institute.
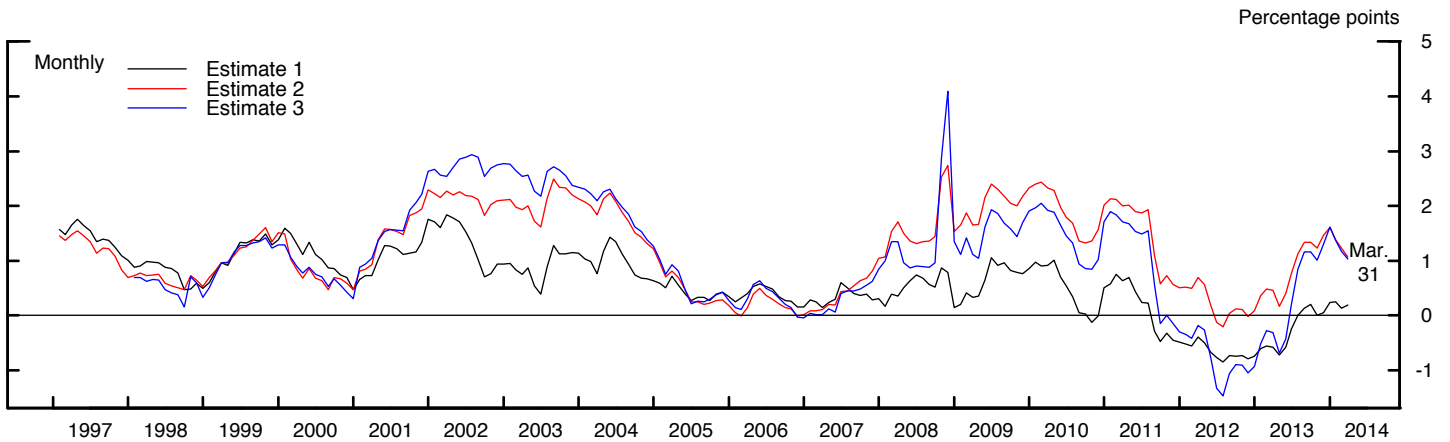
Tables and Figures

Table 1: Monitoring Vulnerabilities in Different Sectors

|	**A. Price of risk**	**B. Leverage**	**C. Maturity and liquidity transformation**	**D. Interconnections and complexity**
(1) Asset markets	Asset valuations in equities, rates, credit, real estate	Investor leverage	Carry trades Mutual funds ETFs Dealer-based finance	Derivatives and counterparties
(2) 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, maturities Secured and unsecured	Systemic risk measures Intra-financial assets and liabilities
(3) Shadow banks, Financial markets	Securities issuance Underwriting standards SCOOS	Securitization tranches New financial products Regulatory capital arbitrage Hedge funds	Agency REITs ABCP conduits Repo markets Sec lending MMFs STIFs	CCPs
(4) Nonfinancial sector	Underwriting standards (LTVs, DTIs)	Debt-to-GDP HH, Bus, Govt leverage	Reliance on ST debt	

Asset Markets

Chart 1
Ten-Year Nominal Yields and Term Premium Estimates

Percentage points

Monthly
— Estimate 1
— Estimate 2
— Estimate 3

Mar. 31

1997 1998 1999 2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014

Note: Term premia are estimated by; Estimate 1: three-factor term structure model combining Treasury yields with SPF interest rate forecasts (Kim and Wright, 2005), Estimate 2: a four-factor term structure model using Treasury yields only (Adrian, Crump, and Moench, 2012), and Estimate 3: a three-factor model using Treasury yields only (Christensen, Diebold, and Rudebush, 2009).

Chart 2
Near- and Far-Term BB Forward Credit Spreads

Percent

Monthly

— Near-term
— Far-term

Mar.

1990 1993 1996 1999 2002 2005 2008 2011 2014
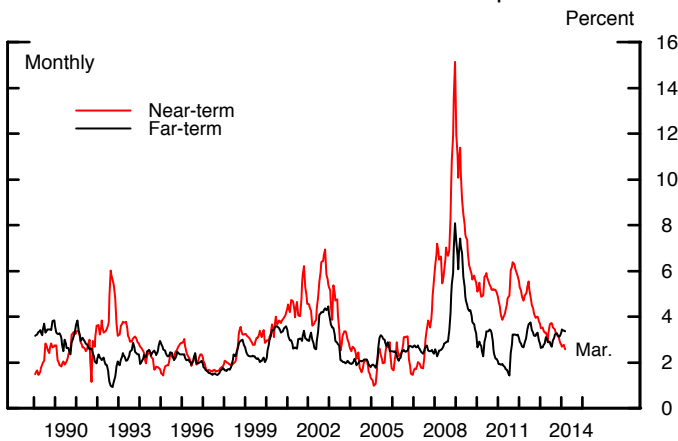
Note: Near-term forward spread between years two and three, far-term forward spread between years nine and ten.
Source: Staff estimates.

Chart 3
Gross Junk Issuance and Share of Deep Issuance

Billions of dollars   Percent

Four-quarter moving average
— Deep Junk Share (right scale)
— Gross Junk Issuance (left)

Q1

1990 1994 1998 2002 2006 2010 2014
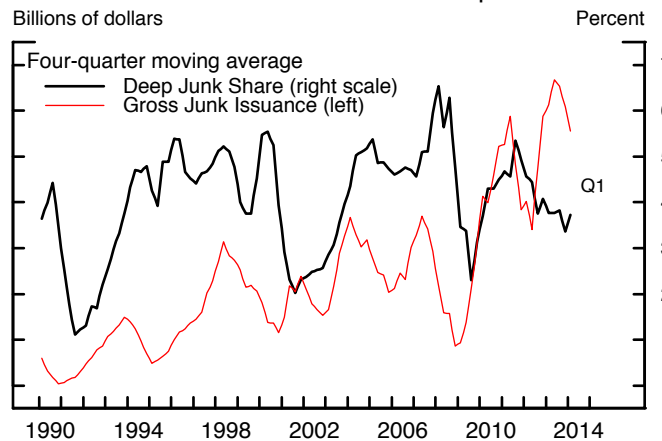
Note: Deep Junk Share is the fraction of bonds rated B- or lower over total nonfinancial junk issuance. Gross Junk Issuance includes public, 144a, euro, and MTN issues.
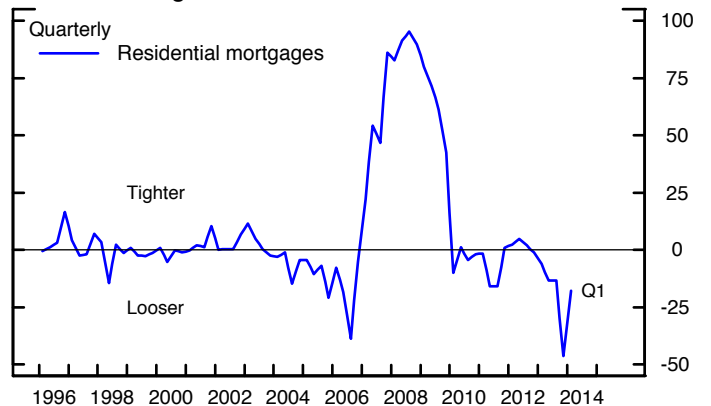Source: Thomson Reuters SDC Platinum (downloaded on Jan. 31, 2013).

Chart 4
House Price Overvaluation Measure

Percent

Quarterly
— CoreLogic

Q1

1982 1986 1990 1994 1998 2002 2006 2010 2014
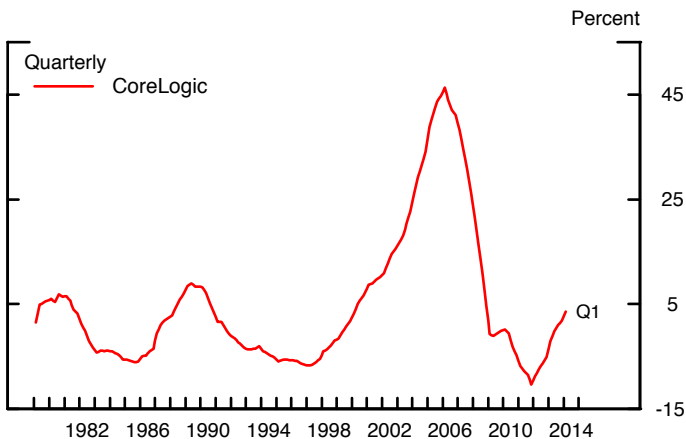
Note. Overvaluation measured as deviation from long-run relationship between house prices and rents.
Source: Staff calculations based on data provided by CoreLogic.

Chart 5
Loan Standards, Weighted by Value of Outstanding Loans

Percent

Quarterly
— Residential mortgages

Tighter

Looser
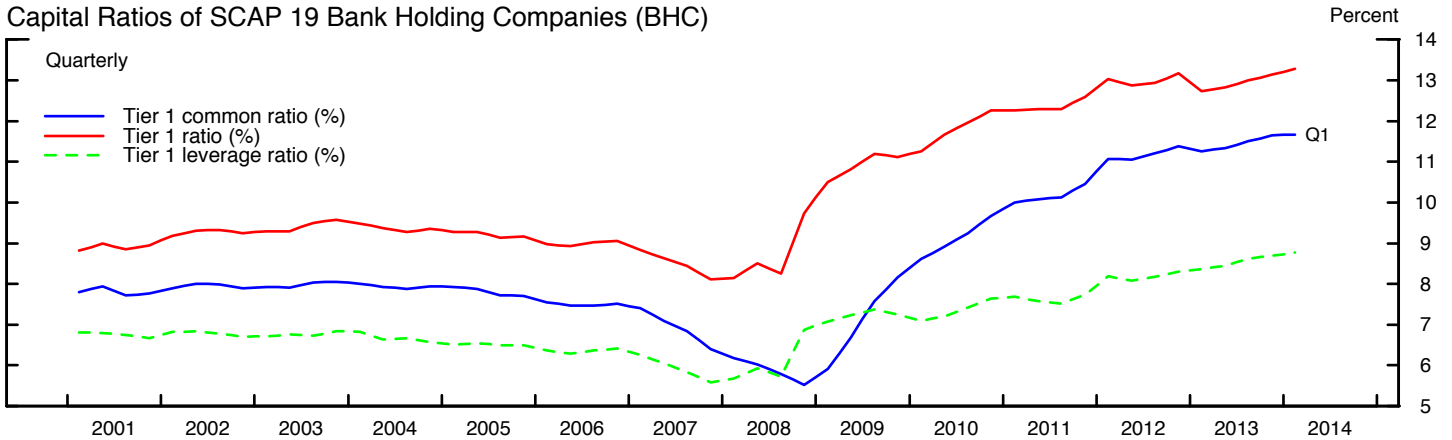
Q1

1996 1998 2000 2002 2004 2006 2008 2010 2012 2014

Note: Net percent of banks reporting tightening standards.
Source: Senior Loan Officer Opinion Survey on Bank Lending Practices.

Banking

Chart 6
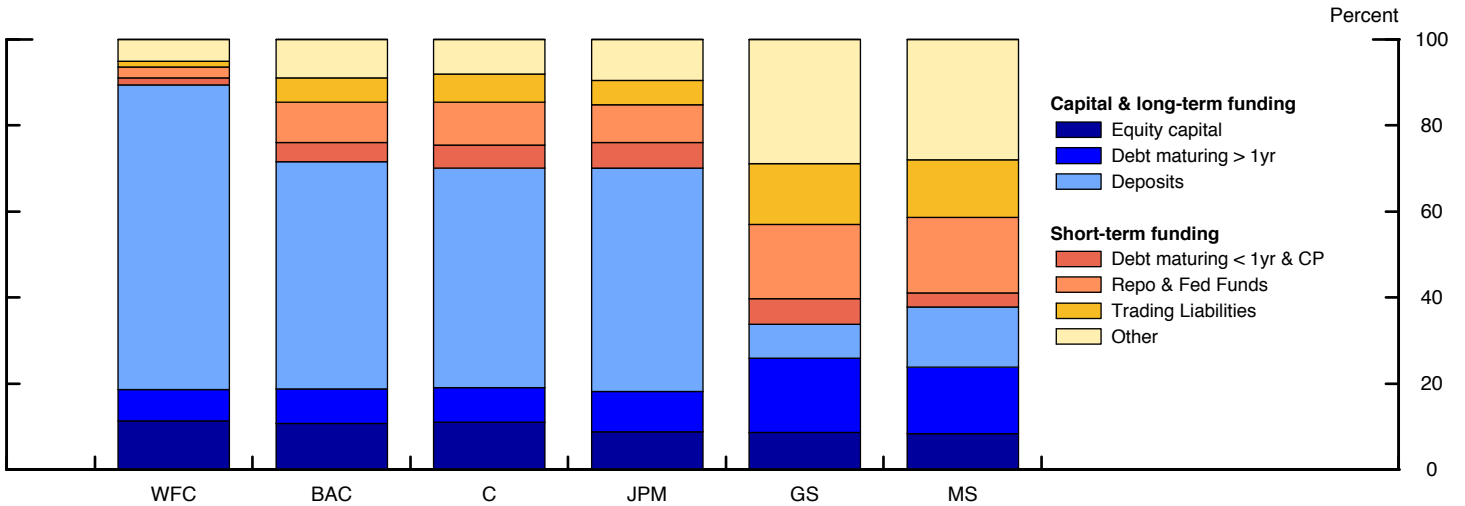### Capital Ratios of SCAP 19 Bank Holding Companies (BHC)

Percent

Quarterly

- Tier 1 common ratio (%)
- Tier 1 ratio (%)
- Tier 1 leverage ratio (%)

Q1

2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014
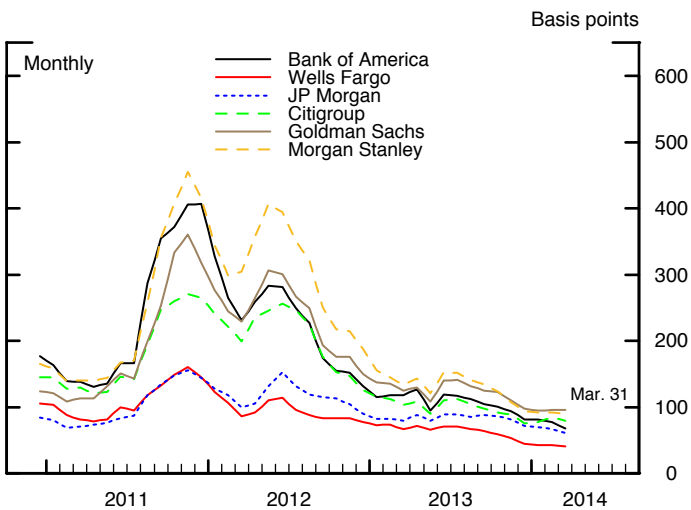
14 13 12 11 10 9 8 7 6 5

Note: In May 2009, 19 BHCs were assessed in the Supervisory Capital Assessment Program (SCAP). In this chart, GS, MS, Ally, and Amex are excluded prior to 2009, as they were not yet bank holding companies. MetLife is no longer a BHC and is excluded from 2012Q4 and 2013Q1 calculations.
Source: FR Y9-C.

Chart 7
BHC Liability Structure 2014Q1

Percent

Capital & long-term funding
- Equity capital
- Debt maturing > 1yr
- Deposits

Short-term funding
- Debt maturing < 1yr & CP
- Repo & Fed Funds
- Trading Liabilities
- Other

WFC   BAC   C   JPM   GS   MS

100 80 60 40 20 0

Source: FR Y-9C.

Chart 8
5-Year CDS Premiums for Select U.S. BHCs

Basis points

Monthly

- Bank of America
- Wells Fargo
- JP Morgan
- Citigroup
- Goldman Sachs
- Morgan Stanley

Mar. 31

2011 2012 2013 2014

600 500 400 300 200 100 0

Source: Markit Group Limited: Markit CDS.

Chart 9
Market-based Capital Ratios for BHCs

Percent

- Dec. 2008
- Dec. 2013

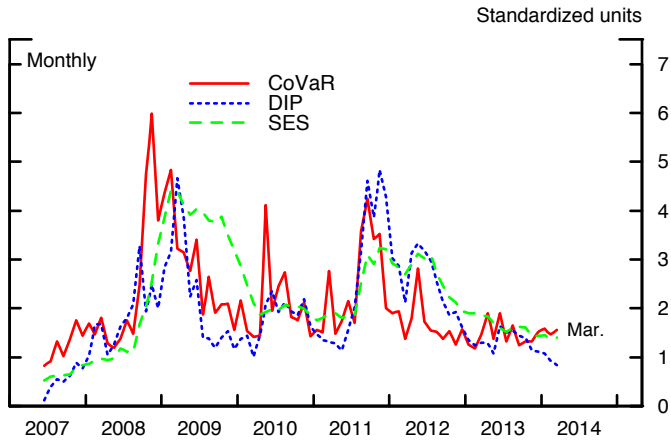BAC   CITI   GS   JPM   MS   WFC

20 16 12 8 4 0
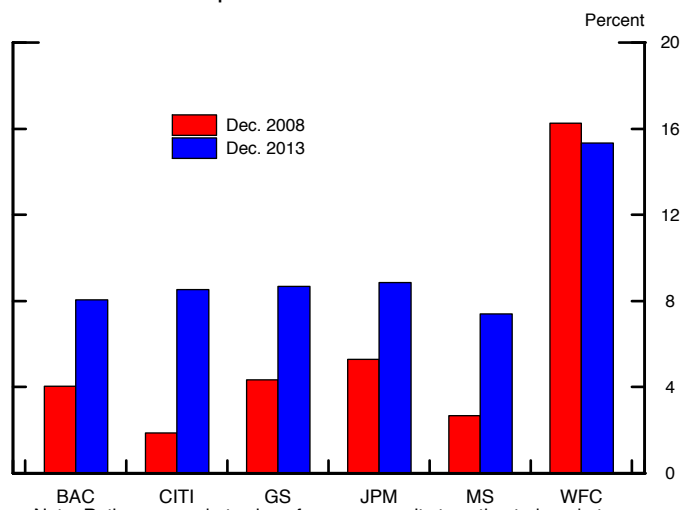
Note: Ratios are market value of common equity to estimated market value of assets.
Source: Staff calculations from Bloomberg data.

Banking

Chart 10
U.S. LISCC Firm Systemic Risk Measures

Standardized units

Note: Each risk measure is averaged across the six largest LISCC BHCs (Bank of America, Citigroup, Goldman Sachs, JP Morgan, Morgan Stanley, and Wells Fargo). Each resulting time-series is then re-scaled by its standard deviation.
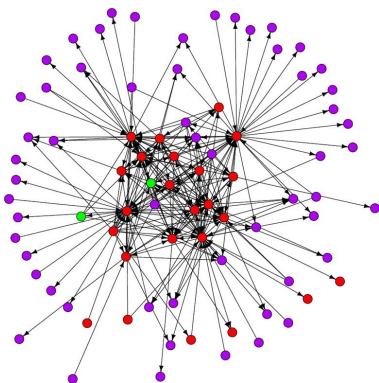
Chart 11
Post-stress Capital Ratios BHCs,
Tier I Common Ratios, CCAR 2013

Percent

Median = 7.46%
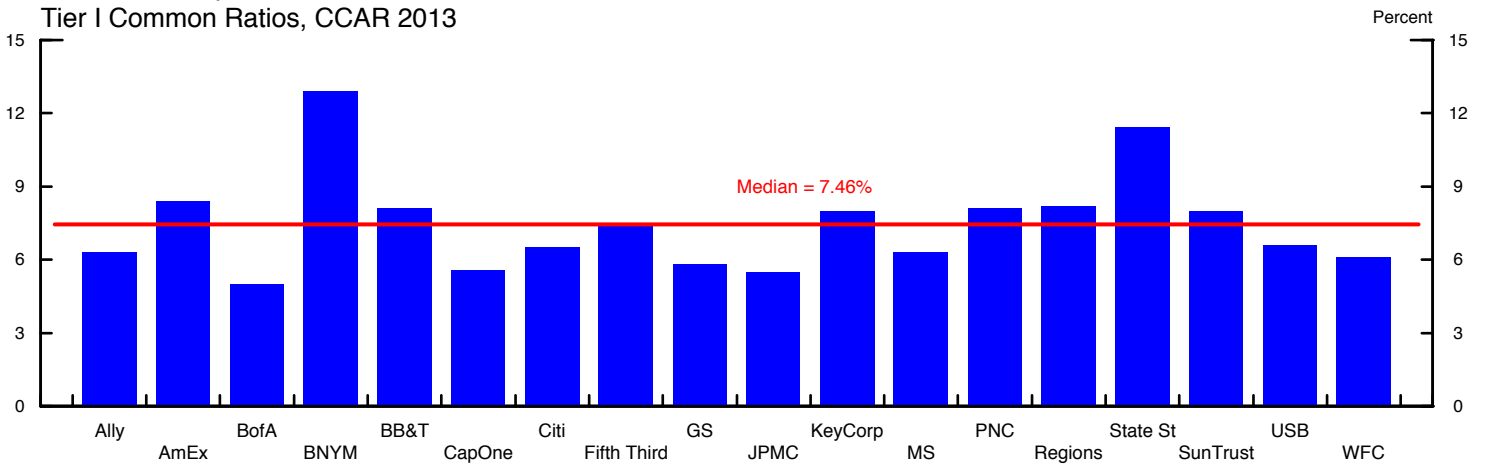
Note: Data represent minimum stressed ratios with original planned capital actions for severely adverse scenarios. The chart and its median line do not include the 12 financial firms added to CCAR 2014.
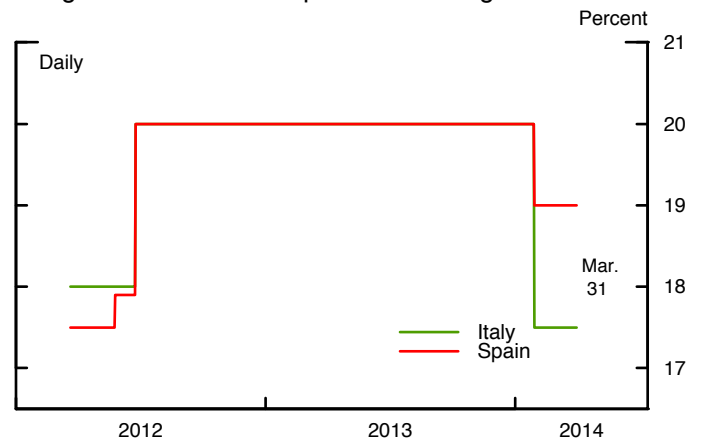
Source: Federal Reserve estimates from the 2014 Comprehensive Capital Assessment Review (CCAR).

Chart 12
Interconnectedness of CCPs, Dealers, and Non-dealers in CDS

Source: Chelso Brunetti and Michael Gordy, June 2012.

Chart 13
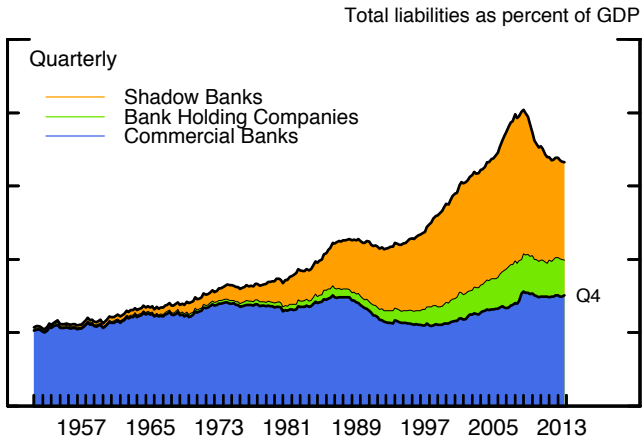## Margins on Italian and Spanish Sovereign Bonds

Percent

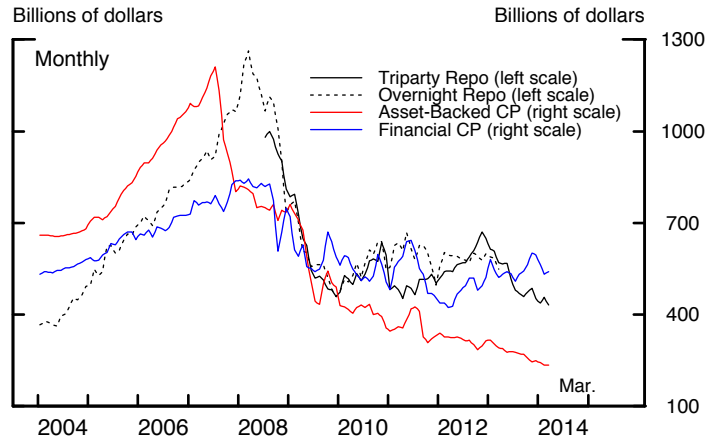Note: For maturities of 15-30 years.
Source: LCH.Clearnet SA

Shadow Banking

Chart 14
Financial Sector Liabilities

Total liabilities as percent of GDP

Quarterly

- Shadow Banks
- Bank Holding Companies
- Commercial Banks

Q4

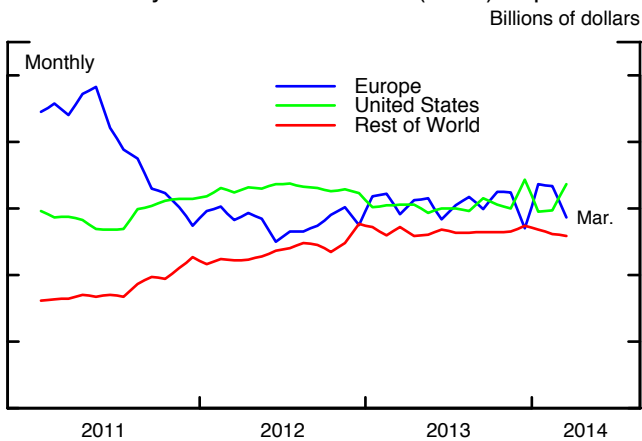1957 1965 1973 1981 1989 1997 2005 2013

Note: Bank Holding Company liabilities include the liabilities of Broker Dealers.

Source: Federal Reserve Flow of Funds.

Chart 15
Commercial Paper and Repo Financing

Billions of dollars   Billions of dollars

Monthly

- Triparty Repo (left scale)
- Overnight Repo (left scale)
- Asset-Backed CP (right scale)
- Financial CP (right scale)
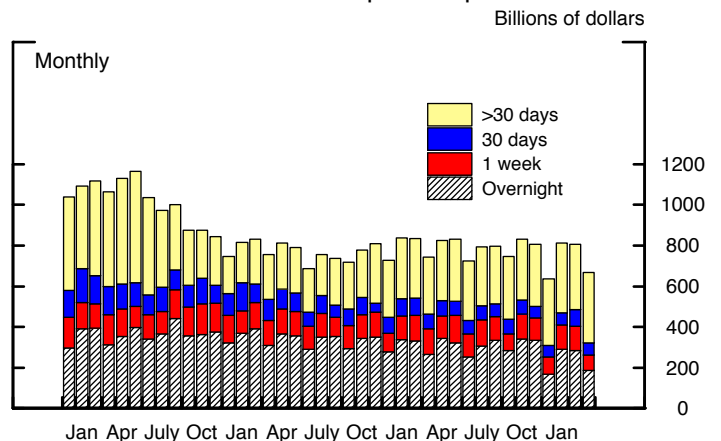
Mar.

2004 2006 2008 2010 2012 2014

Source: FR2004 primary dealer statistics and the Depository Trust Company. For more information see the About page on the FRB's public commercial paper release website.

Chart 16
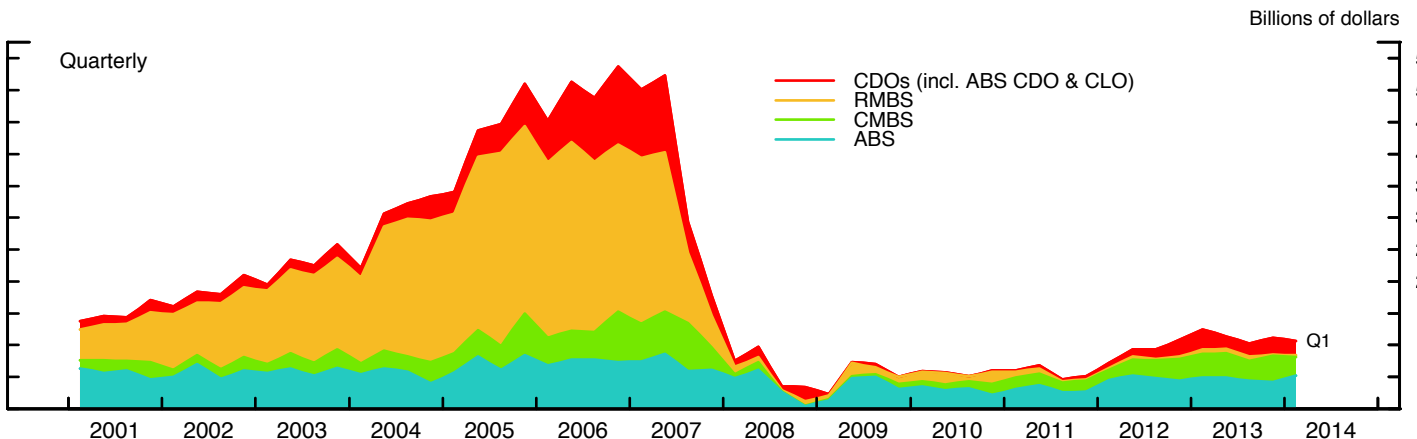## Prime Money Market Mutual Fund (MMF) Exposures

Billions of dollars

Monthly

- Europe
- United States
- Rest of World

Mar.

2011 2012 2013 2014

Source: SEC form N-MFP.

Chart 17
Maturities of Prime MMF European Exposures

Billions of dollars

Monthly

- >30 days
- 30 days
- 1 week
- Overnight

Jan Apr July Oct Jan Apr July Oct Jan Apr July Oct Jan
  2011   2012   2013   2014

Source: SEC form N-MFP.

Chart 18
U.S. Securitization Issuance

Billions of dollars

Quarterly

- CDOs (incl. ABS CDO & CLO)
- RMBS
- CMBS
- ABS

Q1

2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012 2013 2014

Note: CLO refers to all securities backed by loans or bonds issued by businesses. CMBS and RMBS refer respectively to securities backed by commercial and residential mortgages. ABS refers to securities backed by consumer loans.

Source: Asset-backed Alert, Commercial Mortgage Alert from Harrison Scott Publications, Inc. (downloaded May 8, 2013).
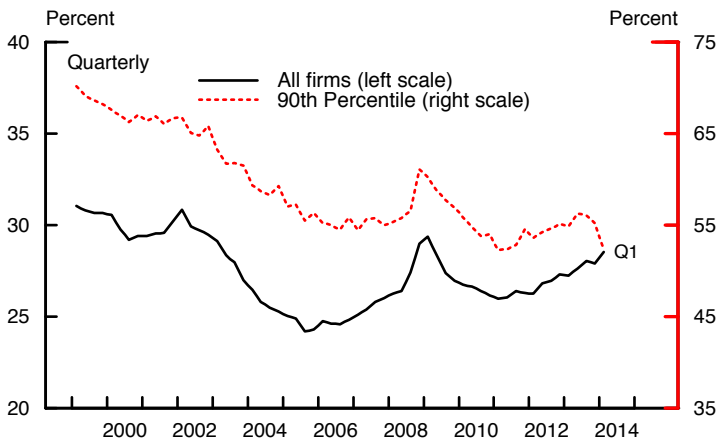
Nonfinancial Sector

Chart 19
## Private Nonfinancial Sector Credit-to-GDP Ratio
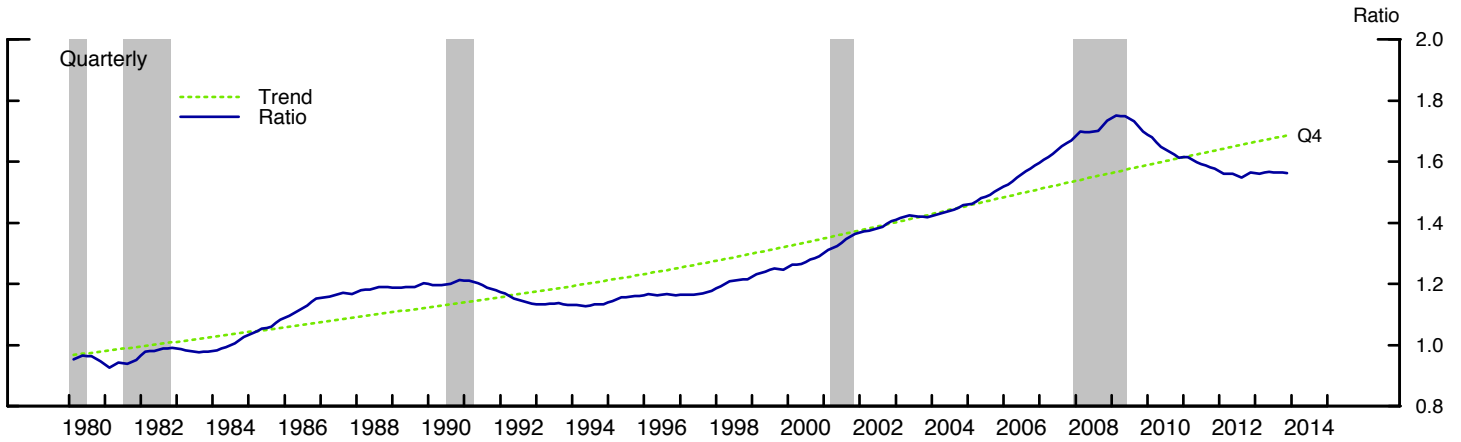
Note: Calculated using an HP filter. Shaded areas denote NBER recessions.
Source: FOFA, NIPA, and staff calculations.

Chart 20
Debt-to-assets Ratio

Note: Ratio of the book value of total debt to total assets. 90th percentile is calculated from subset of 3000 largest firms, by assets.
Source: S&P Capital IQ Compustat XpressFeed.

Chart 21
Underwater Mortgages
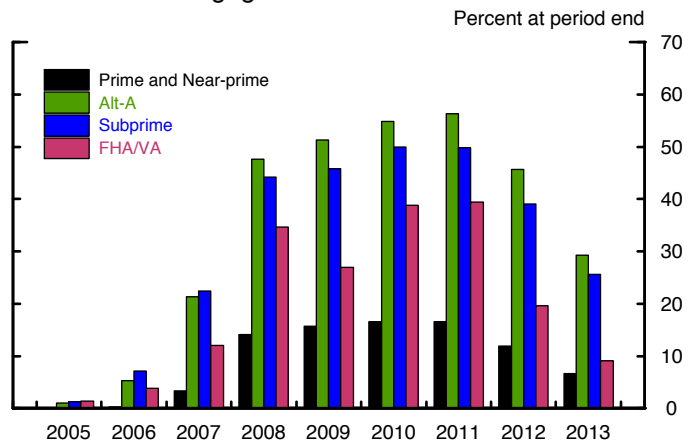
Note: Prime and Near-prime also includes Alt-A.
Source: Staff calculations based on data provided by CoreLogic, and LPS (Lender Processing Services) Applied Analytics.