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Monetary Policy and Bank Risk Taking

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I. INTRODUCTION

Part of the blame for the current global financial crisis has fallen, justly or not, on monetary policy. The story goes more or less like this: persistently low real interest rates fueled a boom in asset prices and securitized credit and led financial institutions to take on increasing risk and leverage. Had central banks preempted this buildup of risk by raising interest rates earlier and more aggressively, the consequences of the burst would have been much less severe.[1]

This claim has become increasingly popular in both academia and the business press, partly because the crisis occurred in the wake of a prolonged period of exceptionally low interest rates and lax liquidity conditions. However, little empirical evidence has been presented to back it up. And theory has had surprisingly little to offer on the subject. Few macroeconomic models have explicitly considered the impact of policy rates on bank risk taking. And models of bank risk taking have yet to incorporate the effects of monetary policy.

Yet the question of how monetary policy affects bank risk taking (defined as choices that increase the volatility of bank profits) is key to the current debate over what role financial stability considerations should play in monetary policy decisions and how best to integrate the macroprudential and monetary policy frameworks. Is there a policy trade-off between price stability and financial stability, or can a single policy instrument achieve both at the same time? Put differently, are monetary and macroprudential policies complements or substitutes? And, consequently, what should the relationship between monetary and macroprudential authorities be?

This paper contributes to the debate by showing that (under reasonable assumptions) the relationship between the monetary policy stance and bank risk taking is more complex than generally believed. Most of the debate so far has focused on how monetary policy easing can induce greater risk taking through a search for yield or its effects on leverage and asset prices, a view this paper broadly supports. But, at least in the short run, there is also an opposite risk-shifting effect when financial intermediaries operate with limited liability. The balance, then, depends on financial intermediaries' degree of limited liability and financial health. When the policy rate is low, high-charter-value (well-capitalized) banks increase risk taking; low-charter-value (poorly capitalized) banks do the opposite.

Preliminary empirical evidence broadly supports the prediction that a low policy rate is associated with greater risk taking. But it also lends some support to the notion that this

[1] See, for example, Taylor (2007) and Borio and Zhu (2008).

relationship depends on the health of the banking system. The implication for policy design (should these findings be confirmed) is that the response of the macroprudential authorities to changes in the monetary policy stance will have to take into account variables determining the financial health of the banking system.

Two important caveats must precede the details of our analysis. First, in what follows, we approximate monetary policy with changes in the real yield on safe assets. The effects of monetary policy regimes and the interaction of the monetary policy stance with the real cycle in determining risk taking are discussed where possible. But they are mostly left to future research. Second, we refrain from assessing the ex ante optimality of risk choices (i.e., whether bank risk taking is excessive or not).[2] Banks financing marginally riskier projects at lower interest rates may well be a socially optimal and even desirable outcome of monetary policy during recessions.

The paper proceeds in three steps. First, it discusses different mechanisms through which monetary policy can affect risk taking. Second, it examines a growing empirical literature on the subject and presents some new stylized facts from U.S. data. Finally, it draws some tentative policy implications from its findings.

II. CONCEPTUAL FRAMEWORK

So far, theoretical models have not explicitly studied the effects of monetary policy on bank risk taking. The macro literature has typically been interested in the *quantity* rather than the *quality* of credit and has not developed models that incorporate bank risk taking. (Papers that consider risk focus primarily on how changes in the monetary policy stance affect the riskiness of borrowers rather than the risk attitude of the banking system).[3] The banking literature has typically focused on how to correct market failures stemming from limited liability and asymmetric information and essentially ignored monetary policy.[4]

Yet these two separate literatures both contain insights into the link between monetary policy and risk taking. In this section, we review what these models have to say

[2] For a first attempt at modeling such trade-offs, see Agur and Demertzis (2010).

[3] The literature on financial accelerators posits that monetary policy tightening leads to more severe agency problems, by depressing borrowers' net worth (e.g., Bernanke, Gertler, and Gilchrist, 1996). The result is a flight to quality. Firms more affected by agency problems will find it harder to obtain external financing. However, this says little about the riskiness of the marginal borrower that obtains financing because monetary tightening increases agency problems across the board, not just for firms that are intrinsically more affected by agency problems.

[4] A few recent exceptions have focused on the role of monetary bailouts rather than on the effects of changes in interest rates (for example, Farhi and Tirole, 2009, and Diamond and Rajan, 2009).

about the issue at hand and explain some of the mechanisms at work using a simple conceptual framework, drawing on formal models developed in De Nicolò (2010), Dell'Ariccia, Laeven, and Marquez (2010), and Valencia (2010). We cast our analysis of these models against a background in which changes in the monetary policy rate affect the real risk-free rate.[5] More precisely, we define monetary policy simply as an exogenous change in the policy rate and bank risk taking as actions that increase the volatility of return on banks assets, such as an increase in credit risk.

A. Portfolio Effects and the Search for Yield

Most of the mechanisms proposed so far in the literature point to a negative relationship between the policy rate and risk. Put differently, they suggest that monetary easing promotes risk taking. This is not surprising given that the most severe financial crisis since the Great Depression occurred in the wake of a prolonged period of exceptionally easy monetary conditions. The arguments in support of this thesis can be broadly grouped under three headings: asset substitution, search for yield, and procyclical leverage.

The asset substitution argument goes as follows. Under relatively general conditions, a lower real yield on safe assets will lead to a decrease in their weight in bank portfolios. Risk-neutral banks will increase their demand for risky assets—hence, in aggregate, reducing their yield—until in equilibrium returns on both types of investments are again equalized. Risk-averse agents will generally reallocate their portfolios in a similar fashion under most utility functions (however, agents with decreasing absolute risk aversion will instead decrease their holdings of risky assets).[6]

A related mechanism operates through a "search for yield." Financial institutions with long-term commitments (such as pension funds and insurance companies) need to match the yield they promised on their liabilities with what they obtain on their assets (Rajan, 2005). When interest rates are high, they can generate the necessary revenue by investing in safe assets. When they are low, they are forced to invest in riskier assets to continue to match the yield on their liabilities (assuming a positive pass-through between the policy rate and the yield on longer-term safe assets). If yields on safe assets remain low for a prolonged period, continued investment in safe assets will likely mean that a financial institution will need to renegotiate (or default on) its long-term commitments. A switch to riskier assets (and higher yields) may increase the probability that it will be able to match its obligations. Managerial compensation linked to absolute yields plays a similar role: the higher the yields on safe

[5] For a taxonomy of traditional mechanisms of monetary policy, see Mishkin (1996).

[6] See, for example, Fishburn and Porter (1976) for conditions under which income effects could dominate these asset substitution effects.

assets, the larger the compensation a manager can obtain by playing it safe and, thus, the lower the incentives for managers to invest in risky assets.

A complementary view is the leverage channel advanced by Adrian and Shin (2009). They assume that financial institutions target constant (in the case of commercial banks) or procyclical (in the case of investment banks) leverage ratios. When faced with shocks to their portfolios or profits, banks react by buying or selling assets rather than by distributing dividends or raising new capital.[7] Strictly speaking, their analysis does not focus on the quality of bank portfolios, but it has implications for bank risk taking. Monetary policy easing will boost assets prices. Bank equity will increase and banks will respond to the fall in leverage by increasing their demand for assets. This reaction reinforces the initial boost to asset values, and so on. The result is a more fragile banking system that is more exposed to negative shocks to asset values and thus riskier.[8]

B. Limited Liability and Risk Shifting

Banks operating under asymmetric information and limited liability will tend to take more risk than is socially optimal. Risk-neutral leveraged banks behave like risk-loving agents, since they do not internalize the losses they impose on depositors and bondholders. At the risk of oversimplifying, a leveraged bank will prefer a risky investment that yields a higher private payoff in case of positive outcomes—but involves large losses for depositors in case of failure—to a more prudent investment that generates a higher net present value (Keeley, 1990). Asymmetric information is key to generating this result. If investors were able to correctly price the bank's risk taking at the margin, the incentive to invest in an excessively risky portfolio would disappear. The higher private yield of riskier investments would be compensated by the higher cost of the bank's liabilities. However, since investors cannot observe the bank's portfolio, and the bank cannot commit to prudent behavior, excess risk taking occurs even when, in equilibrium, the bank's liabilities are priced correctly (that is, even in the absence of deposit insurance).[9]

This moral hazard problem is one of the main rationales for prudential banking regulation in the form of capital requirements. The more of its own capital the bank has

[7] This effect has been associated with a bank capital channel in the literature (e.g., Van den Heuvel, 2007).

[8] Similarly, Acharya and Naqvi (2010) study banks' incentives to take risks when asset prices influence market liquidity. They argue that contractionary monetary policy can curb risk-taking incentives at times of excessive bank liquidity and that expansionary monetary policy should be used at times of scarce liquidity to boost investment.

[9] When deposits are fully protected by deposit insurance, the supply of deposits will not depend on bank risk (see Keeley, 1990).

invested, the more prudently it will invest.[10] This is because of a "skin-in-the-game" effect: the more the bank has to lose in case of failure, the less severe the moral hazard problem.[11] A similar skin-in-the-game effect arises from a bank's franchise value (the net present value of the bank's future profits). A bank with a high franchise value has a lot to lose and little incentive to take excessive risk, whereas a zombie bank (one whose losses are close to or exceed future profits) will be willing to take great risks to gamble for resurrection.[12]

The effect of interest rate changes on bank profits (and thus franchise value) is one of the channels through which monetary policy may affect bank risk taking. Typically, banks transform short-term loanable funds such as deposits into longer-term loans. It follows that a cut in the policy rate (the real yield on safe assets) will increase intermediation spreads and, thus, the value of bank assets and future profits (this will happen whenever the aggregate demand for loans is negatively sloped), which will lessen moral hazard and reduce bank risk taking.[13]

In more formal frameworks of this channel developed by De Nicolò (2010) and Dell'Ariccia, Laeven, and Marquez (2010), a reduction in the policy rate leads to lower deposit rates, which, because of a negatively sloped demand for loans, are only partially passed through to lending rates. This in turn increases the bank's profits in the event of positive outcomes and reduces risk taking. To provide an intuition for this effect it is helpful to consider a fully leveraged bank (one financed entirely through deposits). A policy rate cut will increase the bank's expected net return on all assets by lowering the rate it has to pay on deposits. But this increase will be disproportionately larger for safer assets, since the bank's investment in these assets means a higher probability that it will have to repay depositors. It follows that a reduction in the policy rate makes riskier assets relatively less attractive.

Finally, monetary policy could also affect risk taking through the expectation of a strong policy response to negative shocks. This mechanism has recently gained prominence

[10] Risk-weighted capital ratios will provide further incentives by pricing risk taking at the margin.

[11] Alternatively, increasing shareholder liability would also reduce risk taking by forcing shareholders to bear a greater proportion of the costs associated with negative outcomes (see Esty, 1998, for evidence of such a relationship based on historical data during 1863–1935, when U.S. bank regulators imposed double liability—a form of contingent liability—on bank shareholders to discourage risk taking. Under this system, shareholders were doubly liable in that they could lose both the market value of their shares and, through assessment, an amount equal to the par value of equity to cover creditor obligations, including deposits and other debt).

[12] Note that, at least in theory, regulatory capital and franchise value can push in opposite directions. Since capital is costly, an increase in capital requirements will reduce future profits and thus a bank's franchise value (see Hellmann, Murdock, and Stiglitz, 2000).

[13] This assumption is supported by broad empirical evidence (e.g., Den Haan, Sumner, and Yamashiro, 2007).

and is often referred to as the "Greenspan put" (also known as the "Bernanke put"). If agents expect the central bank to cut rates aggressively when a shock threatens the stability of the system, they will tend to assume greater risk.[14] Proponents of this mechanism have largely focused on the reaction function of the central bank rather than the level of the policy rate. Indeed, it is the implicit promise of lower rates (should they be needed), rather than low rates themselves, that cause this collective moral hazard. Yet the level of the policy rate does have implications for the magnitude of this effect. But they run contrary to what is typically argued: to the extent that there is greater room for monetary stimulus when rates are high than when they are low, higher rates will correspond to greater risk taking. Essentially, an easy stance reduces the collective moral hazard problem by shrinking the room for further monetary expansion.

C. Balancing Opposite Forces

The discussion above suggests that the way monetary policy affects bank risk taking will depend on the many factors that affect the balance between the two main countervailing forces at play: portfolio reallocation and risk shifting. It follows that the effect of a change in the policy rate may not be uniform across time, banking systems, or individual banks. Simplifying again, since the driver of the risk-shifting effect is limited liability, this force will be stronger for weaker banks (for which the downside protection offered by limited liability is most valuable). In contrast, when a bank's capital is relatively high (leverage is low), the bank will behave like an institution without limited liability protection, and the portfolio effect will likely prevail. Then, the net effect of monetary policy changes will depend on the relative health of a country's banking system. In tranquil times, when most banks' charter values and capitalization are high, an easy monetary policy stance will induce greater risk taking. But the opposite may happen when banks are under stress.[15]

The analysis is complicated further if we allow for bank charter values (or leverage) and market shares to be endogenously determined and dependent on monetary conditions, as would occur in a dynamic setup (see De Nicolò, 2010, for a formal presentation of this extension). This leads low-charter-value banks to disappear over time, so that a negative relationship between the policy rate and bank risk taking prevails. Similarly, models that endogenize bank leverage typically find leverage to be decreasing with the monetary policy

[14] See Farhi and Tirole (2009) for a formal model delivering this prediction. Similarly, Diamond and Rajan (2009) show that when banks anticipate interest rates will be lowered to bail them out, they will take on more liquidity risk.

[15] In De Nicolò (2010), this result is obtained by comparing the effects of monetary policy in systems with high and low charter values.

rate.[16] And, again, over the medium term, the negative relationship between the policy rate and bank risk taking is likely to prevail.

These results lend themselves to a natural interpretation. In the short term, when capital cannot be adjusted easily, the aggregate effect of monetary policy on bank risk taking will depend on banks' degree of skin in the game. For example, when the proportion of banks with high capital (low leverage) is sufficiently large, the model predicts a negative relationship between the policy rate and bank risk taking. However, when the proportion of banks with low capital (high leverage) is sufficiently large, a positive relationship between the policy rate and bank risk taking prevails, implying that monetary loosening would reduce risk taking.

In the medium to long term, banks will endogenously adjust their capital so that a negative relationship between monetary policy and bank risk taking prevails.[17] This is because banks will raise new capital following monetary tightening that compresses intermediation spreads and reduces profits to restore capital to its optimal level. As banks increase their capital, bank risk declines.

III. Empirical Evidence

In the previous section, we illustrated how a link between monetary policy and bank risk taking can be established. We now turn to empirical evidence to gauge the net effect of monetary policy shocks on bank risk taking.[18] We first conduct a simple empirical analysis of how measures of ex ante bank risk taking—based either on survey data or financial statement data—vary around changes in the monetary policy stance. To test the conclusions in the previous section, we allow results to vary according to the degree of capitalization of the banking system. We then contrast what we learn from this simple exercise with a review of the (admittedly scant) literature in which more extensive tests have been conducted. There we focus on papers that have a bearing for the riskiness of banks, and in particular on those that make predictions about the quality of bank lending.

A. Evidence from U.S. Lending Surveys

We start with an analysis of how the terms of business lending vary around changes in the monetary policy stance.

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[16] See Adrian and Shin (2009) and Dell'Ariccia, Laeven, and Marquez (2010).

[17] For a dynamic model that considers the implications of endogenous capital for the link between monetary policy and bank risk, see Valencia (2010).

[18] It is worth reiterating that neither the simple framework presented here, nor the empirical evidence we bring to bear allows us to make concrete statements in terms of the economic efficiency of bank risk taking.

The Federal Reserve conducts a quarterly survey on the terms of business lending of a stratified sample of about 400 banks. The survey asks participating banks about the terms of all commercial and industrial loans issued during the first full business week of the middle month in every quarter. The publicly available version of this survey encompasses an aggregate version of the terms of business lending, disaggregated by types of banks.

Figure 1 shows two measures (from the survey) that can be associated with ex ante borrower risk: the average internal risk rating assigned to loans by the bank and the average relative spread between loan rates and the effective federal funds rate. These measures are plotted against the real effective federal funds rate, computed as the difference between the effective federal funds rate and the consumer price index (CPI) inflation rate.[19] The effective federal funds rate is a volume-weighted average of rates on trades arranged by major brokers and calculated daily by the Federal Reserve Bank of New York using data provided by the brokers.

The simple patterns plotted in the figure offer broad support for a negative association between the monetary policy rate and ex ante risk taking. Both the average internal risk rating by banks and the spread over the federal funds rate decline as money tightens. The correlation of these two variables with the real federal funds rate is –0.72 and –0.65, respectively (significant at the 1 percent level).

We run simple ordinary least squares (OLS) regressions using quarterly data over the period 1997–2008 to examine the robustness of these results (Table 1). We add controls for capitalization conditions in the banking sector, recent macroeconomic performance, and expectations of future economic conditions. Specifically, we include an indicator variable denoting whether the banking system's capital-to-assets ratio is low (below its 25th percentile), the one-year lag of real GDP growth, and the median forecast (from the Philadelphia Fed's survey of professional forecasters) of the probability that GDP will decline the following year. One reason for controlling for macroeconomic performance is that when the economy is weaker, and therefore any given loan is riskier, the real funds rate is typically lower. During such times, one would expect banks' loans to be riskier not because banks are choosing to hold a riskier portfolio of loans, but because the set of loans available for them to choose among has shifted toward riskier loans. We also include an interaction between the real interest rate variable and a variable denoting whether or not the bank has a low level of capitalization to gauge the differential effect of low capital (high leverage).

[19] We obtain similar results when using Taylor residuals following Taylor (1995) or when adjusting for inflation by subtracting one-year-ahead inflation expectations taken from the Reuters/University of Michigan Survey of Consumers.

Results for the level effects confirm the intuition from Figure 1: real interest rates are negatively associated with the two ex ante measures of bank risk taking.[20] At the same time, and consistent with the predictions from our analysis, the negative effect of the policy rate on risk taking is less pronounced when bank capital is low. In the case of bank spreads, the association with the real funds rate even turns positive when bank capital is low.[21]

B. Evidence from U.S. Call Reports

A caveat for the analysis above is that it deals only with new loans and thus offers little information about banks' overall risk. Here we examine the impact of changes in real interest rates on the overall riskiness of banks' asset portfolios.

Most U.S. commercial banks and bank holding companies file quarterly financial statements, known as Call Report filings. The advantage of this bank-level data set is its high level of disaggregation, allowing for the control of unobserved time-invariant bank characteristics, such as a bank's business model. As a measure of bank risk we use the ratio of the bank's risk-weighted assets to total assets. Risk-weighted assets are defined as the weighted average of different bank assets, where the weights denote increasing riskiness that is guided by bank regulation. For instance, highly rated government securities, such as U.S. treasuries, command a risk weight of zero, whereas most unsecured household loans command a risk weight of 100 percent.

We run simple OLS regressions with bank fixed effects and the ratio of risk-weighted assets to total assets as the dependent variable. As independent variables of interest we include the real federal funds rate and the bank's leverage ratio, measured as 1 minus the ratio of bank equity to total assets. In alternative specifications, we add an interaction between the real interest rate and bank leverage variables and replace the bank leverage variable with a variable denoting low capital (a capital ratio lower than its 25th percentile), to assess the differential impact of a low level of bank capitalization. Regressions also control for recent macroeconomic performance and expectations of future economic conditions using the one-year lag of real GDP growth and the median forecast of the probability that GDP will decline the following year.

[20] A more formal study of the terms of business lending is conducted in Lang and Nakamura (1995) and Asea and Blomberg (1998). They find that the share of risky bank loans, defined as those made above prime to presumably riskier or harder-to-monitor borrowers, drops during recessions.

[21] The economic effect of the result is significant. Based on the spread results, a one standard deviation decrease in real funds rates (equivalent to about 1.8 percent) would imply an increase in bank spreads of 0.28 percentage point when bank capital is high but a reduction in bank spreads of 0.61 percentage point when bank capital is low. These are large effects compared with the standard deviation of the spread variable of 0.34.

Overall, the results are qualitatively similar to those obtained using lending survey data. We find a strong negative relationship between real interest rates and the riskiness of banks' assets. This relationship is less pronounced when bank capital is low, consistent with the prediction from our analysis. However, at least for tranquil times when capital is sufficiently high, the net effect remains negative.[22] We also obtain a negative association between our two ex ante measures of bank risk and real GDP growth, consistent with loans turning riskier when the economy is weaker.

The negative association between monetary policy and ex ante risk taking is confirmed in a simple chart plotting the system's average risk-weighted assets to total assets ratio against the real effective federal funds rate (Figure 2). The risk-shifting effect is likely more important in times of financial distress. Indeed, regressions limited to the 2006–08 period (not reported) support this view (note also the much flatter scatter plot for this subset of observations in Figure 2).

C. A Selective Review of Existing Empirical Literature

A few studies have focused on the behavior of bank lending standards following monetary policy shocks by using loan officer surveys about the strictness of lending criteria on new loans. Generally, these surveys provide information not about the absolute level of strictness, but about whether lending standards have changed relative to the recent past. In this literature, a loosening of lending standards is interpreted as indicative of improved access to credit for low-quality borrowers. Using U.S. data, Lown and Morgan (2006) find that credit standards tend to tighten following a monetary contraction, but results are not statistically significant. However, Maddaloni, Peydró-Alcalde, and Scope (2009) do find a statistically significant loosening of credit standards when overnight rates are lowered. Moreover, using Taylor rule residuals, they find that holding rates low for prolonged periods of time softens lending standards even further.

Jimenez and others (2008) and Ioannidou, Ongena, and Peydró-Alcade (2009) use detailed information on borrower quality from credit registry databases for Europe and Bolivia. They find a positive association between low interest rates at loan origination and the probability of extending loans to borrowers with bad credit history or no history at all (i.e., risky borrowers). They also find that low rates decrease the riskiness of banks' overall loan portfolios. Therefore, holding interest rates low for a short period of time may improve

[22] The economic effect of this result is significant. A one standard deviation decrease in real funds rates (equivalent to about 1.8 percent) would imply an increase in the share of risk-weighted assets in total assets of 1.4 percentage points when bank capital is high compared with a modest increase of 0.6 percentage point when bank capital is low. These are significant effects compared with the standard deviation of the risk-weighted assets variable of 13.0 percent.

the overall quality of banks' loan portfolios, but holding interest rates low for a prolonged period of time could increase loan default risk substantially over the medium term. However, in both papers, the quantitative importance of their results is undetermined.

The finding that the risk of outstanding loan portfolios decreases with monetary easing appears consistent with the charter value hypothesis stating that decreases in real interest rates positively affect banks' profitability—very much like a bank capital shock in the bank capital channel of monetary policy—and thus make banks safer. Banks are maturity transformers, typically with short-term liabilities and long-term assets. It follows that, in the short term, monetary easing will increase their profitability, since the interest rate pass-through is larger for their liabilities than their assets. Put differently, banks will generally benefit from a steepening of the yield curve. This is consistent with results in Altunbas, Gambacorta, and Marquez-Ibañez (2010), who use rating agency estimates of default probabilities as a proxy for risk taking and find that increases in interest rates and negative Taylor rule residuals are positively associated with default risk measures.

The empirical evidence presented by Jimenez and others (2008) and Ioannidou, Ongena, and Peydró-Alcade (2009) could also be interpreted in the context of the balance sheet channel of monetary policy. Micro-evidence on the balance sheet channel focuses on searching for a differentiated response of firms to monetary policy shocks, based on classifying firms according to some indicative criteria of their access to credit. The main conclusion of this literature is that during periods of money tightening or recessions credit flows away from borrowers that are more severely affected by credit market imperfections (e.g., Morgan, 1992; Gertler and Gilchrist, 1994; Bernanke, Gertler, and Gilchrist, 1996; Kashyap and Stein, 2000; and Ashcraft and Campello, 2007).

In sum, recent empirical work testing a link between monetary policy and bank risk taking offers support for the hypothesis that lax monetary policy is associated with higher risk taking, at least for new loans. However, results do not offer conclusive evidence on the precise channels through which monetary policy induces risk taking. Moreover, the quantitative importance of these results and the economic efficiency of risk taking remain open questions.

IV. Concluding Remarks

The view that monetary policy easing induces greater risk taking by banks through a search for yield or its effects on leverage and asset prices has become increasingly popular. This paper broadly supports this view. But it also shows that the relationship between real interest rates and bank risk taking is more complex. The reason is that, at least in the short term, two opposite forces are at work. Portfolio reallocation and search for yield effects imply a negative relationship between the policy rate and risk taking. Risk shifting by banks

protected by limited liability points in the opposite direction. The balance depends on the degree to which banks have skin in the game.

Preliminary empirical evidence is consistent with these predictions. Monetary policy easing will increase risk taking, but less so for poorly capitalized banks. These results imply that the impact of monetary policy on bank risk taking is likely to differ across countries and time and be dependent on local banking market conditions (such as bank leverage and charter values and the contestability of banking markets) and factors that affect these conditions (such as business cycles).

These findings bear on the debate about how to integrate macroprudential regulation into a macroeconomic policy framework to meet the twin objectives of price and financial stability. Whether price and financial stability are substitutes or complements will depend on the types of shocks the economy is facing and on whether portfolio effects or risk shifting are the dominant force at play.

For instance, there may be no trade-off between price and financial stability when an economy nears the peak of a cycle (when banks tend to take more risk and prices are under pressure). Under these conditions, according to the prevalent view based on portfolio effects and to most empirical evidence, monetary tightening will decrease both risk taking and price pressures. In contrast, a trade-off between the two objectives would emerge in an environment with low inflation but "excessive" risk taking (as may happen when asset price or housing bubbles develop). Under these conditions, the policy rate cannot deal with both objectives at the same time: tightening may reduce risk taking, but will lead to an undesired contraction in aggregate activity (and/or to deflation). The opposite trade-off may manifest itself in the wake of a currency crisis, when inflation is on the rise due to a depreciation of the exchange rate and bank capital is depleted. Then, fighting inflation pressure may come at the cost of increased risk taking.

When a trade-off between price and financial stability emerges, macroprudential measures can complement monetary policy and fine-tune its stance by acting in a discriminatory fashion on selected sectors of the economy (IMF, 2010). As articulated by Blanchard, Dell'Ariccia, and Mauro (2009), the policy rate is likely to be a weak and costly tool to deal with excessive risk taking. Even if a higher policy rate reduces some excessive risk taking, it is likely to do so at the cost of a larger output gap.[23] Regulatory policy may be more effective in limiting bank risk taking, either by taxing or restricting financial activities. For example, capital requirements can be raised to reduce leverage, and lending criteria can

[23] Carlstrom, Fuerst, and Paustian (2009) prove this formally in a model with sticky prices, concluding that even in the presence of this trade-off it is more efficient to keep monetary policy focused on inflation.

be tightened to reduce the risk of banks' loan portfolios (e.g., limits on loan-to-value ratios can help curb a house price boom).

If one accepts the notion that the combination of monetary policy and regulation provides an effective set of tools to deal simultaneously with price stability and financial stability, the question of how to make such policy operational remains. Specifically, this raises the issue of how to coordinate monetary and regulatory authorities. Should these be separate entities or should one agency have responsibility for both stability concerns? The potential interaction among banking market conditions, monetary policy decisions, and bank risk taking implied by our analysis can be seen as an argument in favor of the centralization of macroprudential responsibilities within the monetary authority. And the complexity of this interaction points in the same direction.

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Table 1. Monetary Conditions and Bank Risk Taking: Evidence from the U.S. *Terms of Business Lending Survey*

The dependent variables are the weighted average risk rating and the weighted average relative spread over the effective federal funds rate, respectively. Both dependent variables are increasing in risk and are aggregates for all sampled banks (about 400 in total). The real federal funds rate is computed by adjusting the effective federal funds rate with the CPI inflation rate (in percent). Low capital is a dummy variable denoting whether or not the banking system's capital-to-asset ratio is below its 25th percentile. Lagged real GDP growth is the one-year lag of real GDP growth (in percent). The probability of recession corresponds to the median forecast of the probability that GDP will decline one year ahead (in percent), taken from the Philadelphia Fed's survey of professional forecasters. Regressions are estimated using OLS. The sample consists of quarterly data over the period 1997:Q2 to 2008:Q4 from the Federal Reserve Bank's *Terms of Business Lending Survey*. Standard errors are in parentheses. ***, **, and * denote significance at the 1 percent, 5 percent, and 10 percent level, respectively.

Variables	Risk rating	Spread
Real federal funds rate	–0.072**	–0.155***
	(0.012)	(0.018)
Low capital	–0.147	–0.575***
	(0.245)	(0.150)
Real federal funds rate * low capital	0.030	0.174***
	(0.077)	(0.043)
Lagged real GDP growth	–0.012	0.016
	(0.014)	(0.010)
Probability of recession	–0.003	0.019***
	(0.002)	(0.004)
Observations	46	46
R-squared	0.55	0.42

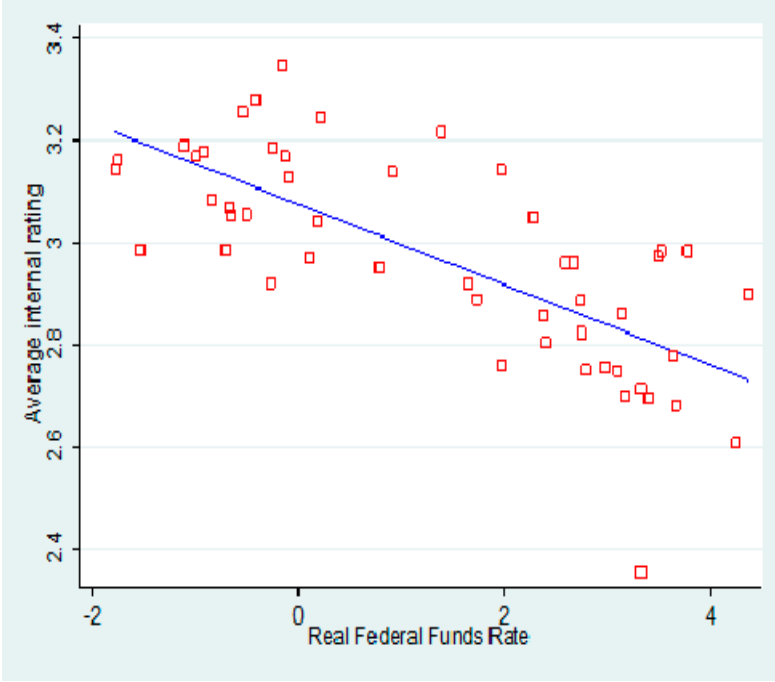
Table 2. Monetary Conditions and Bank Risk Taking: Evidence from U.S. Call Reports

The dependent variable is the risk-weighted assets-to-total-assets ratio. The sample consists of U.S. bank holding companies (BHCs); quarterly data for the period 1986–2008 are from U.S. Call Reports. The real effective federal funds rate is the three-month average effective federal funds rate minus the three-month average change in CPI (in percent). Leverage is 1 minus the equity-to-total-assets ratio of the bank. Low capital is a dummy variable that takes a value of 1 if the equity-capital-to-total assets ratio is below its 25th percentile, and zero otherwise. Lagged real GDP growth is the one-year lag of real GDP growth (in percent). The probability of recession corresponds to the median forecast of the probability that GDP will decline one year ahead (in percent), taken from the Philadelphia Fed's survey of professional forecasters. *Regressions are estimated using OLS and include bank fixed effects.* Standard errors are in parentheses and corrected for clustering at the Federal Open Market Committee date level. ***, **, and * denote significance at the 1 percent, 5 percent, and 10 percent levels, respectively.

Variables	(1)	(2)	(3)	(4)
Real federal funds rate	–0.769***	–0.770***	–1.967***	–0.792***
	(0.182)	(0.182)	(0.577)	(0.180)
Leverage ratio		–0.144***	–0.157***	
		(0.038)	(0.042)	
Real federal funds rate * leverage ratio			1.317*	
			(0.713)	
Low capital				–0.011***
				(0.001)
Real federal funds rate * low capital				0.139***
				(0.041)
Lagged real GDP growth	–0.271	–0.270	–0.270	–0.270
	(0.172)	(0.173)	(0.173)	(0.173)
Probability of recession	–0.039	–0.038	–0.037	–0.038
	(0.076)	(0.076)	(0.076)	(0.076)
Observations	82708	82708	82708	82708
R-squared	0.774	0.774	0.774	0.774
Number of BHCs	3260	3260	3260	3260

Figure 1. Monetary Conditions and Bank Risk Taking: Evidence from the *Terms of Business Lending Survey*

Regression lines depict simple OLS regressions of ex ante bank risk measures and the real federal funds rate for all banks. The dependent variables are the weighted average relative lending spread over the effective federal funds rate and the weighted average risk rating, respectively. Both dependent variables are increasing in risk. Risk measures are based on quarterly data over the period 1997:Q2 to 2008:Q4 and are taken from the U.S. Federal Reserve Bank's *Terms of Business Lending Survey*.



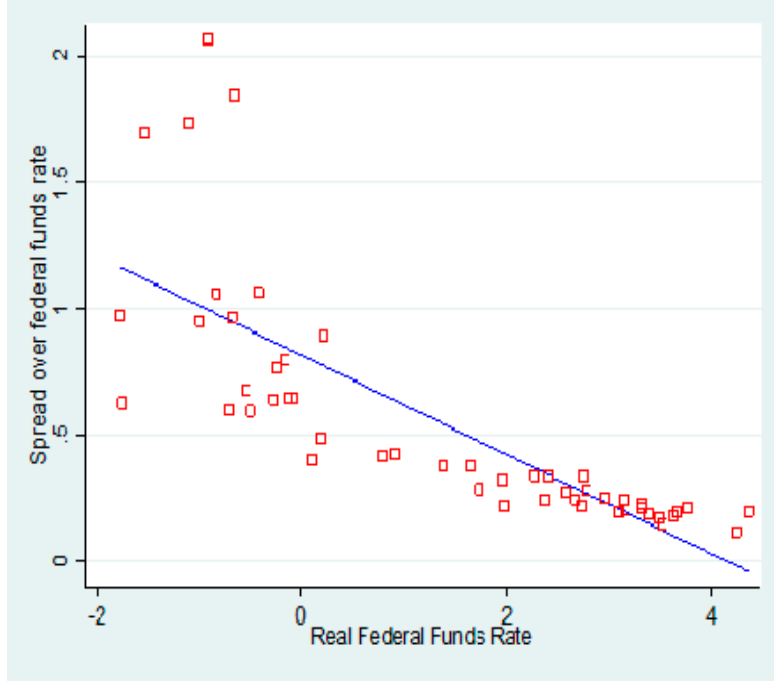


Figure 2. Monetary Conditions and Bank Risk Taking: Evidence from U.S. Call Reports

The regression line depicts an OLS regression of the quarterly average ratio of risk-weighted assets to total assets across U.S. bank holding companies (BHCs) on the real federal funds rate for U.S. banks. The sample consists of quarterly data from U.S. Call Reports over the period 1986–2008. The real effective federal funds rate is the three-month average effective federal funds rate minus the three-month average change in CPI (in percent). Quarterly observations during the period 2006–08 are encircled by an ellipse.