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Monetary Policy, Financial Conditions, and Financial Stability

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Abstract

In the conduct of monetary policy, there exists a risk-return tradeoff between financial conditions and financial stability, which complements the traditional inflation-real activity tradeoff of monetary policy. The tradeoff exists even if monetary policy does not target financial stability considerations independently of its inflation and real activity goals, as the buildup of financial vulnerabilities from persistent accommodative monetary policy when the economy is close to potential increases risks to future financial stability. We review monetary policy transmission channels and financial frictions that give rise to this tradeoff between financial conditions and financial stability, within a monitoring program across asset markets, banking firms, shadow banking, and the nonfinancial sector. We focus on vulnerabilities that affect monetary policies' risk- return tradeoff including (i) pricing of risk, (ii) leverage, (iii) maturity and liquidity mismatch, and (iv) interconnectedness and complexity. We also discuss the extent to which structural and time-varying macroprudential policies can counteract the buildup of vulnerabilities, thus mitigating monetary policy's risk-return tradeoff.

Keywords: risk taking channel of monetary policy; monetary policy transmission; monetary policy rules; financial stability; financial conditions; macroprudential policy

JEL classification: E52, G01, G28

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1. Introduction

Accommodative monetary policy eases financial conditions, but may also contribute to the buildup of financial vulnerabilities and hence increase risks to financial stability. Risks to financial stability are the *potential* for widespread financial externalities, such as from asset sales and contagion, that can result in large negative outcomes for output. In this paper, we argue that macroprudential and monetary policy transmission channels are intertwined, and central banks should consider effects on both financial conditions and financial stability when setting monetary policy. The basis for this argument is a growing body of research advancing a risk-taking channel of monetary policy. This literature suggests that in non-crisis periods when the economy is expanding, accommodative monetary policy interacting with financial frictions can lead to a buildup of financial vulnerabilities. Vulnerabilities, such as compressed risk premiums, and excessive leverage or maturity and liquidity transformation in the financial system, can increase the probability of a financial crisis and severe recession in the future.

We provide a review of transmission channels of monetary policy, focusing not just on financial conditions, but also on the financial stability consequences via financial vulnerabilities. Looser monetary policy may introduce a risk-return tradeoff, where accommodative policy improves financial conditions by reducing risk premia and increasing incentives for risk taking. Financial frictions include agency costs, institutional investor sticky nominal return targets, or financial firms' risk models and limited liability. The frictions introduce an inter-temporal tradeoff when the economy is close to potential, because the frictions may lead to greater vulnerabilities, which will amplify shocks with negative consequences for economic activity in the future.

We also review research that asks to what extent macroprudential policy or monetary policy should respond to financial vulnerabilities. Macroprudential policies—both structural through-the-cycle and cyclical time-varying—are usually viewed as the primary tools to mitigate vulnerabilities and promote financial stability. These regulatory and supervisory tools, such as bank capital requirements or sector-specific loan-to-value ratios, can shore up the resilience of the financial system to possible adverse shocks. However, the impact of macroprudential policies may be limited because financial intermediation can move away from more regulated entities to shadow banking, and the incentives to move may increase as financial conditions become more accommodative and risk-taking behavior increases. At the same time, macroprudential tools targeted at specific sectors may be politically unpopular if they are viewed as government-imposed credit allocation. Monetary policy can be a time-varying macroprudential tool, but cannot be targeted, since it will affect funding conditions for all intermediaries, regulated and unregulated, and all sectors. As a consequence, it may have greater collateral consequences than more sector-specific policies.

This paper builds on the financial stability monitoring framework described by Adrian, Covitz, Liang (2013), as summarized in Table 1. It focuses on specific financial vulnerabilities—A) pricing of risk, B) leverage, C) maturity and liquidity transformation, and D) interconnectedness and complexity—across four sectors—1) asset markets, 2) the banking sector, 3) shadow banking, and 4) the nonfinancial sector. Adrian, Covitz, Liang (2013) explain how financial vulnerabilities can be systematically monitored following this matrix approach, and discuss some policy implications, primarily focusing on

macroprudential policy. This paper is an extension, and focuses specifically on how monetary policy can lead to buildups of vulnerabilities through an endogenous increase in risk-taking, and the efficacy of monetary policy or macroprudential policies to mitigate in each of the four sectors. The monetary policy transmission channels in the four sectors of the financial system can be summarized as follows (see Table 2):

1) Asset markets: Easier monetary policy improves financial conditions by lowering the risk-free term structure, but also compresses risk premiums.
2) Banking sector: Easier monetary policy increases loan supply, but also contributes to higher leverage of banks and broker-dealers and greater risk taking (more credit to riskier firms).
3) Shadow banking: Easier monetary policy increases dealer-intermediated leverage that facilitates maturity and credit risk transformation, and securitization, without an explicit government backstop, but contributes to higher leverage and lower risk premiums.
4) Nonfinancial sector: Easier monetary policy eases borrowing constraints and boosts credit growth, but reduces underwriting quality and increases debt burdens of riskier borrowers.

Macroprudential tools that can be used to mitigate the vulnerabilities in these four sectors include capital, liquidity, and risk weight requirements, as well as supervisory guidance and exposure limits for regulated firms, margins and haircuts for securities, and loan-to-value (LTV) and debt-to-income (DTI) ratios for borrowers (see Table 3).

The remainder of the paper is organized as follows. Section two provides a conceptual framework for the relationship between monetary policy, financial conditions, and financial vulnerabilities, also considering macroprudential policy. Section three provides a literature review of the transmission channels of monetary policy, particularly focusing on the potential buildup of financial vulnerabilities. Section four discusses how financial vulnerabilities can be addressed with macroprudential policy tools, and the extent to which monetary policy should take financial vulnerabilities into account explicitly. Section five concludes.

2. Conceptual Framework

One channel for monetary policy is the credit channel, where interest rate changes affect loan supply through credit market frictions, such as asymmetric information between borrowers and lenders that gives rise to an external finance premium. The size of the external finance premium depends on the balance sheet conditions of the borrower, which vary with the level of interest rates. When interest rates rise and asset values fall, borrowers are less able to borrow (balance sheet channel), and banks may not be able to easily replace deposits with non-deposit funding, and reduce the supply of loans (bank lending channel).

The risk-taking channel posits that accommodative monetary policy will lead to an increase in risk taking by financial institutions and investors that will boost economic activity. If the increase in risk

taking, because of financial frictions, also substantially increases the vulnerability of the financial system to shocks, then the risk-taking channel will increase risks to financial stability. This effect on vulnerabilities can operate through asset prices or financial firms, or both. Low interest rates could incent investors who may target a nominal return that is higher than current returns to reach for yield. Low rates could pressure profit margins of banks and incent them to hold riskier assets, or higher asset values could lead them to underestimate risk. Low rates that boost asset values also may incent carry trades based on short term funding, often secured by the assets, and allow for excessive maturity transformation. Similarly, higher net worth of borrowers arising from higher collateral values allows for greater debt accumulation.

This tradeoff between financial conditions and financial vulnerabilities is typically not considered in the literature on monetary policy. In traditional monetary policy settings, the inflation-real activity tradeoff determines the stance of financial conditions, without giving consideration to financial vulnerabilities. For example, in typical new Keynesian models, the Taylor rule—which determines the stance of monetary policy with respect to inflation and real activity—is derived by taking first order approximations around the steady state, thus explicitly abstracting from downside risk considerations. Furthermore, financial vulnerabilities that can lead to systemic risk are usually not modeled explicitly.

The lack of explicit consideration does not imply that financial stability objectives are inconsistent with the objectives of monetary policymakers. For example, suppose policymakers set interest rates in order to keep output (and inflation) close to target. With a simple quadratic loss objective function, policymakers would minimize the square of the expected value of the gap between output and potential output, and the variance of output (Kocherlakota, 2014; Stein, 2014). Financial stability risks are reflected in the variance term (a more complicated model could incorporate downside risk rather than just variance). When the gap between actual and potential is large, the variance around output would have less weight in the objective function. Moreover, when the gap is large with output well below potential, looser monetary policy might also reduce the variance term, by strengthening the balance sheets of borrowers and lenders.[1] However, when the output gap is close to zero, financial stability considerations would have greater weight in reducing variance. In this situation, a trade-off may emerge as loose financial conditions to continue to promote current economic growth could lead to a build-up of vulnerabilities that increases the variance of output because of an increased likelihood of an economic downturn in the future due to the realization of financial instability.

The risk-return trade-off for monetary policy is affected by the stance of macroprudential policy. A tighter macroprudential stance alters the risk-return tradeoff of monetary policy in two ways. Tighter macroprudential policy reduces financial vulnerabilities for any level of monetary policy, and may also flatten the risk-return tradeoff, indicating that monetary policy faces a less severe tradeoff when macroprudential policy is more forceful. The trade-off for monetary policy exists because it is likely that macroprudential policies cannot adequately reach all vulnerabilities, given the limited reach of policies to regulated sectors, and policies themselves provide incentives to move activities to shadow banking. In the U.S., shadow banking is extensive. One estimate, which includes securitizations and net assets

[1] For example, in a financial crisis, the positive impact of looser policy on risk taking can improve financial stability.

funded by short-term liabilities that are not issued by the regulated banking sector, hit a peak in 2008 at 100 percent of GDP, equivalent to the liabilities of the banking sector (see Adrian, Covitz, Liang, 2013).

A dimension that should be emphasized is the intertemporal nature of the tradeoff between financial conditions and financial vulnerabilities. More accommodative policy eases current financial conditions, allowing businesses to borrow immediately at lower rates. However, if borrowing were to continue at a rapid rate, borrowers and lenders would over time become more leveraged and more vulnerable to an adverse shock. In addition, the impact of monetary policy on economic outcomes via financial conditions is on expected economic outcomes. In contrast, monetary policy affects the buildup of vulnerabilities that raise the *potential* for systemic risk. This tail risk to future macroeconomic outcomes manifests itself only in some states of the world, when adverse shocks are realized. These dimensions are important because they greatly complicate efforts to incorporate financial stability in the determination of monetary policy. Policymakers would need to look beyond expected conditions for potential downside risks in the future, when uncertainty about expected conditions is already considerable.

The distinction between risks and vulnerabilities is a fundamental one, representing an important organizing framework for this paper. We refer to *amplification* mechanisms due to financial frictions as vulnerabilities, which amplify adverse shocks. *Risks* are realizations of adverse shocks. While the dimensionality of risks is very high—and risks are thus difficult to monitor and assess—the assessment of vulnerabilities is more manageable. The paper thus focuses on the tradeoff between financial conditions and financial vulnerabilities.

3. Monetary Policy Transmission and Financial Stability

Before turning to specific transmission channels of monetary policy, it is helpful to review stylized facts about monetary policy, financial conditions, and financial vulnerabilities. We present preliminary suggestive empirical analysis on the risk-return tradeoff of monetary policy and the risk taking channel by looking at the relationship between the stance of monetary policy, financial conditions, and financial vulnerabilities. We first look at the relationship between monetary policy and financial conditions, and next at the relationship between monetary policy and financial vulnerabilities.

Exhibit 1 show correlations between monetary policy and measures of financial conditions and vulnerabilities from 1987 to 2007, before the zero lower bound became a binding constraint.[2] Figures 1 and 2 show that monetary tightening is associated with tightening of funding conditions in fixed income markets, specifically with an increase in a longer-term Treasury yield and an increase in the expectations component of the 10-year Treasury yield (computed from the term structure model of Adrian, Crump, Moench, 2013).

[2] The risk taking channel of monetary policy is also present when the zero lower bound constraint is binding, since other tools such as forward guidance or asset purchases that reduce rates to support financial conditions also impact financial vulnerabilities.

Stylized facts about the relationship between the stance of monetary policy and future financial vulnerabilities are presented in Figures 3 to 6. We relate the one-year lag of Taylor rule residuals to measures of vulnerabilities in financial markets. [3] In general, the stylized facts suggest an inverse relationship between looser financial conditions (negative lagged Taylor rule residual) and declines in risk premiums and increases in financial sector leverage and short-term funding. Looser policy tends to be followed by tighter risk premia, both in equity markets and for interest rates (Figures 3 and 4). Furthermore, we see that looser policy tends to be associated with future higher leverage for securities broker-dealers (figure 5), and the amount of maturity transformation as proxied by the ratio of wholesale short term funding to GDP tends to increase following looser monetary conditions (Figure 6).

Of course, the evidence presented here is only suggestive, and the remainder of this section reviews rigorous empirical and theoretical studies about the linkages between monetary policy, financial conditions, and financial stability.[4] We provide a review of the literature regarding the effect of monetary policy on financial conditions and the buildup of vulnerabilities for the four sectors previously mentioned: A. asset markets, B. banking, C. shadow banking, and D. nonfinancial sector. The economic mechanisms are summarized in Table 2.

A. Asset Markets

Accommodative monetary policy can lead to stronger economic growth by increasing financial asset prices and improving financial conditions, either by lowering the risk-free discount rate or by lowering risk premia. The most direct transmission channel of monetary policy is via the expected path of future short rates. Changes to the current level of rates may affect the path of expected future short rates, and pass through directly to longer-term rates if not offset by changes to term premiums. Changes in risk neutral longer-term yields, that remove risk premia from long term yields using a model of the term structure of interest rates, appear to be directly related to changes in current short rates.

Monetary policy also impacts the pricing of risky assets, such as in equity, credit, housing, and other risky asset markets. Monetary policy may also impact expected cash flows. Bernanke and Kuttner (2005) document that positive monetary policy surprises generate negative stock returns, mostly through increases in risk premia (higher expected returns), rather than through higher expected real rates. In addition, others have shown that easing of monetary policy tends to reduce credit risk premiums on corporate bonds (Greenwood and Hanson, 2012; Gertler and Karadi, 2013; Gilchrist, Lopez-Salido, Zakrajsek, 2014). Bekaert, Hoerova, and Lo Duca (2013) find based on the dynamics of the VIX that tightening shocks lead to increases in investor risk aversion.

[3] Taylor rule residuals measure movements in the federal funds rate that are orthogonal to inflation and real activity, thus allowing us to capture the impact of monetary policy on financial vulnerabilities independently of the contemporaneous state of the macroeconomy. We use Taylor rule residuals for Figures 3 to 6 as we want to illustrate the correlation of the stance of monetary policy with indicators of risk taking in a manner that is orthogonal with the state of the macroeconomy.

[4] In addition, the relationship between monetary policy and financial vulnerabilities is state contingent, likely changing signs in the depth of financial crises.

But the link from monetary policy to asset prices does not necessarily suggest that loose policy increases risks to financial stability. For that to happen, risk premiums would have to become compressed, which can arise because of frictions in financial markets, and the unwinding of risk premiums is asymmetric. We turn to a discussion of these issues next.

Financial Stability

For Treasury securities, looser monetary policy, combined with asset manager behavior, can lead to lower real term premiums than can be justified by fundamentals. Hanson and Stein (2012) provide evidence that monetary policy shocks induce variation in real forward term premiums, consistent with yield-oriented investors who prefer current income to a holding period return. When monetary policy loosens, these investors may rebalance to longer-term bonds, so as to mitigate a decline in current yields, thereby boosting longer-term bond prices and reducing term premiums. This mechanism is similar to unconventional monetary policy, such as asset purchases of Treasury securities, which work by lowering term premiums.

Changes in the stance of monetary policy combined with financial frictions may also compress risk premiums for other assets. Rajan (2005, 2006) argues that low interest rates can lead to compressed risk premiums because they increase the incentives for investors to reach for yield. This incentive arises because some investors operate with constraints, such as fixed nominal rate targets tied to their liabilities, or asset managers have contractual arrangements in which their compensation is based on returns above a nominal level.

More broadly, monetary policy could contribute to a compression of risk premiums by increasing risk taking at financial institutions. Allen and Gale (2000, 2003, 2007) provide models where bubbles in real estate prices can arise because of agency problems between investors and lenders (risk shifting because lenders do not observe the risky investment), and as credit expands. Low interest rates can encourage investors to purchase a risky asset, boosting its current price. The expectation of future credit expansion will also raise current prices, though at the same time increase the likelihood of a future crisis. They argue that expectations about future credit are determined by monetary policy.

Adrian and Shin (2008) also focus on the relationship between lending and asset prices. In particular, looser monetary policy increases the ability of intermediaries to take on leverage, which in turn impacts the pricing of risk (Adrian, Etula, Muir, 2012 and Adrian, Moench, Shin, 2010). In addition, low risk premia and low volatility may contribute to a buildup in imbalances, due to the "volatility paradox" (Brunnermeier and Sannikov, 2014).

Morris and Shin (2014) and Feroli et al (2014) posit that unlevered asset managers who are evaluated based on their relative performance provide a channel for monetary policy to generate sharp rises in risk premia not related to changes in fundamentals. Loose monetary policy may lead to greater flows to funds that are managed by asset managers, who want to avoid being the worst performer since investors can redeem assets. Fund flows lead to increases in prices, generating momentum and a feedback loop between flows and prices. But when investors believe monetary policy may tighten, the

aversion by asset managers to underperformance can create a sharp jump in risk premia. They document this channel for risky bonds, though they do not find empirical support in Treasuries or equities. Even so, more work is needed to determine if the jumps in risk premia are sufficiently large to pose a threat to financial stability in the absence of high leverage and maturity transformation in the broader financial system.

A number of studies have documented that the majority of movements in asset prices reflects movements in the equilibrium compensation for risk. For example, the time variation in Treasury returns primarily is due to changes in the pricing of risk rather than to changes in expectations of future short rates (see Campbell and Shiller, 1984, Cochrane and Piazzesi, 2005, Cochrane, 2011). 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, valuation measures such as the dividend payout or the price-to-rent ratio tend to exhibit large, persistent swings, again indicating that risk premia vary over time (see Campbell and Shiller, 1988 for equity returns, and Case and Shiller, 2003, and Campbell, Davis, Gallin, Martin, 2009 for house prices). Risk premia are time varying, so that periods of compressed risk premia can be expected to be followed by a reversal of valuations. Another well-documented feature of asset prices is their asymmetric conditional density: asset price declines tend to be more violent than asset price appreciations (Harvey and Siddique, 1999 and 2000). This property is often referred to as conditional skewness. The cyclical nature of risk premia combined with the negative skewness in asset returns suggests that asset price booms associated with periods of accommodative monetary conditions potentially pose a financial stability threat.

B. Banking Sector

Besides its impact on asset valuations, monetary policy has traditionally been viewed to work through the banking sector, mainly as lower policy rates lead to an increase in the volume of lending (see Peek and Rosengren, 2013 for a review). The bank lending channel posits that easier policy relaxes borrowing constraints of banks, shifting credit supply (Bernanke and Blinder, 1988; Kashyap and Stein 1994). Bernanke and Blinder (1992), Kashyap, Stein and Wilcox (1993), and Bernanke and Gertler (1995) provide empirical support for the bank lending and balance sheet channels, based on aggregate data, as monetary policy tightening lead banks to shrink lending. Kashyap and Stein (1995, 2000) show that banks that are small and less liquid, and have fewer margins to adjust to a loss of reservable deposits, reduce loans by more when policy tightens. While many studies support the lending channel, recent developments in financial markets, such as growth of securitization, suggest the channel may have become less of an amplification channel for monetary policy (Loutskina and Strahan, 2009).

Capital requirements may influence the impact of monetary policy on bank lending. Peek and Rosengren (1995) show that an adverse capital shock that makes a capital constraint binding will cause banks to shrink assets and liabilities. When comparing capital-constrained to unconstrained banks, the unconstrained were more able to increase loans in response to an easing of policy.

Financial Stability

An increasing number of papers have focused on the link between the stance of monetary policy and the risk-taking behavior of banks, which establishes a connection to financial stability. Loose monetary policy can encourage banks to take on more risk on both the asset side and the liability side. On the asset side, banks can reach for yield (Rajan, 2005), which will increase the share of risky assets. On the funding side, loose monetary policy increases incentives to use more short term funding. Stein (2012, 2013) and Adrian and Shin (2010) show that increases in policy rates are associated with declines in short term liabilities.

Recent papers provide cross-sectional evidence of the risk-taking channel, in which monetary policy affects not just the quantity but the quality of credit. The risk taking effects depend importantly on the amount of bank capital, where higher levels of capital mitigate incentives to reduce the quality of credit. Jiménez et al (2012) use detailed credit register data in Spain to show that lower rates leads to greater risk taking, more credit to riskier firms, and this effect is greater at banks with lower capital. Dell'Ariccia, Laeven, and Suarez (2013) look at this channel in the US, and find a relationship between ex ante riskiness of loans and bank capital. Paligorova and Santos (2012) evaluate loan spreads on syndicated loans in the US and find that required spreads for more risky to less risky borrowers is lower in periods of looser monetary policy, and is stronger for banks with greater risk appetite. Maddaloni and Peydro (2011) find that low rates lead to softer lending standards in both the US and Euro area, which is greater if rates have been low for an extended period, supervision is weaker, and securitization activity is greater. Altunabas, Gambacorta, and Marques-Ibanez (2010) show unusually low rates for an extended period led to a sharper rise in expected default probabilities for banks, consistent with greater risk taking.

Drechsler, Savov, and Schnabl (2014) model the effects of monetary policy through financial institutions by affecting the external finance spread that banks pay to leverage. Easing of monetary policy leads to lower leverage costs for banks, which increases risk taking and lowers risk premia. They document that an external finance spread for banks (the funds rate – Tbill rate) moves closely with the fed funds rate. Monetary policy can be viewed as altering bank leverage by affecting this spread.

Adrian and Shin (2010, 2014) document that broker dealer leverage is endogenous and highly procyclical, owing to the way in which risk management is conducted. In booms, asset market volatility is endogenously low, loosening risk-based capital constraints for broker dealers. When adverse shocks occur, broker dealers sell assets, fueling a decline in asset prices, and a rise in market volatility, further tightening risk management constraints. This procyclical balance sheet management has aggregate consequences. Adrian, Etula, and Muir (2013) show that the cross section of asset returns across various asset classes is well explained by covariation with broker-dealer leverage. Adrian, Moench and Shin (2013) further document that pricing of risk varies with broker dealer leverage over time.

Adrian and Shin (2011a and 2009a) link the procyclical leverage to monetary policy, showing that tighter monetary policy tends to lower risk taking of broker dealers, leading to an increase in the pricing of risk, with associated contractionary macro consequences. In addition, Adrian, Moench and Shin (2009, 2010) link leverage management to aggregate economic activity, and show that shocks to

dealer leverage impact macro activity through the pricing of risk. Adrian and Boyarchenko (2012) and Nuño and Thomas (2014) provide theories that rationalize these facts within dynamic stochastic general equilibrium models. In Adrian and Boyarchenko (2012), higher leverage is further associated with an increase in financial vulnerability in the form of systemic risk. Adrian and Shin (2011b) show that procyclicality of dealers is apparent at the largest bank holding companies that own substantial broker-dealer subsidiaries. The procyclical leverage behavior is thus present in the largest U.S. and global banking organizations.

Schularick and Taylor (2012) document the impact of the procyclicality of bank credit for real activity using a historical dataset that covers almost 140 years across 14 developed countries. They find that lagged credit growth is a highly significant predictor of financial crisis. Financial stability risks tend to increase with the size of the financial sector, and equity market fluctuations have more adverse real economic consequences in more financially-developed economies. Schularick and Taylor also document that while post-World War 2 monetary policy has generally stabilized money growth in the face of adverse financial developments, it has not been able to prevent collapses in credit growth.

C. Shadow Banking

Shadow banking can be defined as maturity transformation, liquidity transformation, and credit risk transfer outside of institutions with direct access to government backstops such as depository institutions (see Adrian, Ashcraft, Cetorelli, 2014 for a recent overview). This intermediation takes place in an environment where prudential regulatory standards and supervisory oversight are either not applied or are applied to a materially lesser or different degree than is the case for regulated banks. The shadow banking system decomposes credit intermediation into a chain of wholesale-funded, securitization-based lending.[5]

The shadow banking system transforms risky, long term loans (mortgages, for example) into seemingly credit-risk-free, short term, money-like instruments. The creation of money-like shadow bank liabilities complements traditional forms of money creation (Gorton and Metrick, 2012). High-powered money can be created only by central banks. Commercial banks create broader forms of money, such as demand deposits. Shadow bank money creation occurs primarily in the commercial paper market and the repo market, and is funded by money market funds and short term investment funds. Shadow bank liabilities can substitute for money in the private sector's asset allocation. Sunderam (2012) shows that shadow banking liabilities respond to money demand shocks. Gallin (2013) provides a comprehensive map of the amount of short term funding from the shadow banking system to the real economy, based on the flow of funds statistics. Short term money creation by the shadow banking system also furthers monetary policy transmission.

[5] Shadow credit intermediation is performed through chains of nonbank financial intermediaries in a multistep process that can be interpreted as a "vertical slicing" of the traditional banks' credit intermediation process into seven steps. Pozsar, Adrian, Ashcraft, and Boesky (2013) explain the seven steps of shadow bank credit intermediation in detail. The seven steps involve 1) loan origination, 2) loan warehousing 3) pooling and structuring of loans into term asset-backed securities (ABS), 4) ABS warehousing, 5) pooling and structuring of ABS into CDOs, 6) ABS intermediation, and 7) funding in wholesale funding markets by money market intermediaries.

Money creation in the shadow banking system is at the root of the breakdown of monetary relationships in the U.S. Until the early 1980s, the relationship between money growth and nominal output growth was very stable, a fact usually labeled as stable velocity of money. Schularik and Taylor (2012) document that credit began to grow rapidly and decouple from broad money since the early 1970s, via a combination of increased financial risk and leverage outside of non-monetary liabilities at banks. Since the shadow banking system became a quantitatively important contributor to credit intermediation, shadow bank money creation has led to a highly time-varying velocity of money. This reflects the feature of the shadow banking system that it responds quickly to changing financial, economic, and regulatory conditions.

Financial Stability

The presence of shadow banking steepens the risk-return tradeoff that monetary policy makers face. The shadow banking system, which is less constrained by prudential regulation, leads to a greater transmission of monetary policy to financial conditions via a larger degree of endogenous risk taking. The greater risk taking may be evident in higher leverage, and greater maturity and liquidity transformation, allowing the system to operate at higher levels of risk taking and increasing the potential for systemic financial crises. The presence of shadow banking thus steepens the risk-return tradeoff relative to an economy with only traditional banking, making monetary transmission faster, but also riskier.

A generic model of shadow bank intermediation that features such a steepening in the aggregate risk-return tradeoff has been proposed by Moreira and Savov (2012). Intermediaries create liquidity in the shadow banking system by levering up the collateral value of their assets. However, the liquidity creation comes at the cost of financial fragility as fluctuations in uncertainty cause a flight to quality from shadow liabilities to safe assets. Gorton and Metrick (2012) document the run on the shadow banking system at the beginning of the financial crisis of 2007-09, as investors began to question the value of subprime mortgage collateral. Covitz, Liang, and Suarez (2013) show that runs on ABCP programs were more likely if they had weaker liquidity and credit support, as commercial paper investors are especially sensitive to being paid in full and on time. Moreover, for programs with these characteristics that were able to issue paper, spreads were wider and maturities were shorter, pointing out their inherent fragility and source of financial instability. ABCP since 2004 was—at least in part—attributable to regulatory arbitrage triggered by a change in capital rules. Acharya, Schnabl, and Suarez (2013) document that the majority of guarantees were structured as liquidity-enhancing guarantees aimed at minimizing regulatory capital, instead of credit guarantees, and that the majority of conduits were supported by commercial banks subject to the most stringent capital requirements.

The financial frictions that lead to excessive risk taking and exacerbate credit losses during downturns also interact with the fragility of funding. Per definition, funding sources for shadow banking activities are uninsured and thus runnable. In many ways, the fragility of shadow banks due to the run-ability of liabilities resembles the banking system of the 19th century, prior to the creation of the Federal Reserve and the FDIC. During that time, bank runs were common, and they often had severe consequences for the real economy. The shadow banking system's vulnerability to runs bears

resemblance to bank runs as modeled by Diamond and Dybvig (1983). Shadow banks are subject to runs because assets have longer maturities than liabilities and tend to be less liquid as well. In a run, shadow banking entities have to sell assets at a discount, which depresses market pricing. Martin, Skeie, and von Thadden (2012) provide a model for a run in repo markets. In their model, repo borrowers face constraints due to the scarcity of collateral and the liquidity of collateral. Under sufficiently adverse conditions, self-fulfilling runs can occur. Duarte and Eisenbach (2013) quantify repo runs and find large systemic effects.

Another source of financial stability risk emanating from shadow banking is related to the perception of tail risk. Misperceived tail risk matters for monetary policy as it impacts estimates of downside risk to real activity and inflation. An early paper warning of the financial system's exposure to such tail risk was presented by Rajan (2005) who asked whether financial innovation had made the world riskier. Rajan (2006) later notes that financial intermediaries have incentives to show superior performance in periods when financing is ample, which leads them to take on tail risk. Shadow banking activity is often tailored to take advantage of mispriced tail risk, making the shadow banking system particularly sensitive to tail events. Such tail risk might be mispriced ex-ante, either due to irrational or due to rational reasons. Gennaioli, Shleifer, and Vishny (2013) posit that actors neglect risk based on behavioral evidence. When investors systematically ignore the worst state of the world, overinvestment and overpricing during the boom and excessive collapse of real activity and the financial sector during the bust are generic features of shadow credit intermediation. Coval, Jurek, and Stafford (2009) point out that the AAA tranches of private label asset backed securities behave like catastrophe bonds that load on a systemic risk state. Neglected risk also manifests itself through over-reliance on credit ratings by investors. For example, Ashcraft, Goldsmith-Pinkham, Hull, Vickery (2011) document that subprime MBS prices are more sensitive to ratings than ex post performance, suggesting that funding is excessively sensitive to credit ratings relative to informational content. Merrill, Nadauld, Strahan (2014) show that life insurance companies exposed to unrealized losses from low interest rates in the early 2000s increased their holdings of highly rated securitized assets, assets which offered higher yield per unit of required capital. The results are only evident in accounts subject to capital requirements and at firms with low levels of ex ante capital.

Chodorow-Reich (2014) investigates the impact of monetary policy during and since the financial crisis on the tradeoff between financial conditions and financial stability by focusing on the behavior of financial institutions. He documents that the accommodative policy led to a rise in asset values that reduced market-based default risk measures for bank holding companies and life insurers, thus helping to stabilize the financial sector. In terms of testing for reach for yield, Chodorow-Reich documents for money market funds that the interaction of low nominal interest rates and administrative costs forced the funds to waive fees; funds with higher costs reached for higher returns in 2009-11, but not thereafter. Chodorow-Reich also shows that private defined benefit pension funds with shorter duration of liabilities or worse funding status increased their risk taking beginning in 2009, but that such behavior largely dissipated by 2012. However, he does not relate behavior to whether the funds have target returns that exceeded current market rates.

D. Nonfinancial Sector

The balance sheet channel is a standard transmission channel for monetary policy, which emphasizes the impact of policy on the net worth of borrowers (the seminal contribution by Bernanke and Gertler (1989) was further extended by Kiyotaki and Moore (1997), and Bernanke, Gertler and Gilchrist (1999)). Empirical evidence on the balance sheet channel, often referred to as the "financial accelerator," is extensive. For example, Levin, Natalucci, and Zakrajsek (2004) find a sharp rise in external finance premiums for businesses during the 2001 recession, and Iacoviello (2005) shows changes in home equity affects household borrowing and spending by more than a conventional wealth effect. The literature generally finds that large shocks are needed for the accelerator to matter. Furthermore, in the financial crisis of 2007-09, borrower balance sheet frictions alone were not sufficient to explain the large observed amplification. As a result, the literature has been evolving to combine borrower frictions with additional frictions, such as financial constraints of lenders, or asset price bubbles.

Financial Stability

Increases in net worth will increase access to credit, but frictions in financing markets could lead to excessive debt growth that increases the likelihood that borrowers will default. Lorenzoni (2008) generates excessive borrowing ex ante and excess volatility in investment ex post, due in part to limited ability to commit to future payments. Borrowers have limited access to outside funds, so when hit by bad shocks, they are forced to fire sell assets. Inefficiencies arise because borrowers do not consider the general equilibrium of fire sales on asset prices. Korinek and Simsek (2014) in a model of deleveraging, show that borrowers do not take into account the negative externalities of leverage on aggregate demand, which leads to excessive leverage. In their model, tight monetary policy could be used to address aggregate demand externalities caused by leverage.

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 a systemic financial crisis 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.

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, likely due to an increase in the supply of credit, is a strong predictor of recession severity. Mian and Sufi (2012) suggest that lower demand driven by the deterioration in household balance sheets is responsible for a large share of job losses during 2007-09. For businesses, insurance companies' reach for yield behavior coincides with greater bond issuance by riskier firms, suggesting ex post greater systematic risk and volatility (Becker and Ivashina, 2013). In addition, businesses that default or violate loan covenants as net worth declines are forced to cut back on

investment and employees, potentially amplifying the initial declines in spending if cutbacks are widespread (Opler and Titman, 1994; Chava and Roberts, 2008; Falato and Liang, 2013).

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 (He and Krishnamurthy, 2012c, Brunnermeier and Sannikov, 2012)

4. Financial Stability Considerations for Monetary and Macroprudential Policies

We have reviewed papers where in periods of economic expansions, accommodative monetary policy can lead to buildups in financial vulnerabilities and increase risks to financial stability. However, since tightening monetary policy to reduce vulnerabilities could have undesirable consequences for macroeconomic activity, we turn next to the question of what macroprudential tools could be used. In this section, we review papers that focus on the use of macroprudential tools, and interactions of macroprudential and monetary policy to mitigate asset overvaluations, rapid credit growth, and excess leverage and maturity transformation.

There are a variety of macroprudential tools that could be used, depending on the type of vulnerability and in which sector of the financial system vulnerabilities occur. A categorization by the Committee on the Global Financial System (2012) includes countercyclical capital buffers, sectoral capital requirements, countercyclical liquidity requirements, margins and haircuts, and LTVs and DTIs. However, some of these countercyclical tools are new and most of the other tools have not been used widely; thus their effectiveness in mitigating vulnerabilities is unknown. An empirical study by Kuttner and Shim (2012) of the use of macroprudential tools in 57 countries from 1980 to 2012 identifies the use of sectoral risk weights, exposure limits, loss provisioning, LTVs, and DTIs. They find that LTVs and exposure limits can mitigate increases in house prices, and DTIs can reduce credit growth. Kuttner and Shim (2012) document 662 actions, but about one-third were used by only five countries, so their findings may not be applicable broadly, given the diversity of financial systems across countries.

Macroprudential policies can tilt the risk-return tradeoff for monetary policy by pre-emptively lowering vulnerabilities of the financial system. Supervisory and regulatory tools can target the stability of individual institutions or if there are externalities, aimed at the stability of the system as a whole. For example, short-term funding fragilities can be addressed partly by removing the first-mover advantage in the fixed net asset value of money market mutual funds; and risk shifting by insufficiently capitalized banks that leads to lower quality loans can be addressed by increasing capital requirements. Such structural macroprudential policies can be considered to be set exogenously for monetary policy, as they typically do not vary with the business cycle. In contrast, cyclical macroprudential policies may adjust endogenously with monetary policy. A simple approach to the interaction between cyclical

macroprudential policy and monetary policy would be to think of them as being separable, invoking the Tinbergen principle. The argument goes as follows: Monetary policy should narrowly focus on macroeconomic objectives, i.e. the inflation-real activity trade off. Conditional on the stance of monetary policy, macroprudential policy would be used to mitigate vulnerabilities to achieve an acceptable level of systemic risk.

However, this argument overlooks two important interactions between macroprudential and monetary policies.[6] On the one hand, cyclical macroprudential policies do not only impact vulnerabilities, but also financial conditions, thus influencing the stance of monetary policy. For example, if loose monetary policy causes reach for yield behavior, which could motivate tighter macroprudential policy tools, such as a higher countercyclical capital buffer, the higher capital requirement would not only counteract the reach for yield vulnerability, but would tighten financial conditions in a way similar to monetary policy tightening. A second interaction arises because of shadow banking. Macroprudential policies imposed on the regulated sector could generate potentially sizable regulatory arbitrage responses, pushing intermediation to shadow banking, which could offset the tightening at regulated firms, leaving unclear the net effect on financial conditions.

As a result of the interactions between macroprudential and monetary policy transmission, and the interdependencies between the risk-return and inflation-real activity tradeoffs when the economy is expanding, monetary and macroprudential policies should be considered jointly. Decisions to implement policies require policy makers to assess 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 pre-emptive macroprudential 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 of a build up invulnerabilities with systemic consequences. Potential policies vary widely in their costs of implementation: Increased supervisory scrutiny targeted to specific firms and activities, communications by authorities, or public recommendations by financial stability coordinating or decision bodies (such as FSOC in the U.S. or the FPC in the U.K.) to regulators, financial institutions, or market participations are relatively inexpensive actions. At the other end of the cost spectrum, a countercyclical capital buffer could imply significant capital raising and international cooperation, and monetary policy would affect all risk taking.

The interdependence between macroprudential and monetary policy has been examined by Farhi and Tirole (2009, 2012). In their setting, financial intermediaries make private choices about leverage and maturity transformation, taking into account anticipated monetary policy responses. Loose interest rate policies increase the likelihood of future crises because they provide incentives for greater maturity mismatch because central banks ex ante cannot commit not to inject liquidity after a crash, leading to excessive risk taking in the aggregate. Farhi and Tirole (2012) argue that pre-emptive macroprudential policies, such as limits on short-term debt that mitigate excessive valuations due to risk taking would increase welfare.

[6] The International Monetary Policy Fund (2013) proposes a complementary discussion of the interaction between monetary and macroprudential policies.

More broadly, a theory of the interdepence of macroprudential, fiscal, and monetary policies is provided by Brunnermeier and Sannikov (2011, 2014). Their I-Theory stresses the importance of spillover effects that link price stability, financial stability, and fiscal stability, and the difficulties of separation of the stability concepts. For example, financial instability prompts financial intermediaries to shrink their balance sheets and create less inside money. Consequently the money multiplier collapses and Fisher deflation pressure emerges. This increases the real value of banks' liabilities and worsens financial instability. Also monetary policy redistributes wealth to the ailing sector by changing the relative value between government debt and money in order to stabilize the overall economy.

Of course, the consideration of both financial conditions and financial stability in the conduct of monetary policy is not without possible costs. Firstly, monetary policy tightening can result in risk shifting incentives for intermediaries, leading them to take on more, not less risk (Landier, Thesmar, Sraer, 2011). Furthermore, without clear priorities, incentive problems between price stability and financial stability could arise (Smets, 2013). For example, ex post monetary policy easing in a credit bust to inflate away some of the debt overhang could generate an inflation bias. If there are political pressures not to lean too hard, or to not engage in credit allocation, policy makers have incentives to use monetary policy ex post, which can then risk price stability.

In the remainder of this section, we discuss considerations for the use of monetary policy and macroprudential policy to address financial vulnerabilities in the four sectors considered in the previous section: asset markets, the banking sector, the shadow banking system, and the nonfinancial sector. Table 3 summarizes existing macroprudential tools for each of these sectors.

A. Asset Markets

Macroprudential tools that can be used to mitigate risks from overvalued assets, such as poor quality loans and mortgages, include tightening underwriting standards such as LTVs and DTIs, to the extent the debt is originated or distributed through firms subject to prudential regulations. Other tools include countercyclical capital buffers, or higher risk weights or sectoral capital buffers for regulated firms. In addition, if asset prices are being fueled by leverage, standards could be tightened on implicit leverage through securitization or other risk transformations, or by limiting the debt provided to investors in either unsecured or secured funding markets by raising margins and haircuts.

Empirical evidence of the effectiveness of macroprudential tools on asset prices is scarce, and limited to effects on house prices. Kuttner and Shim (2012) find that LTVs and exposure limits at financial institutions may help to reduce house price growth, using a sample of actions in 57 countries. Looking at recent specific cases, the use of LTV limits combined with other actions in Hong Kong, Korea, and Canada may have mitigated some growth in house prices.

Bernanke and Gertler (1999) analyze the extent to which monetary policy should react to asset valuations. Bernanke and Gertler argue that monetary policy should target inflation flexibly and take asset prices into account only to the extent that they impact the inflation-activity tradeoff. Some have accepted Bernanke and Gertler's view with respect to equity market bubbles, as the burst of the late 1990's tech bubble, which was not fueled by credit provision by leveraged financial institutions,

appeared to be successfully offset with changes in the stance of monetary policy. Others have moved from this view. For example, Christiano, Ilutz, Motto, and Rostagno (2010) document that stock market booms tend to be accompanied by low inflation. As a result, interest rate rules that focus narrowly on inflation targets will destabilize asset markets and the broader economy. Interest rate rules should thus be adjusted for asset valuations, for example by allowing an independent role for credit growth, to reduce the volatility of output and asset prices.

Gilchrist and Zakrajšek (2011, 2012) study monetary policy rules that augment the Taylor rule with a credit spread. Gilchrist and Zakrajšek use a new New Keynesian model—augmented with the standard Bernanke, Gertler, Gilchrist (1999) financial accelerator mechanism—which is capable of producing the dynamics of the U.S. economy during the recent financial crisis. The benefits of a monetary policy rule that incorporates credit spreads arise as asset prices anticipate the beneficial effects of such a rule in mitigating the financial frictions. In a calibration of the model to U.S. data, the spread-augmented policy rule dampens the negative consequences of financial disruptions on real economic activity, while engendering only a modest increase in inflation.

There is some empirical evidence suggesting that monetary policy in the U.S. does take the price of risk into account. Bekaert and Hoerva (2013) estimate a Taylor rule that is augmented with measures of financial market risk and uncertainty. They decompose equity-implied volatility as measured by the VIX into a risk and an uncertainty component and find that Taylor rule residuals are particularly strongly correlated with the uncertainty component of the VIX. Adrian, Moench, and Shin (2009) estimate a "macro risk premium" from a GDP tracking portfolio. In a reduced form vector autoregression, Adrian, Moench and Shin find that monetary policy shocks significantly impact the macro risk premium, which in turn significantly forecasts real activity. Furthermore, the fed funds target depends significantly on the macro risk premium, even after taking account of inflation and output.

There is a strong case for pre-emptive monetary policy action to reduce over-valuation in credit and housing markets as these assets are closely intertwined with the leverage and risk taking of the financial and the nonfinancial sectors. Still there needs to be some evaluation of whether monetary policy would be effective, given the financial frictions such as asymmetric information or mismeasurement of tail risks that lead to overvaluations, and whether other macroprudential tools can be pre-emptive or can mitigate risk of fallout. Dokko et al (2009) show that deviations from the Taylor rule explain only a small part of the rise in house prices in the U.S. leading up to the financial crisis. Kuttner and Shim (2013) show for a cross-section of 57 countries that low short-term interest rates contribute to house price increases and credit growth, but cannot account fully for the booms and busts.

B. Banking Sector

Macroprudential tools that could offset excessive risk taking in banking include the new Basel III 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 banks better equipped to withstand large adverse shocks. A release of the countercyclical capital buffer in a downturn would

mitigate pressures for banks to deleverage, thus mitigating the potentially adverse amplification of forced deleveraging during an economic downturn. 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. 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.

Other policy tools include supervisory guidance and stress tests. 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, in practice working to offset pro-cyclicality inherent in capital regulations (Liang, 2013). Stress tests can also highlight potential salient risks, such as a sharp rise in term premiums when interest rates have been low for an extended period. However, because excessive tightening of prudential regulations for banks can be expected to push financial intermediation into the shadow banking system, especially when the pricing of risk is low, macroprudential policies aimed at SIFIs should be complemented by prudential policies for the shadow banking system.

Rigorous analysis of macroprudential tools in the presence of banking frictions within equilibrium models is rapidly developing. For example, Kiley and Sim (2012) examine a setting where banks face an external finance premium. Modigliani-Miller is assumed to fail so that debt is cheaper than equity and outside equity is the most expensive form of funding. The key friction in Kiley and Sim is the pecuniary fire sale externality across banks, reflecting bank balance sheet problems. Kiley and Sim evaluate policies to lean against credit growth, against asset prices, and against loan spreads. In particular, they analyze a pro-cyclical capital buffer (interpreted as a tax on leverage) aimed at closing the gap between private and social costs of bank debt. In their setting policies for loan spreads work best. While Kiley and Sim feature a monetary policy rule, they do not look at the interaction of the monetary policy rule with the macroprudential instruments.

The prior to the 2007-09 financial crisis, the monetarist view that that inflation was always and everywhere a monetary phenomenon had been largely replaced by New Keynesian theories where money and credit played little role (see Woodford, 1998). However, even prior to the crisis, Christiano, Motto, Rostagno (2006) argued that monetary policy which focuses narrowly on inflation may inadvertently contribute to welfare reducing boom-bust cycles in real and financial variables.[7] The authors showed that a policy of monetary tightening when credit growth is strong can mitigate such problems. The New Keynesian literature following the financial crisis has focused on incorporating financial vulnerabilities into monetary policy models. Gertler and Kiyotaki (2011) develop a canonical framework to analyze credit market frictions and aggregate economic activity in the context of the 2007-09 crisis, augmenting Bernanke and Gertler (1989) and Bernanke, Gertler, Gilchrist (1999) with a financial sector. Gertler and Kiyotaki (2013) add a banking sector that features bank net worth and

[7] See Adrian and Shin (2006) and Gertler (2006) for related arguments.

liquidity mismatch, which gives rise to bank runs, as in Diamond and Dybvig (1983). Woodford (2010) proposes a Keynesian IS-LM model augmented with financial intermediary frictions, based on Curdia and Woodford (2010). In that setting, the financial intermediation friction gives rise to a state variable in addition to inflation and real activity. That state variable can be mapped into credit spreads (loan less policy rate), which in turn enters into the optimal monetary policy rule. Optimal policy is thus explicitly dependent on credit supply conditions. Woodford (2011) studies optimal monetary policy in a setting with financial crises and finds that inflation targeting rules should consider explicitly the possibility of financial crises.

Gambacorta and Signoretti (2014) examine the performance of augmented Taylor rules that adjust the policy rate in response to asset prices and credit indicators, comparing them to more standard rules with flexible inflation targeting. They also use the setting of Curdia and Woodford (2010), and additionally analyze the impact of high household leverage and a risk taking channel. Gambacorta and Signoretti's key result is that even if financial stability is not an explicit target for monetary policy, monetary policy rules that enhance financial stability are desirable in the presence of supply shocks. This is because financial frictions through borrower balance sheets and credit supply affect the trade-offs faced by monetary policy. In particular, pre-emptive monetary policy enhances welfare.

While the first order effect of the risk taking channel of monetary policy is that tighter policy reduces risk taking, there is a secondary effect that goes in the opposite direction. Tighter monetary policy might bring institutions closer to the default boundary, resulting in risk shifting incentives. This has been documented by Landier, Sraer, Thesmar (2011) for the subprime crisis. In particular, Landier, Sraer and Thesmar investigate the lending behavior of New Century Financial Corporation, a large subprime lender in the run-up to the 2007-09 crisis. As the Fed began tightening rates in 2004, the increase in rates led to a large, adverse shock in the value of the loan portfolio that New Century held for investment purposes. New Century reacted to this loss to the value of its assets by lowering underwriting standards and issuing deferred amortization mortgages. These loans were riskier, and more sensitive to housing valuations, substantially increasing risk taking. New Century's shareholders thus gambled for resurrection, as their equity value was low, and their risk taking incentives (due to limited liability) were large.

The potential presence of gambling for resurrection in the face of rising rates has important implications for the conduct of monetary policy, as it suggests that increases in rates following prolonged periods of low rates can generate the perverse effect where tighter rates lead to increased risk taking, going against the traditional mechanism of the bank lending channel. In fact, in the U.S., the worst subprime mortgages were originated between 2005 and 2007, while the Fed was already tightening. The presence of risk-shifting incentives suggests that 1) macroprudential policy is a preferred tool, and 2) tightening should occur early. A theoretical setting that studies this second order risk shifting effect is presented by Dell'Ariccia and Marquez (2013) and Dell'Ariccia, Laeven, Marquez (2014). While risk shifting is theoretically possible in that setting, it is usually dominated by the first order effect which links rising rates to lower risk taking, when capital constraints are not binding. However, in practice, under certain conditions such as when capital is constrained, the risk shifting effect might be the dominant one.

C. Shadow Banking

Regulatory capital and accounting rules in the pre-crisis period had created significant incentives for banks to shift assets off balance sheet into shadow bank special purpose entities (SPEs). Since then, bank regulatory and accounting reforms have been adopted to restrict regulatory arbitrage. For example, Basel III reforms have increased the capital charge for providing explicit support to shadow banks, assuming a higher drawdown rate under the LCR for credit and liquidity facilities, and the Financial Accounting Standards Board adopted new rules that require sponsors to consolidate many previously off-balance-sheet transactions. These reforms should help reduce shadow banking that is done for the purpose of regulatory arbitrage. That said, more stringent banking regulations could also increase incentives to move some activities away from banks, especially if demand for credit or for cash-like assets strengthens.

Macroprudential policy tools that affect shadow banking are not well defined, and are very heterogeneous across entities and activities. Adrian (2014) reviews financial stability policies for the shadow banking system, pointing out that the nature of policies differ widely across shadow banking activities. While shadow banking activities are often regulated for market conduct and market functioning, most shadow banking entities and activities are not subject to prudential regulation. As a result, the availability of macroprudential policies for shadow banking is limited, though there is an international effort underway to improve shadow banking regulation.[8]

One possible tool to address pro-cyclical incentives in secured funding markets, such as repo and sec lending, is minimum standards for haircut practices, to limit the extent to which haircuts would be reduced in benign markets. Margins and haircuts effectively set the maximum amount of leverage that borrowers can take on. Margins and haircuts are set by exchanges, clearing houses, brokers-dealers, and in repo transactions. In practice, 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.

Goodhart, Kashyap, Tsomocos, Vardoulakis (2012, 2013) consider the impact of margin constraints on shadow banks, capital and liquidity requirements on banks, and loan-to-value limits on borrowers in a dynamic equilibrium setting. The presence of a shadow banking sector generates fire sale externalities on the banking sector and the household sectors, as haircuts tend to rise in times of stress. Limiting shadow bank leverage by setting margins pre-emptively can mitigate this fire sale externality, but comes at the cost of reduced credit intermediation in the boom. Goodhart et al do not

[8] 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.

find countercyclical capital requirements on banks to be particularly useful at preempting systemic risk in the presence of shadow bank intermediaries, as the shadow banking system can arbitrage the increased capital requirement. However, the joint usage of countercyclical capital requirements and countercyclical margin setting can be more effective. A constraint on the effectiveness of capital policies is the fact that collateral values are increasing in asset price booms, making capital constraints ineffective as preemptive tool, though they are still useful as a prudential instrument. For pre-emptive purposes, Goodhart et al find liquidity requirements to be more effective in constraining risk taking. However, the tightness of liquidity requirements is tightly linked to the stance of monetary policy, and safe asset availability more generally.

The currently limited availability of macroprudential policy tools for the shadow banking system, and the large share of credit intermediation in the shadow banking system leaves monetary policy as an important instrument. Stein (2012) studies monetary policy in the presence of shadow bank intermediation. In Stein's setting, shadow bank intermediaries create money-like short term debt. Due to an externality, shadow banks issue too much short term debt, creating excess vulnerability to financial crises. Stein points out that balance sheet policies of the central bank can be a useful complement to open market operations, as balance sheet policies affect the value to the shadow banking system of issuing short term debt, and hence regulate the magnitude of excess vulnerability in the shadow banking system.

D. Nonfinancial Sector

Macroprudential tools to address emerging imbalances in the nonfinancial sector aim primarily at improving underwriting standards. For example, increasing loan-to-value (LTV) ratios or debt-to-income (DTI) ratios on mortgages can limit the exposures of households and businesses to a collapse in prices, thereby bolstering their resilience. Goodhart et al (2012) study LTV limits in conjunction with capital and liquidity regulations. In their model, LTV tools are relatively ineffective in the presence of asset price booms. One reason is that as the rise in asset prices boost collateral values, it becomes relatively easier to satisfy LTV constraints.

Kuttner and Shim (2013) provide evidence based on a cross-section of 57 countries that limits on debt service-to-income ratios can help to restrain housing credit, thereby moderating the cycle, while LTVs are less successful at restraining credit growth since credit can increase with real estate values. In the U.S., there is some evidence that the use of LTVs and maturity caps in the early 1950s, as imposed by the Federal Reserve Board, were effective in reducing housing starts, but Congress removed that authority, partly reflecting uneasiness with the Fed targeting particular types of credit growth (Elliott, Feldberg, and Lehnert, 2013).

Because of significant differences across countries in financial system structures that could change the effectiveness of macroprudential tools, it will be instructive to examine case studies. In recent years, a number of countries have increased loan-to-value ratios on residential mortgages to limit an increase in exposures of households to a collapse in prices, and to lean against rising real estate prices. For example, Hong Kong has increased LTVs multiple times on residential mortgages in the past

decade to mitigate the house price boom. As prices have continued to rise, they have also "stress-tested" borrowers for resilience to increases in interest rates. Korea imposed LTV and DTI limits on households, which appears to have reduced mortgage loans, housing transactions, and house prices in the six months after implementation. The Bank of Israel took several steps between 2009 and 2011 to rein in a housing boom, including a supplementary reserve requirement for banks' mortgage loans with high LTVs, increased capital requirements for mortgages with floating rates and high LTVs, and restricting the adjustable interest rate component of mortgage loans. Canada has employed a mix of LTV and DTI restrictions, in addition to maturity caps and mortgage insurance limits, to restrain a build-up in household leverage and house prices.

The role for monetary policy to reduce leverage in the nonfinancial sector is unclear, as is the combined effects of higher rates on the nonfinancial sector and the financial sector. Korinek and Simsek (2014) consider a setting where borrowers do not take the negative aggregate demand externality of leverage into account, resulting in excessive risk taking. Monetary policy is constrained at the zero lower bound, giving rise to a shortfall in aggregate demand. Debt limits (or mandatory insurance) can improve welfare. An interesting result of their model is that it highlights different possible effects for monetary policy. The conventional view to mitigate a buildup in leverage would be to raise interest rates. However, a rise in rates could prompt a recession, and borrowers may want to borrow even more to smooth consumption. In addition a rise in rates transfers wealth from borrowers to savers, providing another incentive to borrow. Thus, Korinek and Simsek (2014) find macroprudential policies to be more efficient than monetary policies for reducing excessive leverage. Efficiency requires setting a wedge between borrowers' and lenders' relative incentives to hold bonds, whereas interest rate policies create a different inter-temporal wedge that affects all incentives equally.

5. Conclusion

The stance of monetary policy is transmitted to the real economy via multiple channels. In asset markets, the pure expectations channel is complemented by the risk-taking channel, which operates via changes in the pricing of risk. Risk taking is conducted in asset markets, by the banking sector, the shadow banking system, and nonfinancial sectors. As financial intermediation has become increasingly market based, the risk-taking channel has become more important, particularly in the shadow banking system. When the economy is close to potential, the risk taking associated with expansionary monetary policy tends to cause the buildup of vulnerabilities that can generate systemic financial crises when adverse shocks hit.

Macroprudential policies are the first order defense against such buildups of vulnerabilities. However, macroprudential policies only impact a limited set of financial institutions due to shadow banking, have limited international reach, and are potentially subject to long implementation lags. Monetary policy, on the other hand, impacts funding conditions for all intermediaries, almost immediately, and has some global reach.

If monetary policy takes financial vulnerabilities into account, it would not imply that macroeconomic and macroprudential objectives are necessarily in conflict. For example, during the recovery phase following a recession or crisis, macroeconomic objectives are likely aligned with macroprudential objectives as inflation and real activity tend to be suppressed at the same time as risk taking in the financial sector is low. Similarly, in a crisis, expansionary monetary policy that increases risk taking might be beneficial to financial stability. At other times a conflict might arise if inflation remains at target, real activity is close to potential, but financial vulnerabilities are building as risk appetite and asset valuations become elevated. In the latter scenario, conditional on the stance of macroprudential policy, a relatively tighter monetary policy might be chosen than one implied by a simple Taylor rule, as estimates of downside risk to future outcomes will have increased due to the buildup of these vulnerabilities.

When financial vulnerabilities increase downward tail risk, these tail risks may not only depend on the current output gap, but also additional state variables. For example Stein (2014) has recently argued that estimated credit risk premia provide valuable information about the amount of tail risk, while Kocherlakota (2014) has argued that monetary policy should take financial vulnerabilities into account once estimated future tail risk is beyond a threshold. Dudley (2010) argues that monetary policy should take asset bubbles into account to the extent that they are associated with excessive leverage. Woodford (2010) also uses variables such as credit spreads as additional variables in a Taylor rule, while Gambarcorta and Signoretti (2014) argue that indicators of financial sector leverage should directly enter into an augmented Taylor rule. We note again that financial stability objectives are compatible with the dual mandate as the buildup of financial vulnerability increases tail risks to inflation and real activity mandates.

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Data Sources

Variable:	Real federal funds rate
Units:	Percent
Source:	Federal Reserve Board, BLS
Data Conversion:	Raw data is monthly, converted to quarterly using EOP values
Notes:	The effective federal funds rate minus CPI inflation (year-over-year percentage change) for all items, less food and energy (Haver: YPCUSLFE@USECON)

Variable:	Taylor Residuals
Units:	Percent
Source:	Federal Reserve Board, Bureau of Economic Analysis, Haver Analytics
Data Conversion:	Raw data is monthly, converted to quarterly using EOP values
Notes:	Difference between federal funds target rate and the hypothetical target implied by the Taylor (1993) rule, using output gap and PCE inflation (Haver: FTRULE1@USECON)

Variable:	Risk Neutral Yield
Units:	Percent
Source:	Federal Reserve Bank of New York
Data Conversion:	Raw data is monthly, converted to quarterly using EOP values
Notes:	Risk neutral expectation component of yields based on the Adrian, Crump, Moench (2013) term structure model and calculated by the NY Fed

Variable:	Equity Risk Premium
Units:	Percent
Source:	Federal Reserve Bank of New York
Data Conversion:	Raw data is monthly, converted to quarterly using EOP values
Notes:	First principal component of 29 equity risk premium models reported by Duarte and Rosa (2013) calculated at the NY Fed

Variable:	Term Premium
Units:	Percent
Source:	Federal Reserve Bank of New York
Data Conversion:	Raw data is monthly, converted to quarterly using EOP values
Notes:	Based on the Adrian, Crump, Moench (2013) term structure model and calculated by the NY Fed

Variable:	Broker Dealer Net Leverage
Units:	Ratio
Source:	Flow of Funds (Z.1 Release)
Notes:	Security brokers and dealers, Ratio of total financial assets to equity capital

Variable:	Net Short Term Debt of Financial Sector to GDP
Units:	Ratio
Source:	Flow of Funds (Z.1 Release)
Notes:	Net short-term wholesale debt of financial sector to GDP, FOF Z.1 Items: ((fof'FL703069175.Q + fof'FL703067005.Q) - (fof'FL703135005.Q +fof'FL702150005.Q + fof'FL763178005.Q + fof'FL704110005.Q)) /(us'gdp.q*1000))*100

Tables and Figures

Table 1. Monitoring Vulnerabilities in Different Sectors (Adrian, Covitz, Liang 2013)

	Price of risk	Leverage	Maturity/ liquidity transformation	Interconnections and complexity
(1) Asset markets	Risk premiums and non-price terms in equities, credit, real estate Term premiums for rates	Investor leverage	Dealer-based finance Carry trades Mutual funds ETFs	Derivatives and counterparties
(2) Banking sector	Risk taking in credit and rates Underwriting standards SLOOS	Regulatory capital ratios, banks and broker-dealers Market measures of risk and capital Post-stress capital from stress tests	Financial firm liabilities, maturities Secured and unsecured funding	Systemic risk measures Intra-financial assets and liabilities Common asset holdings, correlated risks Size, critical functions, TBTF
(3) Shadow banks, Financial markets	Securities issuance Underwriting standards SCOOS	Securitization tranches Regulatory capital arbitrage Hedge funds Use of derivatives to mimic leverage	Agency REITs ABCP conduits Repo markets Sec lending MMFs STIFs	CCPs New financial products
(4) Nonfinancial sector	Underwriting standards (LTVs, DTIs)	Debt-to-GDP Leverage and debt service burdens of households, business, and government	Use of short-term or floating rate debt	

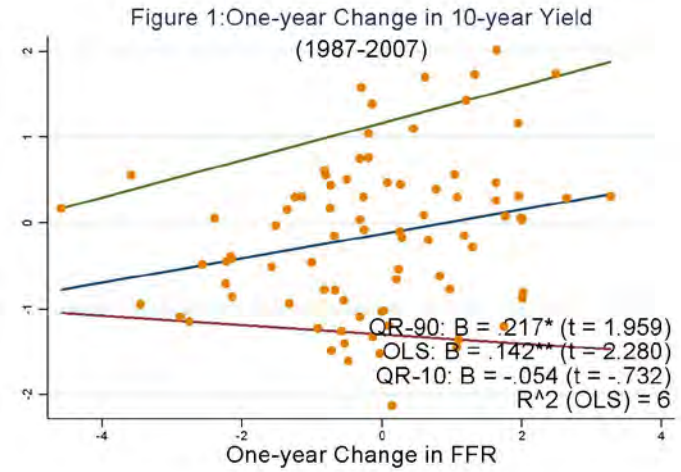
Table 2. Monetary Policy Transmission on Financial Conditions and Financial Stability in Different Sectors

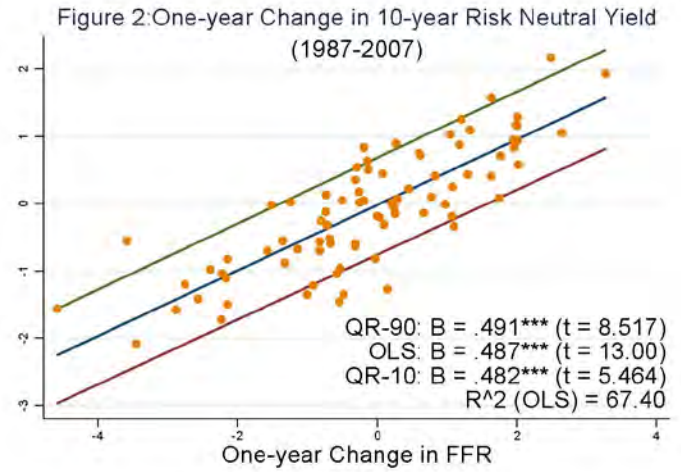
	Financial conditions	**Financial stability**
(1) Asset markets	Risk free term structure Higher asset prices Lower risk premiums	Compressed risk premiums • Reach for yield because of nominal targets • Supported by leverage from an external finance premium, asymmetric information • Asset managers that prefer yield income or are evaluated based on relative performance Low volatility and low risk premiums • Procyclical risk management practices • Mismeasurement of risk
(2) Banking sector	Credit channel	Pro-cyclical leverage of banks and dealers • Procyclical risk management practices and inflated collateral values Risk-shifting channel reduces the quality of credit • Low bank capital
(3) Shadow banking	Securitization Liquidity creation Maturity transformation by nonbank intermediaries	Pro-cyclical dealer intermediated leverage • Procyclical risk management practices and inflated Excessive maturity transformation • Short-term funding fragilities Regulatory arbitrage
(4) Nonfinancial sector	Borrowing conditions Balance sheet channel Credit growth (credit/GDP)	Deterioration in underwriting standards Excess leverage • Fire sale externalities • Negative demand externalities

Table 3. Macroprudential Policy Tools in Different Sectors

	Financial stability	**Macroprudential Tools**
(1) Asset markets	Compressed risk premiums • Reach for yield because of nominal targets • Supported by leverage from an external finance premium, asymmetric information • Asset managers that prefer yield income or are evaluated based on relative performance Low volatility and low risk premiums • Procyclical risk management practices • Mismeasurement of risk	Underwriting standards for debt, like LTVs and DTIs Sectoral risk weights at banks Countercyclical capital or liquidity buffers Margins and haircuts Limits on short-term collateralized funding
(2) Banking sector	Pro-cyclical leverage of banks and dealers • Procyclical risk management practices and inflated collateral values Risk-shifting channel reduces the quality of credit • Low bank capital	Higher capital and liquidity requirements Countercyclical capital and liquidity requirements Sectoral risk weights Supervisory guidance, exposure limits Supervisory stress tests
(3) Shadow banking	Pro-cyclical dealer intermediated leverage • Procyclical risk management practices and inflated Excessive maturity transformation • Short-term funding fragilities Regulatory arbitrage	Monitor for regulatory arbitrage and reduce regulatory and accounting incentives to move activities from regulated sector Higher minimum haircuts or margins Tighter standards on securitizations
(4) Nonfinancial sector	Deterioration in underwriting standards Excess leverage • Fire sale externalities • Negative demand externalities	Limits on underwriting standards, such as LTVs and DTIs Limits on adjustable rate loans for borrowers, stress test borrowers for rising rates

Exhibit
Monetary Policy and Financial Conditions





Monetary Policy and Financial Stability