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Abstract

In an investigation of banks' loan pricing policies in the United States over the past two decades, this study finds supporting evidence for the bank risk-taking channel of monetary policy. We show that banks charge lower spreads when they lend to riskier borrowers *relative* to the spreads they charge on loans to safer borrowers in periods of low short-term rates compared to periods of high short-term rates. The interest discount that banks offer riskier borrowers when short-term rates are low is robust to borrower-, loan-, and bank-specific factors as well as to macroeconomic factors known to affect loan rates. The discount is also robust to bank-firm fixed effects. Finally, our tests that build on the micro information banks provide on their lending standards in the Senior Loan Officers Opinion Survey suggest the interest rate discount that riskier borrowers receive when short-term rates are low is bank driven.

JEL classification: G21
Bank classification: Financial institutions; Monetary policy framework

Résumé

L'étude des politiques de tarification des prêts suivies par les banques américaines ces vingt dernières années tend à accréditer l'hypothèse voulant que la politique monétaire influe sur la prise de risque des institutions financières. Les auteurs montrent en effet que lorsque les taux d'intérêt à court terme sont bas, les marges que les banques appliquent à leurs prêts aux emprunteurs à risque diminuent par rapport à celles imposées aux autres emprunteurs. Ce rabais d'intérêt persiste même si l'on tient compte des caractéristiques des emprunteurs, des prêts et des banques, de l'état de la conjoncture macroéconomique et des effets fixes propres aux banques ou aux entreprises. Enfin, les tests réalisés par les auteurs à partir des microdonnées que les banques fournissent sur leurs critères de prêt dans le cours de l'enquête auprès des responsables du crédit indiquent que les rabais d'intérêt consentis aux emprunteurs à risque en contexte de bas taux d'intérêt sont déterminés par l'appétit des banques pour le risque.

Classification JEL : G21
Classification de la Banque : Institutions financières; Cadre de la politique monétaire

1 Introduction

Early theories of the bank lending channel of monetary policy were met with a good deal of skepticism. As the number of studies of the bank lending channel grew larger over time, a consensus began to emerge that monetary policy can have an effect on the availability of bank credit. Recent claims that monetary policy could affect financial intermediaries' risk-taking incentives were also received with some skepticism. In this paper, we attempt to contribute to the debate on the existence of a bank risk-taking channel of monetary policy by investigating whether the stance of monetary policy in the United States over the past two decades affected the loan pricing policies of banks.

The link between monetary policy and banks' risk-taking incentives is absent from the theoretical literature. The macro literature, which has typically been interested in the link between the stance of monetary policy and the availability of bank credit, has not developed models that incorporate bank risk-taking incentives. The banking literature, in contrast, has investigated banks' risk-taking incentives, but has not considered the effects of monetary policy.

The so-called risk-taking channel of monetary policy has received wide attention in the wake of the latest financial crisis, following claims that the accommodative policies of the Federal Reserve spurred risk-taking among financial intermediaries.[1] Low interest rates can lead banks to take on more risk for a number of different reasons. They may cause banks to take risky investments in "search for yield" (Rajan (2006)). Financial institutions often enter into long-term contracts committing them to produce high nominal rates of return. In a period of low interest rates, these contractual rates may exceed the yields available on safe assets. To earn excess returns, banks may turn to risky assets.[2]

Low interest rates may also lead to more bank risk-taking through the effect they have on valuations. With increasing asset and collateral values, banks' perception of risk, including their risk estimates, may decline leading to more risk taking. In addition, because volatility tends to decrease when prices go up, this effect will release risk budgets of financial institutions and possibly lead to yet more risk taking. According to Adrian and Shin (2009) low short-term rates may lead to more risk-taking because they improve banks' profitability and relax their budgetary constraints. When short-term rates and term spreads are negatively related (as in the United States), continued low short-term rates will imply a steep term spread and higher net interest margin for some time in the future, resulting in an increase in the risk-taking

[1]See Borio and Zhu (2008), Brunnermeier (2009), and Diamond and Rajan (2009).

[2]A similar mechanism could be in place if managers' pay is benchmarked to past targets set up in times of high interest rates or if investors use short-term returns as a way of judging manager competence and withdraw funds after poor performance (Shleifer and Vishny (1997)).

capacity of the banking sector.[3]

Low interest rates may lead to more bank risk-taking for yet other reasons. Dell′Ariccia and Marquez (2009) point out that low interest rates reduce adverse selection in credit markets and thus decrease banks' incentives for screening loan application. Investors become less risk-averse during economic expansions because their consumption increases relative to normal levels. If low interest rates increase real economic activity, investors will have less risk aversion. Akerlof and Shiller (2009), in turn, suggest that, due to monetary illusion in periods of low interest rates, investors take higher risks to increase returns.

In contrast to the theoretical literature, several empirical studies have already examined the link between monetary policy and banks' risk taking incentives. Altunbas et al. (2010) find evidence of a link between low interest rates for protracted periods and bank risk, as captured by banks' expected default frequencies, based on data for 600 European and U.S. listed banks. Using data from the Spanish Credit Register, Jimenez et al. (2007) document that low interest rates lead banks to soften their lending standards and lend more to borrowers with bad credit histories. Ioannidou et al. (2009) document that Bolivian banks increased the number of risky loans and reduced the rates they charged risky borrowers relative to the rates for less risky ones when the Bolivian peso was pegged to the U.S. dollar and short-term rates were at a low level in the United States. Finally, using information from bank-lending surveys for the Euro Area and the Unites States, Peydro and Maddaloni (2011) document that in periods of low short-term rates banks soften their lending standards.

In this paper, we consider a novel approach to investigating the bank risk-taking channel of monetary policy. We use detailed information on loans extended by banks over the 1990–2010 period in the United States. For each loan, we observe the date of initiation and maturity, amount, interest rate, purpose and type of the loan, and information on its covenants. We complement this data with information about the originating bank (e.g., size, capital ratio, charge-offs, liquid assets, and the like) and information about the borrower (e.g., size, leverage, tangible assets, profitability, stock returns, and volatility). Using this data, we begin by investigating whether banks' loan pricing policies vary with the monetary policy stance. Specifically, we investigate if banks offer an interest rate discount to riskier borrowers in periods of low short-term interest rates relative to the rates they charge safer borrowers.

This part of our paper is closer to Ioannidou et al. (2009), but it differs from them in many important respects. They use banks' loan pricing policies to gauge the effect of monetary policy on banks' risk-taking incentives in Bolivia. We investigate instead banks' loan pricing policies in the Unites States. Their key measure of loan risk is the hazard rate which is the

[3] The term spread drives the profitability of the marginal loan (because banks borrow short term to fund long-term loans) and that profitability in turn affects the future net interest margin of the bank.

probability that the loan defaults in the current period conditional on survival until that period. We focus instead on the market-based, and thus forward-looking, probability of default of the borrower. We control for loan-, bank- and borrower-specific characteristics. They too control for loan- and bank-specific characteristics, but for confidentiality reasons are unable to control for borrower-specific characteristics. Since borrowers may be both balance-sheet constrained and bank dependent (Gertler and Gilchrist (1994)) any analysis based either on firm-level or on bank-level data suffers from an omitted-variable problem. For that reason, it is important to use *individual loan-level* information *together with* bank and firm characteristics.

We begin by documenting that banks charge lower spreads to riskier borrowers *relative* to the spreads they charge on loans to safer borrowers in periods of low short-term rates, controlling for a large set of borrower-, loan- and bank-specific factors as well as a set of macroeconomic factors known to play a role in loan rates. Periods of low or high short-term rates correspond to periods when the federal funds target rate is below or above the sample median. We find that in periods when short-term rates are high the percentage difference between the spread banks charge on their loans to borrowers rated below investment grade and the spread charged to borrowers rated investment grade is 117 percent. In periods when short-term rates are low that difference shrinks to only 87 percent.

The interest rate discount that banks "offer" below investment grade borrowers may derive from banks' increased risk appetite when short-term rates are low, but it may also derive from a differential impact of short-term rates on borrowers' risk, which is not properly captured in their credit rating. To address this concern, we reestimate our test focusing instead on the borrower's probability of default. Since this is a market-based, and thus a forward-looking, measure of risk, it should account for any effect that short-term rates may have on the borrower's risk of default. We continue to find that when short-term rates are low, banks demand relatively lower spreads on their loans to riskier borrowers than on their loans to safer ones. One percent increase in the probability of default leads to a 188 percent increase in loan spreads in the period when the interest rates are high, but it leads to only to 148 percent higher spreads when the short-term interest rates are low.

This finding is consistent with the existence of a bank risk-taking channel of monetary policy, but it may also derive from other explanations that are not directly related to bank risk-taking as defined in this paper. To isolate (unobservable) effects of supply on loan interest rates, we control for bank fixed effects. This approach takes care of time-invariant bank factors, but it does not account for unobservable changes in the pool of borrowers across different monetary policy regimes. For this reason, we show that our finding also holds when we control for bank-firm fixed effects. In this case, we compare loan spreads for the same borrower and bank under different economic and monetary conditions. To the extent that the correlation between credit supply and credit demand is due to endogenous matching between lenders and borrowers, including bank-firm fixed effects should account for it.

Bank-firm fixed effects account for time-invariant unobservable factors that could drive loan spreads, but they will not control for time-variant factors, including those related to demand. For example, in times of expansionary monetary policy the external finance premium declines because low interest rates induce an increase in a borrower's cash flows, net worth and collateral values. To the extent that the decrease in the external finance premium is relatively higher for risky borrowers, they would be charged relatively less in periods of easy monetary policy. Another challenge to the identification of the bank risk-taking channel derives from the potential effect of economic cycles.[4] To the extent that economic and monetary policy cycles are overlapping, economic conditions may alone explain our results. We design several tests to address concerns with these alternative explanations for our findings.

To address the possibility that the economic cycle drives our results, we find that the interactive effect of monetary policy and probability of default on loan spreads continues to hold when we also account for the interactive effect of economic growth and probability of default. Since loans originated in low-interest-rate regimes are present in difference phases of the economic cycle, we can identify the separate effects of monetary policy and economic regimes on loan spreads. To further reduce concerns with the economic cycle, we document that U.S. banks offer an interest rate discount when they lend to riskier Canadian borrowers (relative to the rates they charge safer Canadian borrowers) in periods of low interest rates in the United States as compared to periods of high interest rates in the Unites States.

To confirm that our findings are driven by banks' risk appetite and do not arise instead from demand factors, we design several tests using the bank-level information banks provide in the Federal Reserve's Senior Loan Officer Opinion Survey (SLOOS). In this regard, our paper shares some similarities with Peydro and Maddaloni (2011) who also rely on data from the SLOOS to investigate the risk-taking channel of monetary policy. However, while they rely on the aggregated information from the publicly available survey, to identify changes in banks' risk preferences, we rely on the disaggregated micro-level version of the survey data.

The SLOOS is instrumental to an investigation of the bank risk-taking channel of monetary policy because several of its questions speak directly to banks' lending standards. The SLOOS also allows us to better isolate the effect of the risk-taking channel of monetary policy from the broad credit channel (bank lending channel and balance sheet channel) of monetary policy.[5] In the broad credit channel, a decrease in interest rates induces an increase

[4]Erel et al. (2012) show that macroeconomic conditions play an important role on firms' decision to raise debt financing. They find that below-grade-rated borrowers raise less debt when market conditions are poor, while the opposite holds for the investment-grade-rated borrowers.

[5]It is well understood that monetary policy affects credit demand, the quality of the pool of borrowers, and

in a borrower's cash flows, net worth and collateral values.[6] Under this channel, banks may increase lending volumes and reduce loan prices because of an improved borrower's risk profile. Hence, to the extent that certain firms experience a greater increase in net worth, a reduction in default probability and consequently better investment opportunities, a decrease in the interest rates may facilitate them to originate relatively larger loan amounts at better terms. While this outcome may be consistent with the risk-taking channel, it is only the effect of the broad credit channel. The former goes beyond the effects of interest rates on borrowers' riskiness and net worth. If this risk-taking channel is at work in times of low interest rates, greater *intrinsic* risk tolerance would be reflected into loan pricing policies. In a way, the risk-taking channel is an amplification mechanism in the broad credit channel. Using SLOOS reassures us that we do not attribute changes in loan pricing policies to the broad lending channel. Having information about the intrinsic risk tolerance of banks is crucial to detect the presence of risk-taking channel of monetary policy.

We begin with the SLOOS' question that asks banks to indicate whether their standards for approving C&I loans were on net easier than their standards in the prior three months. We make such identifications by extracting the residuals from a first-stage model that attempts to explain the bank's SLOOS answer, controlling for its financial condition, the macroeconomic conditions, and the stance of monetary policy. These residuals will correlate with the bank's *intrinsic* willingness to approve loan applications. We then use these residuals in our loan pricing model to investigate whether an increase in the bank's *intrinsic* willingness to approve loan applications has a differential impact on loan spreads of risky borrowers during periods of low short-term versus high short-term rates. The results of this investigation are consistent with our earlier finding: when banks' *intrinsic* willingness to approve loan applications increases, they offer an interest rate discount to riskier borrowers. It is important to note that this discount is higher when short-term rates are low.

We further our investigation by using the information banks provide to another question that is even more pertinent to an investigation of the banks' risk-taking channel. While answering the former question, banks indicate whether they eased their lending standards, but

the volume of supplied credit through the bank lending channel and the broad credit channel. According to the *the bank lending channel* an increase in the policy rate leaves fewer available reserves to banks and thus a bank lending falls. Assuming that some firms cannot costlessly substitute the loss of bank credit with other types of credit, investment spending is expected to decline as well. According to *the broad credit channel,* when interest rates decrease, so does the external finance premium and the price of loans because a borrower's cash, net worth, and collateral values improve. See Bernanke (1983), Bernanke and Blinder (1992), Bernanke and Gertler (1995) and Kashyap and Stein (2000).

[6]Oliner and Rudebisch (1996) find that investment spending is more closely linked to internal funds after a monetary tightening which is due to the higher premium on external funds after a monetary contraction. Conversely, the results show that during episodes of monetary easing, there is no significant change in the link between liquidity and investments.

they do not provide information on the exact reason for doing so. In this follow-up question, banks are asked to indicate whether "increased tolerance for risk" played an important role in their decision to ease lending standards. Using the same two-step approach we described in the previous paragraph, we investigate whether an increase in the bank's *intrinsic* tolerance for risk has a differential impact on loan spreads of risky borrowers during periods of low short term rates. The results of this investigation show that when banks' *intrinsic* risk tolerance increase, they offer an interest rate discount to riskier borrowers. Again, we find that this discount is higher when short-term rates are low.

The results of these two tests provide solid supporting evidence that the effect of short-term rates on banks' risk taking is indeed supply driven. Since this is a critical aspect of any investigation of the bank risk-taking channel of monetary policy, we do one more test also using data from the SLOOS. Banks are asked to indicate whether the demand for C&I loans was stronger, unchanged, or weaker over the past three months. If our results are supply-driven and firm controls effectively capture demand for loans, then we would expect that loan spreads are not sensitive to any information about loan demand. Indeed, the results of this test show that loan spreads are not sensitive to information about loan demand. This result is important for another reason—it can be viewed as a check on the quality of the information banks report in their answers to the SLOOS.

Finally, we present evidence that banks undercut loan spreads when they lend to riskier borrowers in times of *falling* interest rates. Defining monetary policy easing when interest rates are falling for a prolonged time period gives us insight into the role of banks' expectations about easing and tightening in pricing loans.

In sum, our paper provides strong evidence of a bank risk-taking channel of monetary policy in the Unites States. As a result, risky borrowers benefit from an interest rate discount (relative to safe borrowers) when they borrow from banks in periods of easy monetary policy. Our findings are mute about the real effects of the bank risk-taking channel and they silent about the ex ante optimality of the interest rate discount that banks offer riskier borrowers. Our evidence on the existence of a bank risk-taking channel of monetary policy, nonetheless, indicates that policymakers may also want to consider the risk-taking incentives of financial intermediaries when they set the terms of monetary policy.

The remainder of our paper is organized as follows. We discuss the data, empirical strategy and sample characteristics in section 2. In section 3, we examine the impact of the monetary policy regime on loan spreads. In section 4, we report several robustness tests, and in section 5 we present results of our tests that build on the SLOOS data. Section 6 shows evidence of the risk-taking channel when we consider an alternative specification of monetary policy. Section 7 concludes the paper.

2 Data, methodology, and sample characterization

2.1 Data

The data for this project come from several sources, including the Loan Pricing Corporation's Dealscan database (LPC), the stock price data of the Center for Research on Securities Prices (CRSP), Merrill Lynch's bond yield indices, Compustat, the Federal Reserve's Bank Call Reports, and the Federal Reserve's Senior Loan Officer Opinion Survey on bank lending practices.

We use LPC's Dealscan database of business loans to identify the firms that borrowed from banks and when they did so. Most but not all of the loans in this database are syndicated. The database goes as far back as the beginning of the 1980s. In the first part of that decade, the database had a somewhat reduced number of entries, but its comprehensiveness has increased steadily over time. It is for this reason that we begin our sample in 1990. Our sample ends in 2010. We also use the Dealscan database to obtain information on individual loans, including the loan's spread over LIBOR (that is, the London interbank offering rate), maturity, seniority status, purpose and type; information on the borrower, including its sector of activity, and its legal status (private or public firm); and finally, information on the lending syndicate, including the identity and role of the banks in the loan syndicate.

We use Compustat to get information on firms' balance sheets. Even though LPC contains loans from both privately held firms and publicly listed firms, given that Compustat is dominated by publicly held firms, we have to exclude loans to privately held firms from our sample.

We rely on the CRSP database to link companies and subsidiaries that are part of the same firm and to link companies over time that went through mergers, acquisitions or name changes.[7] We then use these links to merge the LPC and Compustat databases to find out the financial condition of the firm at the time it borrowed from banks. We also use CRSP to gather data on the stock prices of the firms in our sample.

We use Merrill Lynch's yield indexes on new long-term industrial bonds to control for changes in the market's credit risk premium. We consider the indexes on yields of triple-A and triple-B rated bonds because these go further back in time than the indexes on the investment-grade and below-grade bonds.

We use the Reports of Condition and Income compiled by the Federal Deposit Insurance Corporation, the Comptroller of the Currency, and the Federal Reserve System to obtain bank data, including capital-to-asset ratio, size, profitability and risk, for the lead bank(s) in each loan syndicate. Wherever possible, we get these data at the bank holding company level using

[7] We adopted a conservative criterion and dropped companies that could not be reasonably linked.

Y9C reports. When these reports are not available, we rely on Call Reports, which have data at the bank level.

Finally, we use the Fed's SLOOS to get information on the lead bank's lending policy at the time of each loan. Since the late 1960s, the Fed has collected information each quarter on loan officers judgments about changes in their banks non-price lending practices.[8] The survey collects information through multiple- or dichotomous-choice questions, that is, respondents must select a response from a list provided. Over the years the survey sample as well as its format has been adjusted several times. In the early years the survey covered at least 121 banks and the Fed conducted the survey through written questionnaires. In May 1981, the sample was cut to 60 large U.S. commercial banks, and the Fed began conducting the survey through telephone interviews with senior loan officers at the sample bank. Over the years, the Fed has added questions to capture the various aspects of banks' lending policies that became relevant, including questions about mortgage lending and consumer loans. However, the part of the survey that is of interest to us as well as the set of banks surveyed remained unchanged during our sample period.

We consider the answers banks provide to the following three questions of the survey. The first question asks whether the bank's credit standards for approving applications for commercial and industrial (C&I) loans were, on net, tighter, easier, or unchanged from three months earlier. The second question asks the bank about the importance of "increased (reduced) tolerance for risk" when it eases (tightens) the terms for C&I loans. Finally, we consider the answers banks provide to the question that asks whether the demand for C&I loans weakened or strengthened (apart from normal seasonal variation) over the past three months.

2.2 Methodology

Our methodology has two parts. The first part investigates whether banks' risk-taking incentives vary with the stance of monetary policy and in particular whether their risk appetite is higher when interest rates are low. To that end, we compare the difference in the loan spreads they charge to risky and to safe borrowers when interest rates are low with the same spread difference when interest rates are high, controlling for a set of factors known to explain loan spreads.

Even though the first part of our methodology controls for a large set of bank factors and focuses on within-bank results, the question may still arise whether differences in spreads indeed capture differences in banks' risk appetite or some omitted factor. To address this concern, in the second part of our methodology we use a two-step procedure. The first step builds on

[8]For further details on the Survey of Senior Loan Officers Opinion, see Schreft and Owens (1991).

bank information on lending standards in the SLOOS to isolate changes in those standards that are likely attributable to unobservable factors related to adopting softer standards. This information is then used in the second step to ascertain whether banks' use of lax lending standards leads to commensurate changes in their loan pricing policies. We describe below in detail the procedures we follow in the two parts of our methodology.

2.2.1 Banks' risk-taking and the monetary policy stance

To ascertain whether banks charge relatively lower loan spreads to riskier borrowers when interest rates are low than when they are high, we investigate the following model of loan spreads:

$$\begin{aligned} L\,LOANSPD_{f,l,b,t} = {} & c + \alpha LOW\ RATE_t + \beta BOR\,RISK_{f,t} \\ & + \gamma LOW\ RATE_t \times BOR\,RISK_{f,t-1} \\ & + \sum_{i=1}^{I} \psi_i X_{i,f,t} + \sum_{j=1}^{J} \nu_j Y_{j,f,t-1} + \sum_{k=1}^{K} \eta_k Z_{k,b,t-1} + \sum_{u=1}^{U} \zeta_u M_{u,t-1} + \epsilon_{f,l,b,t} \end{aligned} \tag{1}$$

$L\,LOANSPD_{f,l,b,t}$ is the natural log of the all-in-drawn spread over LIBOR of loan l to firm f from bank b at issue date t. According to Dealscan, our source of loan data, the all-in-drawn spread is a measure of the overall cost of the loan, expressed as a spread over LIBOR, because it takes into account both one-time and recurring fees associated with the loan.

$LOW\ RATE_t$ is a dummy variable that is equal to one if the federal funds rate at the time of loan origination is below the sample median of the federal funds rate. We have experimented with other cutoff points such as the 30th and 20th percentiles of the federal funds rate distribution. In the robustness tests' section, we also compare banks' loan pricing policies in periods when the federal funds rate is coming down as opposed to periods when it is going up. Banks usually charge lower interest rates on their corporate loans when the federal funds rate is low because of the reduced cost of funding. However, the decline in interest rates may not always accompany the decline in the federal funds rate. As a result, loan spreads may be higher when short-term interest rates are low.

$BOR\,RISK_{f,t-1}$ is a measure of the risk of default of the borrower computed in the quarter prior to the loan. Since banks usually charge higher spreads on loans to borrowers with a higher risk of default, we expect $\beta > 0$. We consider two alternative measures of the borrower's risk of default. The first measure is the credit rating of the borrower. In this case, $BOR\,RISK$ is the dummy variable $BGRADE$, which equals 1 for borrowers rated below investment grade, and $UNRATED$, which equals 1 for unrated borrowers. The omitted category includes the borrowers rated investment grade. Our second measure is a proxy for the borrower's probability of default. In this case, $BOR\,RISK$ is $P\,DEFAULT$, which we measure following Bharath and Shumway (2008)'s "naive" estimate of the firm's probability of default. This is a "simple" implementation of Merton (1974)'s model of corporate bankruptcy.[9]

Our second measure of a borrower's risk of default has two clear advantages over the first one. Not all firms have a credit rating. In contrast, it is possible to compute our naive probability of default for all firms that are publicly listed. Credit ratings, in addition, have been extensively questioned as a forward-looking measure of firm risk. Our naive estimate of the firm's probability of default is more likely a forward-looking measure of the firm's risk of default because it is driven by market information. This feature is particularly important for us because we want to make sure that any differences in loan spreads that banks charge corporate borrowers when interest rates are low do not derive from a potential effect that these interest rates may have on the firm's risk of failure. We have computed all our tests with both measures of risk, but for the reasons we just discussed, we focus on the results when we proxy the borrower's risk of default with $P\,DEFAULT$.

The key variable in our model of loan spreads is the interaction between our proxy for low interest rates and our measure of the borrower's risk of default, $LOW\,RATE \times BOR\,RISK$. If banks do indeed seek to take on more risk when short-term interest rates are low, then we should expect $\gamma < 0$. In other words, banks charge higher spreads to risky borrowers than to safer ones, but this difference shrinks in periods when short-term interest rates are low.

As noted above, in testing this hypothesis we include a number of firm-specific controls Y, loan-specific controls, X, bank-specific controls, Z, and macro factors, M, which may also affect the spreads banks charge on their corporate loans. We begin by discussing the firm-specific variables that we use. Several of these variables are proxies for the risk of the firm. $L\,AGE$ is the log of the firm's age in years. To compute the firm's age, we proxy the firm's year of birth by the year of the initial public offering of its equity. Because older firms are typically better established and therefore less risky, we expect this variable to have a negative effect on the loan spread. $L\,SALES$ is the log of the firm's sales in hundreds of millions of dollars. Given that larger firms are usually better diversified across customers, suppliers, and regions, again we expect this diversification to have a negative effect on the loan spread.

We also include variables that proxy for the risk of the firm's debt rather than that of the overall business. $PROF\,MARGIN$ is the firm's profit margin (net income divided by sales). $L\,INTCOV$ is the firm's interest coverage, which we measure as the log of one plus

[9] This estimate has the virtue of being easier to calculate than more rigorous implementations, and actually outperforms them in predicting actual default probabilities. We give the details of this measure in Appendix 1.

the interest coverage ratio (i.e., earnings before interest, taxes, depreciation, and amortization (EBITDA) divided by interest expense). More profitable firms as well as firms with higher interest coverage have a greater cushion for servicing debt and should therefore pay lower spreads on their loans. $LEVERAGE$ is the firm's leverage ratio (debt over total assets); higher leverage suggests a greater chance of default, which should have a positive effect on spreads.

Another aspect of credit risk is losses to debt holders in the event of default. To capture this risk, we include several variables that measure the size and quality of the asset base that debt holders can draw on in default. $TANGIBLES$ is the firm's tangible assets—inventories plus plant, property, and equipment—as a fraction of total assets. Because tangible assets lose less of their value in default than intangible assets such as brand equity do, we expect this variable to have a negative effect on spreads. $ADVERTISING$ is the firm's advertising expense divided by sales; because this variable proxies for the firm's brand equity, which is intangible, we expect it to have a positive effect on spreads. Similarly, $R\&D$ is the firm's research and development expense divided by sales; because this variable proxies for intellectual capital, which is intangible, and we also expect it to have a positive effect on spreads.[10] NWC is the firm's net working capital (current assets less current liabilities) divided by total debt; given that NWC measures the liquid asset base, which is less likely to lose value in default, we expect it to have a negative effect on spreads. $MKTBOOK$ is the firm's market to book ratio, which proxies for the value the firm is expected to gain by future growth. Although growth opportunities are vulnerable to financial distress, we already have controls for the tangibility of assets. Thus, this variable could have a negative effect on spreads if it represents the additional value (over and above book value) that debt holders can partially access in the event of default.

We complement this set of firm controls with two variables linked to the firm's stock price. $EX\ RET$ is the firm's excess stock return (relative to the overall market) over the past 12 months. To the extent that a firm outperforms the market's required return, it should have more cushion against default and thus a lower spread. $STOCK\ VOL$ is the standard deviation of the firm's daily stock return over the past 12 months. Because higher volatility indicates greater risk, and thus a higher probability of default, we expect this variable to have a positive impact on spreads. Since $EX\ RET$, $STOCK\ VOL$, and $LEVERAGE$ are the key components of Bharath and Shumway (2008) naive estimate of the firm's probability of default, $PDEFAULT$, we leave them out of our models when we use the probability of default to control for the borrower risk.

We now discuss our loan-specific variables Y. We include dummy variables equal to one

[10]Firms are required to report advertising expenses only when they exceed a certain value. For this reason, this variable is sometimes missing in Compustat. The same is true for expenses with research and development. In either case, when the variable is missing, we set it equal to zero.

if the loan has restrictions on paying dividends ($DIVRESTRICT$) and is secured ($SECURED$). All else equal, any of these features should make the loan safer, decreasing the spread, but it is well known that lenders are more likely to require these features if they think the firm is riskier (see for example Berger and Udell (1990)), so that the relationship may be reversed. Loans with longer maturities (measured by the log of maturity in years, $L\ MATURITY$) may face greater credit risk, but they are more likely to be granted to firms that are thought to be more creditworthy; again, the effect on spread is ambiguous. Larger loans (measured by $L\ AMOUNT$, the log of loan amount in hundreds of millions of dollars) may represent more credit risk, raising the loan rate, but they may also allow economies of scale in processing and monitoring the loan; again, the sign of this variable's effect on loan spreads is ambiguous.

Because the purpose of the loan is likely to affect its credit spread, we include dummy variables for loans taken out for corporate purposes ($CORP\ PURPOSES$), to repay existing debt ($DEBT\ REPAY$), and for working capital ($WORK\ CAPITAL$). Similarly, we include dummy variables to account for the type of the loan—whether it is a line of credit ($CREDIT\ LINE$) or a term loan ($TERM\ LOAN$).

We also include bank-specific controls Z that may affect banks' willingness or ability to supply funds. $L\ ASSETS\ BK$, the log of the bank's total assets, controls for bank size. Arguably, larger banks may be better-diversified or have better access to funding markets, leading to a lower cost of funds and (potentially) lower loan spreads. Similarly, a bank's return on assets ($ROA\ BK$) may proxy for a bank's improved financial position, again leading to a lower loan spread. For the same reason, we expect the bank's capital-to-assets ratio, $CAPITALBK$, to be negatively related to loan interest rates. This relationship may also arise because, according to Boot et al. (1993), banks with low capital are more willing to consume reputational capital to build up financial capital and thus are more likely to renege on implicit guarantees, including the guarantee not to exploit their informational monopoly. On the other hand, since capital does not enjoy the tax benefits of debt funding, that relationship may be reversed. Indicators of bank risk such as the volatility of return on assets ($ROA\ VOL\ BK$) or net loan charge-offs as a fraction of assets ($CHARGEOFFS\ BK$) may mean that the bank faces a higher cost of funds or is more willing to consume reputational capital to build up financial capital; either case suggests a positive impact on spreads.[11]

Finally, we control for the bank's holdings of cash and marketable securities as a fraction of total assets, $LIQUIDITY\ BK$, and for the bank's access to public debt markets through the fraction of the bank's subordinated debt to total assets, $SUBDET\ BK$. Banks with more liquid assets should find it easier to fund loans on the margin, leading to lower loan spreads.

[11] We use the volatility of return on assets ($ROA\ VOL\ BK$) rather than the stock return because a large number of the banks in the sample are not listed on the stock market.

Similarly, banks with access to the bond market may be able to raise funds at a lower cost, again leading to lower loan spreads. A bank's subordinated debt may also act as a substitute for equity capital, in which case we should also expect the impact on loan spreads to be negative.

Our last set of controls, M, attempts to account for macro conditions and the conditions in credit markets that may also affect the spreads banks charge on their corporate loans. We control for the firm's cost to access the bond market by including the difference between the current yields on BBB- and AAA-rated bonds, $BBB\,SPREAD$. Last, we include the slope of the yield curve ($SLOPE\,YC$), computed as the daily yield difference between the five- and one- year zero-coupon bond, to control for expected changes in short-term rates. To account for the effect of any additional factors at the yearly and quarterly levels, we add year and quarter fixed effects.

We estimate all our models with robust standard errors clustered at the bank level. We present the estimates from a pooled model, but we focus on models estimated with bank fixed effects to reduce concerns about unobserved heterogeneity at the bank level that may affect loan pricing policies. We go a step further and also report the results of our models estimated with bank-firm fixed effects. In this case, the difference in spreads comes from a difference in the loan pricing policy for the *same* bank and the *same* borrower.

2.2.2 Banks' risk-taking and the monetary policy stance: Two-step procedure

A potential concern with the findings we derive in the first part of our methodology is that they do not arise from a change in banks' risk appetite induced by the level of short-term interest rates, but from an omitted factor correlated with the borrower's risk of default. The second part of our methodology addresses this concern by using the information banks provide in the SLOOS. This survey is particularly valuable for our purposes because it contains specific bank-level information on banks' standards for approving loan applications in each quarter. We use this information to design a two-step procedure. In the first step, we estimate the following probit model of the bank's lending standards:

$$EASING_{b,t} = c + \sum_{k=1}^{K} \eta_k Z_{k,b,t-1} + \sum_{u=1}^{U} \zeta_u M_{u,t-1} + \epsilon_{b,t}. \tag{2}$$

$EASING_{b,t}$ is a dummy variable that takes the value one in the quarters in which the bank indicates that its standards for approving loans were on net easier than in the three months earlier. We gather this information from the SLOOS which asks whether the bank's credit standards for approving applications for C&I loans were, on net, tighter, easier, or unchanged from three months earlier.

In the second step, we use the residual of the first step in the following model of loan spreads:

$$
\begin{aligned}
L\,LOANSPD_{f,l,b,t} &= c + \alpha LOW\ RATE_t + \beta BOR\,RISK_{f,t-1} + \mu EASING_{RES\ b,t-1} \\
&+ \gamma LOW\ RATE_t \times BOR\,RISK_{f,t-1} + \phi EASING_{RES\ b,t-1} \times LOW\ RATE_t \\
&+ \lambda EASING_{RES\ b,t-1} \times BOR\,RISK_{f,t-1} \\
&+ \theta EASING_{RES\ b,t-1} \times LOW\ RATE_t \times BOR\,RISK_{f,t-1} \\
&+ \sum_{i=1}^{I} \psi_i X_{i,l,t} + \sum_{j=1}^{J} \nu_j Y_{j,f,t-1} + \sum_{k=1}^{K} \eta_k Z_{k,b,t-1} + \sum_{u=1}^{U} \zeta_u M_{u,t-1} + \epsilon_{f,l,b,t}. \qquad (3)
\end{aligned}
$$

We extract the generalized residual $EASING_{RES}$ from the first stage, following Gourieroux et al. (1987).[12] This residual is uncorrelated with the explanatory variables in equation (2) by construction. The inclusion of the generalized residual accounts for the correlation between the error terms in equations (2) and (3), suggesting that if these residuals play a role in loan spreads, it is not through changes in bank and macro factors. Rather, any impact of $EASING_{RES}$ on loan spreads is due to unobservables associated with a bank's decision to ease its lending standards. Hence, the residual captures the bank's choice to ease the standards for approving loan applications for reasons other than its financial and macroeconomic conditions. We view this measure as a proxy for a bank's *intrinsic* decision to rely on more lax standards for approving loan applications.

This part of our analysis has some similarities with Bassett et al. (2010), who use SLOOS to identify bank loan supply shocks. They extract the residuals from a model that estimates the lending standards on macro and bank factors. They then aggregate the residuals to a quarterly index to examine how exogenous bank supply shocks affect real gross domestic product (GDP) and core lending capacity in a VAR framework. We extract the generalized residuals instead at the bank-quarter level and examine their impact on loan pricing in times of high and low interest rates.

Our second-stage model investigates the impact of the bank's lending standards or, more specifically, the impact of the bank's *intrinsic* decision to ease its lending standards on the spreads it charges borrowers with different default risk when the short-term rate is low compared to when the short-term rate is high. The key effect of interest is identified by the coefficient on the triple interaction, θ, which essentially is a difference-in-differences-in-differences estimator. This coefficient tells us whether the decline in loan spreads that risky borrowers enjoy (relative to safe borrowers) when banks ease their lending standards in periods of low interest rates is larger or smaller than the decline in loan spreads that risky borrowers

[12] It is useful to note that the inverse Mills ratio is also the generalized residual for the probit model.

enjoy (relative to safe borrowers) when banks ease their lending standards in periods of high interest rates.

We use a second question in the SLOOS survey to push our investigation a step further into the effect of monetary policy on a bank's risk-taking appetite. In addition to being asked whether the bank's credit standards for approving applications for C&I loans were, on net, tighter, easier or unchanged from three months earlier, banks are also asked about the importance of "increased (reduced) tolerance for risk" when they ease (tighten) the terms for C&I loans. Using this information, we construct the dummy variable $RISKTOL$, which takes the value one in the quarters a bank indicates that it eased its lending standards *and* that "increased tolerance for risk" was very important or somewhat important for easing the terms for C&I loans. We then repeat the two-step procedure described above, using this proxy for the bank's risk tolerance. The residual from the probit model of $RISK\,TOL_{RES}$ captures the bank's decision to ease loan standards because of added risk tolerance for reasons other than its financial and macroeconomic conditions at the time of the loan applications. In other words, the residuals retrieved from the $RISKTOL_{RES}$ regression captures the bank's *intrinsic* decision to ease its lending standards because of great risk tolerance.

A key advantage of the $RISK\,TOL_{RES}$ over the $EASING_{RES}$ is that it isolates those periods when banks not only indicate that their lending standards are "looser" but they further specify that increased risk tolerance plays a key role in easing those standards. Therefore, if the stance of monetary policy affects banks' risk-taking incentives we should find clear evidence of this link when we use $RISK\,TOL_{RES}$.

We use yet a third question from the SLOOS survey, the question that asks the banks whether C&I loan demand, for reasons other than seasonal changes, was strong or weak in the quarter. Using these answers, we construct the dummy variable $DEMAND\,WEAK$, which takes the value one in the quarters a bank indicates that C&I loan demand was weak for reasons other than seasonal changes. In one test, we add this new variable to our model of loan spreads to ascertain whether it helps explain loan spreads in the presence of our controls. In another test, we follow a two-step procedure similar to the one described above. The dependent variable in the first step is the dummy variable $DEMANDWEAK$. We leave out bank controls and consider only the set of macroeconomic controls and the dummy variable that captures the stance of monetary policy in the first step. For the sake of comparability, we use the generalized residual from the probit regression, $DEMAND_{RES}$, in the second-stage model of loan spreads. If firm and macroeconomic controls explain most of the differences in loan demand, then $DEMAND_{RES}$ should not affect difference in the loan spreads banks charge risky and safe borrowers when short-term rates are low compared to loan spread differences when rates are high.

As in the first part of our methodology we focus on models estimated with bank fixed effects and on models estimated with bank-firm fixed effects.

2.3 Sample characterization

Table 1 presents the characteristics of our sample. There are 18,787 loans in our sample that were taken out by 4,223 (publicly listed) nonfinancial corporations between 1990 and 2010 from 235 banks. We begin with the firm controls. As is common in corporate samples, many variables are positively skewed, with mean values greater than median values. For example, the median firm is 13 years old and has a leverage ratio equal to 30 percent and a market-to-book value of 1.4, whereas the mean firm is 20 years old and has a leverage ratio of 32 percent and a market-to-book value equal to 1.7. Several other variables, including the fraction of tangible assets, expenditures on R&D or advertising, interest coverage, stock return and probability of default are also positively skewed. The median firm has sales worth \$722 million, whereas the mean sales are \$4,069 million. With regards to credit rating, 44 percent of the loans in our sample are from rated borrowers. There is a slight predominance of loans in the sample from borrowers rated investment grade. Specifically, 24 percent of all loans are from borrowers rated investment grade and 20 percent are from borrowers rated below investment grade.

Turning our attention to the loan controls, we find that the loan amount is positively skewed, with a median of \$64 million and a mean of \$204 million. In contrast, the loan spread is negatively skewed with a median of 250 basis points over LIBOR and a mean of 247 basis points over LIBOR. The median maturity is four years. Large numbers of loans are secured, or have dividend restrictions, and virtually all of them are senior. Most of the loans (34 percent) are for corporate purposes. With regards to the type of contract, 28 percent of loans are term loans, and 54 percent are credit lines.

Next, we consider the set of bank controls we use in our study. We measure these controls at the holding company level, and not at the bank level, to capture any potential effects that may arise with transference within entities of the same holding company. For ease of exposition, though, we will continue to refer to these as bank controls. Banks are significantly larger than their borrowers: median bank assets are \$272 billion, and mean bank assets are \$574 billion. The average bank has an equity-to-assets ratio of about 8 percent, and is funded predominantly with deposits. The average deposit-to-assets ratio of the banks in the sample is about 65 percent. In contrast, subordinated debt accounts for only about 1 percent of the funding used by the average bank. Both the return on assets and the net charge-offs have a mean and a median of about 0.1 percent. The return on assets volatility, however, is strongly negatively skewed with a mean of 0.2 percent and a median of 0.1 percent.

Finally, looking at the lending standards variables we obtain from the SLOOS, we see that on average in each quarter about 7 percent of the banks indicate that their standards for approving loans are on net easier than in the three months earlier. Furthermore, on average about 5 percent of banks specifically indicate that "increased tolerance for risk" was very important or somewhat important for easing the terms for C&I loans. During the sample period, on average in each quarter about 28% percent of banks indicate that demand for C&I loans was weak for reasons other than seasonal changes. As we will show in the next section, these variables play a very important role in identifying the risk-taking channel of monetary policy.

3 Do risky firms enjoy a discount when interest rates are low?

In this section, we study the bank risk-taking channel of monetary policy by investigating how banks' lending policies vary with the stance of monetary policy. We begin by comparing the loan spreads between low- and high-interest-rate regimes. Next, we investigate whether the risk of borrowers affects loan spreads differently in low and high regimes.

3.1 Loan spreads and the federal funds rate

Table 2 reports our first set of regressions. This table aims to show the impact of short-term interest rates on loan spreads by distinguishing periods of low- and high-interest-rate regimes. That table also aims to show the impact on loan spreads of the two measures of firm risk we use to investigate the bank risk-taking channel of monetary policy—credit rating and probability of default.

We classify interest rates as "low" if the federal funds rate at the time of the loan is below the sample median. As we can see from Figure 1, which plots the federal funds rate over the sample period, the low period is dominated by the 2000s. In contrast, the "high" period is dominated by the 1990s. In the Robustness section, we investigate the importance of this classification of the stance of monetary policy for our findings.

Models (1) through (3) control for the credit rating of the borrower by distinguishing borrowers that are rated below investment grade from those that are unrated and those that are rated investment grade (the omitted category). Models (1) and (2) have bank fixed effects and model (3) has bank-firm fixed effects. Given that some loan controls may be endogenous we first estimate our model of loan spreads without these controls (model 1) and then investigate what happens when we include them (model 2). Models (4) though (6) follow a similar structure but the focus is on the probability of default of the borrower. All the models reported in Table (2) include our sets of firm- and bank-specific controls, as well as our set of macroeconomic controls. Throughout, our regression results reflect robust standard errors clustered by bank.

Two important results stand out in Table 2. First, in periods when the federal funds rate is low, banks charge higher spreads on their corporate loans. LOW is positive and highly statistically significant in all models of the table. Second, riskier borrowers, as measured by their credit rating or by their probability of default, pay higher spreads on their loans. This finding is true both when we compare loan spreads across borrowers and when we compare loan spreads within borrowers (models 3 and 6). $B\,GRADE$ is positive and statistically significant in the first three models of the table, and $P\,DEFAULT$ is positive and statistically significant in the last three models of the table. The results of Table 2 also appear to confirm that some of the loan controls are endogenous since the coefficients on $B\,GRADE$ and $P\,DEFAULT$ decline when we add these controls to our models. Most importantly, adding these controls does not affect the statistical significance of either one of these measures of borrower risk.

According to our base model, which accounts for macroeconomic, firm- and bank-specific controls as well as for bank fixed effects (model 1), borrowers rated below investment grade pay a 127 percent higher spread on their corporate loans than borrowers rated investment grade.[13] This difference declines to 100 percent when we expand our set of controls to account for loan-specific characteristics (model 2), and it declines further to 50 percent when we replace bank-fixed effects with bank-firm fixed effects (model 3). We find a similar pattern when we focus on the borrower's probability of default. According to our base model (model 4), one percent increase in the probability of default leads to a 250 percent higher spread. In columns (5) and (6), where first loan controls and then loan controls and bank-firm fixed effects are included, a one-standard-deviation increase in the probability of default results in an 164 percent and a 106 percent higher spread, respectively.

Most of the controls in our models have reasonable effects on loan spreads and are generally consistent with other studies of loan spreads.[14] Looking at our firm controls, we see that older and larger firms pay lower spreads, as do firms with more tangible assets or high excess stock returns. Firms with higher interest coverage and those with more growth opportunities also pay lower spreads on their loans. In contrast, firms with higher leverage or stock volatility pay higher spreads. The only firm control that is statistically significant and contrary to expectations is the profit margin as it indicates that firms with a higher profit margin pay higher spreads on their loans.

With regard to the loan controls, banks appear to extend larger loans as well as longer-term loans to safer borrowers. In contrast, and in line with the evidence offered by Berger and Udell (1990), they generally demand that loans to riskier borrowers be secured, thereby

[13]An increase of 127 percent in the log loan spread translates to an increase of exp(-0.824)-1.

[14]For other studies of loan spreads see, for example, Santos and Winton (2008), Hale and Santos (2009), and Santos (2011).

explaining why these loans carry lower spreads. A similar reason explains why loans that result in dividend restrictions carry higher spreads.

In regard to our set of bank controls, those that are statistically significant are generally consistent with expectations. Like Hubbard et al. (2002) and Santos and Winton (2011) we too find that banks with higher equity-to-assets ratio charge lower spreads. Banks with better ratings also charge lower spreads. By contrast, banks with higher charge offs demand higher spreads on their corporate loans. ROA volatility and the ratio of deposits over assets are generally not significant, but when they are significant, they have an unexpected impact on loan spreads. The remaining bank controls (assets, subdebt, ROA and liquidity) do not appear to play a role in loan spreads, at least when we control for bank ratings.

Finally, the other two macroeconomic controls we include—the triple-B spread in the bond market and the slope of the Treasury yield curve—have the expected positive effects on loan spreads. However, while the triple-B is highly significant in all models, the slope of the Treasury yield curve is significant only in models (5) and (6).

Looking ahead, we reemphasize that banks charge higher spreads to riskier borrowers and that on average they charge higher spreads when the federal funds rate is low. Next, we investigate whether riskier borrowers benefit from a "discount" vis-*à*-vis the loan rates banks charge safer borrower in periods when the federal funds rate is low. In the interests of space, in what follows, we do not report the results for the various firm-, loan-, and bank-specific controls or the results for the macroeconomic controls.

3.2 Risk structure of loan spreads and the federal funds rate

In this section, we begin our investigation of the bank risk-taking channel of monetary policy by analyzing whether the risk premium that banks charge riskier borrowers varies with the stance of monetary policy. We hypothesize that if there is a bank risk-taking channel of monetary policy, banks will charge riskier borrowers relatively less than they charge safer borrowers in times of low interest rates in comparison with times of high interest rates. To test this hypothesis, we add the interaction term $LOW\ RATE \times B\ GRADE$ in models (1) to (3) in Table 3 and $LOW\ RATE \times P\ DEFAULT$ in models (4) to (6). All models are analogous to those in Table 2: model (1) omits loan controls and has bank fixed effects, model (2) adds loan controls and has bank fixed effects, and model (3) has loan controls and bank-firm fixed effects. The estimates on loan-, firm-, and bank-specific controls are unreported because they are very similar to those already discussed in Table 2.

The results of our tests indicate that it is "advantageous" for riskier borrowers to take out loans in periods of low interest rates. This finding is consistent with the existence of a bank risk-taking channel of monetary policy. The sign on the interaction term

$LOW\ RATE \times B\ GRADE$ in columns (1) through (3) is negative and significant for all three models. This result implies that the difference between the loan spread of below-investnent-grade borrowers and investment-grade borrowers is lower when short-term interest rates are low than when they are high. In model (1), borrowers rated below investment grade pay only 114 percent higher spreads than what investment-grade borrowers pay when short-term interest rates are low. However, when the interest rates are high, they pay 145 percent more which is significantly higher than in the low regime. Similarly, in model (2), below-investment-grade borrowers pay 87 percent higher spreads than investment-grade borrowers when interest rates are low, and 117 percent more when interest rates are high. Likewise, in model (3), the percentage spread difference between below-investment-grade and investment-grade borrowers is 50 percent in times of low interest rates and 65 percent in high-interest-rate regime. Across all three models, the estimates on $LOW\ RATE \times UNRATED$ and $LOW\ RATE \times B\ GRADE$ have similar magnitudes, which suggests that the unrated borrowers experience underpricing similar to the below-investment-grade borrowers.

A potential concern with the results we just reported is that they rely on credit ratings. If credit ratings do not accurately reflect how changes in the stance of monetary policy affect the risk of borrowers, this could potentially explain our findings. Our next test addresses this concern by focusing on the borrower's probability of default. This measure of risk has two important advantages over the credit rating. It is computed from market data, and consequently it is a forward-looking measure of risk. As such, it is more likely to account for any effect that the stance of monetary policy may have on the borrower's risk of failure. Furthermore, in contrast to the credit rating which exists for only 50 percent of the borrowers in our sample, the probability of default is available for all the borrowers. For these reasons, we will rely on the borrower's probability of default in the rest of the paper.

The results of our tests using the borrower's probability of default are reported in models (4) through (6) of Table 3. The key insight of our investigation based on credit ratings continues to hold when we use the borrower's probability of default. The point estimate on $LOW\ RATE \times P\ DEFAULT$ is negative in all models, although it is statistically significant only in models (5) and (6). In model (4) where the set of loan controls is omitted the estimate of the interaction term is insignificant, highlighting the importance of these variables. In model (5), one percent increase in the probability of default is associated with a 148 percent increase in spreads in the low-interest-rate regime and with a 188 percent increase in the high-interest-rate regime. When we control for unobservable factors at the bank-firm level, risky borrowers enjoy 75 percent higher spreads in the low regime and almost 200 percent higher spreads in the high-interest-rate regime.

Our finding that loan spreads are less sensitive to the borrower's risk of default in times of low short-term rates than in times of high short-term rates is consistent with the idea that banks discount risk in periods of easing monetary policy. In other words, our finding is consistent with the existence of a bank risk-taking channel of monetary policy. It is possible, however, that the difference in the sensitivity of loan spreads to borrower risk is biased due to omitted variables at the macroeconomic or firm level. It is also plausible that a portion of that difference is due to loan demand factors rather to loan supply factors. Controlling for the loan characteristics, a large number of time-variant firm and bank controls, and time-invariant factors at the bank and bank-firm levels as well as the macroeconomic conditions at the time of the loan should mitigate those concerns. To further rule out concerns that our findings are demand driven rather than bank driven, in Section 5 we report tests that use information from the Senior Loan Officers Opinion Survey on their lending standards. Before we do that, however, we discuss several robustness tests that we conducted on our key finding on the effect of monetary policy on banks' loan pricing policies.

4 Robustness tests

In this section, we report the results of some robustness tests of our key findings. In the interest of space and because of the advantages that the probability of default has over the credit rating, we use the borrower's probability of default in the robustness tests.

4.1 Regression specification

The first test investigates whether our key finding is robust to different regression specifications. Columns (1) and (2) of Table 4 present the estimates from a more comprehensive specification in which each variable in models (5) and (6) in Table 3 is interacted with $LOW\ RATE$. If monetary policy regimes affect loan spreads through borrower-related channels other than the probability of default, this specification will account for it. The takeaway from these two models is that the estimates of $LOW\ RATE \times P\ DEFAULT$ in columns (1) and (2) in Table 4 are comparable to those in columns (5) and (6), Table 3, respectively. This finding suggests that the effect of the probability of default continues to hold above and beyond the joint effect of firm, bank, and loan factors and their interaction terms with the monetary policy regime.

4.2 Borrower size

Our second test investigates whether our results hold across borrowers of different size. To that end, in columns (3) through (6) of Table 4, we estimate our model of loan spreads separately for large and small firms. This test is important because large and small firms may be subject to different unobserved firm-specific demand shocks that happen to be correlated with monetary policy regimes. Therefore, if $LOW\ RATE \times P\ DEFAULT$ is strongly correlated with demand shocks, we run the risk of observing that the estimate is negative and significant either for large or for small firms. This would suggest then that demand rather than supply factors are at play. We observe in columns (3) and (4) (bank fixed effects) and in columns (5) and (6) (bank-firm fixed effects) that the estimates are negative and significant for both large and small firms. As far as the magnitude of these estimates is concerned, large firms experience a greater undercut when interest rates are low than small firms do. One possible explanation is that large firms may have alternative sources of financing and that banks decrease their price more aggressively to make them borrow. Alternatively, according to the broad credit channel, loose monetary policy causes borrowers' balance sheets to improve their collateral values. To the extent that small firms improve relatively more, we would expect that smaller firms are more affected by this channel. This explanation, however, is not supported by the data, which ameliorates the concern that our results capture the effect of the broad lending channel.

4.3 Probability of default after loan origination

Finding that loan spreads are relatively lower for riskier borrowers in times of low versus high interest rates is consistent with a bank risk-taking channel of monetary policy, but it could also be the result of the following situation. Loan spreads of risky borrowers are relatively lower when interest rates are low because banks expect these borrowers to improve their risk profiles in the future. Similarly, when interest rates are high, banks may expect firms to deteriorate their risk profiles. Recall that our measure of borrower risk—the borrower's probability of default—aims at capturing the borrower's risk of default in the year following loan origination and that the average maturity of the loans in our sample is four years. To address this concern, we examine whether the probability of default changes one, two, and three years after loan origination compared to the year of origination. In Table 5 we report results for the first, second, median, and last loan. The median number of loans by firm in the period of low interest rates is three. We estimate the probability of default regressions during and after loan origination periods. In the upper panel we focus on loans originated in the low-interest-rate regime, and in the lower panel we focus on loans originated in the high-interest-rate regime.

In the upper panel, we observe that the probability of default is not statistically different for one, two or three years after loan origination compared to the year of loan origination. We observe in column (4) that the probability of default is actually higher after the last loan is originated. Looking at the lower panel of the table, we do not detect any systematic pattern of the probability of default after loan origination in the high-interest-rate regime. These results indicate that banks do not give an interest rate discount to risky borrowers in periods of low interest rates relative to periods of high interest rates because they expect risky borrowers to have lower or higher probability of default in the near future.

4.4 Economic conditions

Our final robustness test investigates the importance of economic conditions. We use the target federal funds rate to define periods of "low" and "high" short-term interest rates. Using the raw policy rate implies that our measure of the stance of monetary policy captures monetary policy, inflation and output cycles. Consequently, our loan spread findings can be the result of the economic conditions rather than the result of monetary policy *per se.* Of course, the policy rate and macro conditions evolve endogenously in the economy and isolating economic from monetary policy fluctuations would require a setting in which monetary policy is exogenous to loan demand and supply. For example, Ioannidou et al. (2009) examine the effect of U.S. monetary policy on Bolivian loans, based on the fact that the Bolivian peso is pegged to the US dollar but the Bolivian economy does not affect U.S. monetary policy.

In our paper, we aim at directly examining how U.S. monetary policy affects U.S. loan spreads. That is why we cannot rely on an approach in which monetary policy is assumed to be 'imported' from another country as in Ioannidou et al. (2009). We address the issue of having overlapping monetary policy and economic conditions in several different ways. First, instead of using interest rate levels, which feed directly into GDP growth and inflation, we rely on low and high monetary policy regimes defined at an arbitrary cut off point and episodes of prolonged falling and rising interest rates (see Section 6). High and low monetary policy regimes do not overlap with the economic cycle, which allows us to identify separate effects of the monetary policy regime and the business cycle.

Next, in unreported analysis, we use the Taylor definition of easing and tightening. Easing occurs when the actual monetary policy rate is lower than the rate predicted from a model.[15] When plotting the difference between the actual and the predicted federal funds rate, we observe that easing (or a negative difference between the actual and the predicted federal funds rate) occurs mainly after 2000. We find that our main results hold both before and after year 2000. Hence, the Taylor's definition of easing and tightening, which explicitly removes the effect of economic conditions, does not affect our results and their interpretation.

Finally, in Table 6 we address the role of economic conditions by using a formal regression analysis. In column (1), we add the quarterly GDP growth rate (GDP) and its interaction with the borrowers's probability of default. We find that the estimates on $LOW\ RATE{\times}P\ DEFAULT$ in columns (1) and (2) preserve their negative sign and are comparable to those in Table 3, columns (5) and (6). The estimates on $GDP{\times}P\ DEFAULT$ in

[15]The typical regression from which Taylor rule residuals are retrieved accounts for the effect of output gap and inflation rate on federal funds targets.

models (1) and (2) take a positive sign suggesting that high GDP growth and high probability of default are associated with higher spreads.[16]

In columns (3) and (4), we use negative output gap ($NEG\ OUTPUT\ GAP$) as an alternative measure of economic conditions. This variable is the negative value of the difference between the actual GDP and the estimated potential GDP according to the Congressional Budget Office. The results are very similar to those in columns (1) and (2) with the exception that the estimate on $LOW\ RATE{\times}P\ DEFAULT$ loses its significance in the specification with bank fixed effects.

In columns (5) and (6) we identify recession periods as defined by the National Bureau of Economic Research and find that the estimates on $LOW\ RATE{\times}P\ DEFAULT$ are preserved. Overall, using three different measures of economic conditions does not distort the impact of borrower risk on loan spreads in times of low interest rates. This is not to say that economic conditions do not affect loan spreads but rather that they contribute to those spreads together with the stance of monetary policy.

In columns (7) and (8), we introduce the Chicago Fed National Activity Index as a proxy for economic activity. This index tracks periods of economic expansion and contraction.[17] We note that including the index in the loan spread regression does not affect our coefficient of interest on $LOW\ RATE{\times}P\ DEFAULT$.

These results should alleviate concerns that the results in Table 3 can be explained by cycles of economic activity that overlap with monetary policy. To reduce these concerns further, we investigate the robustness of our findings to the importance of the economic conditions by looking at lending of U.S. banks to Canadian firms. Specifically, we investigate whether U.S. banks also undercut loan spreads to riskier borrowers in Canada in periods when U.S. interest rates are low.

4.4.1 U.S. banks lending to Canadian firms

If U.S. banks are affected by U.S. monetary policy, they are likely to transfer this effect to *both* their U.S. borrowers *and* their Canadian borrowers. The reverse, that is, the impact of loan

[16] In unreported analysis, we have estimated a model with a triple interaction term between GDP, $LOW\,RATE$ and $P\ DEFAULT$. Our results continue to hold. We have also defined high and low GDP regimes similar to the monetary policy regimes. The unreported results are consistent with the specifications in Table 6.

[17] The economic indicators used for the index are from several data sources: production and income data, employment and unemployment hours, personal consumption and housing, and sales, orders and inventories. All data series are adjusted for inflation. Overall, the index is a weighted average of 85 economic indicators. It is observed that if the three-month moving average falls below -0.7, there is an increasing likelihood that a recession has begun. The idea behind the index construction is that there is some factor common to all of the various inflation indicators, and it is this common factor, or index, that is useful for predicting inflation. Research has found that the CFNAI provides a useful gauge on current and future economic activity and inflation in the United States.

demand by Canadian firms and the Canadian economic environment on U.S. monetary policy, is not likely to happen. Therefore, if we find that U.S. banks have the same pricing policy for Canadian borrowers as for U.S. borrowers, this will provide stronger support that our results are not driven by the response of monetary policy to demand shocks and vice versa, to the extent that the U.S. and Canadian economies are not subject to the same demand shocks.

To investigate this hypothesis, we first identified the loans in Dealscan that U.S. banks extended to nonfinancial corporations operating in Canada. We found 6,127 loans taken out by 1,669 Canadian corporations. Next, since only 525 of these corporations are publicly listed, we estimate our model of loan spreads both with and without firm controls. For the same reason, in this test we proxy for the risk of the borrower by its credit rating and do not consider our specification which uses the borrower's probability of default.[18] Also, because Canadian borrowers have fewer loans than their American counterparts, we estimate our model of loan spreads only with bank fixed effects.

The results of this test are reported in Table 7. Model (1) investigates whether U.S. banks charge riskier Canadian borrowers lower spreads (relative to the spreads they charge to safer Canadian borrowers) when they lend in periods of low interest rates in the United States compared to periods of high interest rates, controlling for our set of bank-specific and macroeconomic controls. Model (2) expands the set of controls to account for our loan-specific controls. Models (3) and (4), in turn, repeat these tests after we expand the set of controls to account for our borrower-specific controls. As we can see from this table, below-investment-grade Canadian firms that borrow from U.S. banks pay relatively less than their investment-grade counterparts in times of low interest rates in the United States. This result holds across all four specifications reported in the table. This result is similar to the result we found for U.S. borrowers. Since the Canadian economic environment is less likely to influence U.S monetary policy than the economic environment in the U.S., our evidence that U.S. banks offer an interest rate discount to both riskier corporations operating in the U.S. and riskier corporations operating in Canada when short-term interest rates are low in the United States adds important support to our evidence on the existence of a bank risk-taking channel in the U.S.[19]

[18] Even though we identify 525 Canadian publicly listed firms, the probability of default data is available for only 150 of these firms.

[19] We also conducted a counterfactual exercise in which we compared loan spreads between investment- and non-investment-grade borrowers for periods of low interest rates in Canada and high interest rates in the United States with periods of high interest rates in Canada and low interest rates in the United States. There is evidence that loan spreads are relatively higher when interest rates are low in Canada and high in the United States than in periods of high interest rates in Canada and low rates in the United States. This exercise suggests that Canadian monetary policy does not affect risk-taking behavior by U.S. banks when they price loans to Canadian borrowers. The drawback, however, is that we rely on a small number of overlapping periods of monetary policy regimes in the United States and Canada, which precludes us from drawing strong conclusions.

5 Do banks discount risk when interest rates are low?

Our evidence on the interest rate discount that banks offer riskier borrowers when short-term interest rates are low provides strong support to the existence of a bank risk-taking channel of monetary policy in the United States. To further confirm that this discount derives from a change in banks' risk appetite induced by the level of short term interest rates, and not from an omitted factor correlated with the borrower's risk of default, in this section we report the results of the two-step procedure we developed using the information banks provide in the Senior Loan Officers Opinion Survey on their lending standards.

That information is very valuable for an investigation of the bank risk-taking channel of monetary policy because it allows us to extract a bank-specific measure of risk appetite that by construction is not driven by changes in banks' balance sheets and macroeconomic conditions.

5.1 Bank lending standards and the federal funds rate

We begin this part of our investigation by considering the information banks provide in response to the SLOOS' question of whether they have eased their standards for approving loans.[20] Using that information, we estimate a probit model in the first stage of our two-step approach in which the dependent variable is a categorical variable that takes the value one if the bank indicates it has eased its lending standards and zero otherwise. The independent variables of the first-stage model are the set of bank and macro factors described in Section 2.2.2.[21] The policy rate does not enter into the first stage because we are interested in exploring the joint impact of the monetary policy regime and the residual bank risk tolerance in the second stage.

We construct the generalized residuals following Gourieroux et al. (1987) and use them as a measure of the bank's 'intrinsic' easing of lending standards in the second stage regression. As we cannot point to the direct reason for easing, we view this measure as a more general proxy for soft lending. Because we already control for bank and macro specific factors, the residual picks up a bank's choice to ease lending standards for intrinsic, unspecified reasons. A significant impact of the residuals on loan spreads shows the importance of unobservables associated with the bank's choice to ease lending standards in a certain quarter. Alternatively, if the residual do not play a role in loan spreads, it would mean that banks that choose to ease their standards do not charge significantly different spreads than the rest.

[20]The exact survey question is: "Over the past three months, how have your bank's credit standards for approving applications for C&I loans or credit lines—other than those to be used to finance mergers and acquisitions—to large and middle-market firms changed (annual sales of $50 million or more)?"

[21]We do not report the results of the first stage in the interest of space, but they available from the authors upon request.

One advantage of using that measure of bank lending standards is that it allows us to pin down directly the propensity to ease at the bank level. In our previous tests, we relied on an indirect measure of risk taking—the sensitivity of loan spreads to the borrower's probability of default in times of low versus high short-term rates. Another advantage of that measure is that it is not built on bank balance sheet information, but it comes instead from an alternative source of bank information—the survey of bank lending standards. These data permit the extraction of a cleaner measure of banks' incentives to ease their lending standards based on responses of bank officers.

Table 8 reports the results of the second-stage regressions on loan spreads. In column (1), the estimates on $EASING_{RES}$, and $P\,DEFAULT \times EASING_{RES}$ are not significant, suggesting that softer lending standards neither alone nor through a firm's probability of default affect loan spreads. The same result is preserved when bank-firm fixed effects are included in column (2). One reason for not observing any effect of the residual on loans spreads may be that the residual on easing affects loan spreads in an opposite direction across short-term interest rates regimes and hence the total effect is confounded.

Because we are interested in the differential impact of $P\,DEFAULT \times EASING_{RES}$ across low and high monetary policy regimes, in columns (3) and (4) we introduce regression models that allow for the complete interaction among $P\,DEFAULT$, $EASING_{RES}$ and $LOW\ RATE$. The estimate on $EASING_{RES} \times LOW\ RATE \times P\,DEFAULT$ shows whether $P\,DEFAULT \times EASING_{RES}$ differs across monetary policy regimes. In column (3), where bank fixed effects are considered, the estimate on $EASING_{RES} \times LOW\,RATE \times P\,DEFAULT$ is -1.223 and it is statistically significant. This suggests that when interest rates are low, more easing banks charge riskier borrowers relatively less compared to the high regime of monetary policy. The same conclusion holds when we add bank-firm fixed effects in column (4).

One concern with these results is that banks ease their lending standards only when interest rates are low. When comparing the distribution of $EASING_{RES}$ between high and low monetary policy regimes, we find that the parameters of the two distributions are very similar. In other words, banks have an intrinsic tendency to ease their lending standards that is independent of the monetary policy regime. This finding is important because it allows us to isolate the effect of $LOW\ RATE \times P\,DEFAULT$ from $EASING_{RES} \times LOW\ RATE \times P\,DEFAULT$.

The significant coefficient of -1.223 on the triple interaction term in column (3) suggests that loan spreads for risker borrowers originated by easing banks are 133 percent lower in times of low interest rate regime relative to times of high interest rate regime.[22] In column (4), where bank-firm fixed effects are included the corresponding decrease is 176 percent. This finding is

[22]Based on the coefficients in column (3), the estimated percentage difference in loan spreads for easing banks in high monetary policy regime (2.33=1.147+0.007+1.178) versus easing banks in low monetary policy regime (1=0.078+1.147+0.007-0.193+0.006+1.178-1.223) is 1.33, i.e. it is (2.33-1.000)/1.00

in line with the result of our first test in Table 3. Consequently, it adds important support to the existence of a bank risk-taking channel of monetary policy in the United States. It also confirms that the effect of the bank risk-taking channel is not only statistically significant, but also economically meaningful.

5.2 Bank risk tolerance and the federal funds rate

We continue our investigation by considering the information banks provide in response to the followup question in SLOOS about the importance of "increased tolerance for risk" when they ease the terms for C&I loans.[23] The information banks provide in this question is particularly valuable to our investigation because it captures precisely the bank's appetite for risk. While the residuals in Table 8 capture risk appetite due to easing of the lending standards in general, easing due to greater risk tolerance goes a step further to clarify the exact reason for such easing.

Using the information from this second question, we construct $RISKTOL_{RES}$. This is the residual from a probit regression that builds on the indication that a bank's "increased tolerance for risk" played an important role in the decision to ease its lending standards for C&I loans. We then use this information in our model of loan spreads similar to what was done with $EASING_{RES}$. The second stage results that use $RISK\ TOL_{RES}$ are reported in Table 9. In column (1), the negative sign on $P\ DEFAUL \times RISK\ TOL_{RES}$ suggests that banks that are easing because they have become more risk tolerant charge riskier borrowers relatively less than other banks. In column (2), where bank-firm fixed effects are included, this estimate is purged away suggesting that banks' underpricing behavior is attenuated when we account for repeated relationships between borrowers and banks. In column (3), the negative sign and large magnitude on the estimate on $RISK\ TOL_{RES} \times LOW\ RATE \times P\ DEFAULT$ suggest risk tolerant banks lower spreads relatively more for risky borrowers entirely in the low monetary policy regime. The interpretation is that more risk-taking banks offer lower spread to relatively less riskier borrowers in low interest rate regimes relative to high interest rate regimes.

The results of model (3) imply that the estimated loan spread for risker borrowers charged by banks with more appetite for risk is 189 percent lower in times of low interest rates than in times of high interest rates (calculated as in footnote 22). The results of model (4), which account for bank-firm fixed effects instead of bank fixed effects, in turn imply that the average loan spread for risker borrowers charged by banks with more appetite for risk is 32 percent lower in times of low interest rates compared to times of high interest rates.

[23]The exact survey question is: "If your bank has eased its credit standards or its terms for C&I loans or credit lines over the past three months, how important have been increased tolerance for risk?"

Our tests based on banks' answers to the SLOOS provide two critical pieces of evidence in support of the bank risk-taking channel. The first piece of evidence shows that riskier borrowers enjoy relatively lower spreads when they borrow in periods of low interest rates from banks that soften their lending standards. The second piece of evidence shows that riskier borrowers enjoy relatively lower spreads when they borrow in periods of low interest rates from banks that indicate they soften their lending standards because they have a greater appetite for risk.

5.3 Could loan demand explain our findings?

In this section, we take another look at the role of loan demand. As we noted above, this is important because a portion of the risk-taking effect may be attributed to demand factors as opposed to bank risk taking per se. In Section 4, we reported several tests that aim to ameliorate concerns that demand for loans drives the results. In this section, we investigate the role of loan demand by using the information banks provide to the question in the SLOOS that asks banks whether demand for C&I loans has changed over the past three months apart from normal seasonal variation.[24]

We estimate a first stage regression in which the dependent variable is a dummy variable that takes the value one if banks indicate they faced weak loan demand and zero otherwise.[25] If demand factors do not play a role in the loan spreads banks charge riskier borrowers relative to the spreads they charge safer borrowers in periods of low interest rates versus high rates, then we would expect the effect of unobserved demand on loan spreads for riskier borrowers to be insignificant. Finding such evidence would reassure us that firm controls capture loan demand well. Finding such evidence would be important for yet another reason. It would show that the SLOOS survey data are a reliable source of information on banks' loan policies as the use of qualitatively different information yields consistent results.

In Table 10, we estimate the same set of models as in Tables 8 and 9. In columns (1) and (2), the estimates on $P\,DEFAULT \times DEMAND_{RES}$ are insignificant. The differences in these estimates for high- and low-interest-rate regimes are insignificant, which shows up in the insignificant estimate on the triple interaction term in columns (3) and (4). These findings confirm that demand factors are not the key driver of the interest rate discount that riskier borrowers enjoy when they take out loans in periods of low short-term interest rates.

[24] The exact survey question is: "Apart from normal seasonal variation, how has demand for C&I loans changed over the past three months?"

[25] For the sake of comparability, we also rely on the generalized residual from the probit regression that includes macro economic conditions. In an unreported specifications, we have omitted the first stage and directly used the answer to this question in the loan regression. The results continue to hold.

In sum, we have presented thus far three important results in support of the existence of a bank risk-taking channel of monetary policy. First, riskier borrowers enjoy an interest rate discount relative to the interest rates safer borrowers pay when they take out loans in periods of low interest rates as opposed to periods of high interest rates. Second, we continue to find evidence of this interest rate discount when we refine our tests to isolate the effect of borrowing in periods of low interest rates from banks with softer lending standards and perhaps even more importantly when we isolate the effect of borrowing in periods of low interest rates from banks with a higher risk tolerance. Third, we show that the interest rate discount is neither demand driven nor arise as a result of macroeconomic factors.

6 Do banks discount risk when interest rates are coming down?

In Section 3 we established that banks charge riskier borrowers relatively less when the rates are low compared to periods of high interest rate. In section 5 we continued to follow this approach to emphasize the impact of low interest rates on banks risk-taking incentives. However, some of the mechanisms that have been suggested to encourage banks to take more risk when rates are low would also be at play when short-term rates are falling for a prolonged period. For example, the search for yield mechanism is more likely to be active when interest rates are coming down than when they are going up. To investigate whether the bank risk-taking channel is present when interest rates are coming down, we repeat the exercise we undertook in Table 3. This time, however, we compare bank loan pricing policies between periods of decreasing and increasing interest rates. We identify monetary policy easing to be present in periods of falling interest rates; tightening is identified to be present in periods of increasing interest rates.[26]

Table 11 has the same structure as Table 3, with the only difference that monetary policy is specified as a decreasing rate or an increasing rate. In columns (1) through (3), we use the credit rating of the borrower to separate risky borrowers from safer ones. In these models, the estimates on $DECREASING \times B\,GRADE$ take the expected negative sign. That is, in periods when short-term rates are coming down it is relatively less expensive for below-grade-rated borrowers to take out loans than when short-term rates are going up. The difference

[26] Periods of falling rates include loan originated from 1 January 1990 to 04 September 1992; 1 February 1995 to 30 January 1996; 29 September 1998 to 14 November 1998; 16 May 2000 to 25 June 2003; 17 August to 30 December 2010. Basically, looking at Figure 1 when the policy rate is downward sloping monetary policy is defined as easy and when it is upward sloping monetary policy is considered to be tight. We omit loans originated from January 31, 1996, to September 29, 1998 because during that period the rates cannot be clearly identified either as falling or increasing. Using a 30 day forward rate on fed fund futures, we find that the definition of easing and tightening is similar to the one when using that when using the announced policy rate. Hence, our definition of monetary policy regimes reflects banks' expectations about monetary policy.

between the spreads that below-grade borrowers and investment-grade borrowers pay in the two monetary policy regimes is very similar to that reported in Table 3.

In columns (4) through (6), we use the probability of default to measure borrowers' risk. In these models, the estimates on $DECREASING \times PDEFAULT$ take also the expected negative sign. These models, therefore, confirm the result we obtain with the credit rating of the borrower—riskier borrowers enjoy an interest rate discount when they take out loans in periods of decreasing short-term interest rates as opposed to borrowing in periods of increasing short-term rates.

The results we present in this section show that riskier borrowers also benefit from an interest rate discount when they take out loans in periods of declining short-term rates as compared to periods of increasing short-term interest rates. Since some of the mechanisms that explain why banks may seek risk when short-term rates are low are also at play when short-term interest rates are coming down, the latest results add further support to the evidence of a bank risk-taking channel of monetary policy in the United States.

7 Final remarks

Our findings provide evidence in support of a bank risk-taking channel of monetary policy in the Unites States. However, our findings are mute on the ex ante optimality of the interest rate discount that banks offer riskier borrowers. Furthermore, it is unclear from our analysis to what extent bank risk-taking incentives induced by monetary policy play an important role in the stability of the financial system. Nonetheless, our evidence of a bank risk-taking channel of monetary policy suggests an additional aspect for potential consideration in the design of monetary policy.

Our findings open up several avenues for future research. For instance, our tests focus on banks' loan pricing policies to existing borrowers to reduce concerns with selection. It would be useful to investigate whether the risk-taking incentives brought about by monetary policy also leads banks to change their loan granting policies to new borrowers.

Similarly, our tests do not distinguish new loans from renegotiations of existing loans. Mian and Santos (2011), however, show that credit market conditions are an important driver of firms' incentives to refinance their existing credits. Therefore, it would seem useful to investigate the extent to which banks' risk-taking incentives brought about by monetary policy affect a role on firms' incentives to refinance and on the terms of their "refinanced" credits. Lastly, our findings suggest that an investigation of the real effects of banks' risk-taking policies induced by monetary policy is also a fruitful area for future research.

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Appendix 1: Bharath and Shumway's (2008) "Naive" Estimator

Bharath and Shumway (2008) introduce a "naive" estimate of a firm's distance-to-default (DD) as follows. First, they define the firm's "naive" estimated asset volatility, σ_V by

$$\sigma_V = \frac{E}{E+D}\sigma_E + \frac{D}{E+D}\left(0.05 + .25\sigma_E\right).$$

Then the "naive" DD is given by

$$DD_{naive} = \frac{\ln[(E+D)/D] + (r_{it-1} - 0.5\sigma_V^2)T}{\sigma_V\sqrt{T}}.$$

In implementing this, E equals the firm's market value of equity; D equals short-term debt (Compustat item 45) plus one-half long-term debt (Compustat data item 51); σ_E is stock return volatility over the past year; r_{it-1} is the actual stock return over the last year; T is assumed to be one year. Finally, the estimated probability of default (what we call $PDEFAULT$) is the cumulative normal distribution of $-DD_{naive}$, $N(-DD_{naive})$.

Appendix 2: Definition of Variables

ADVERTISING is advertising expenses scaled by a firm's sales

BBBSPREAD is the natural log of the difference between the Moody's indexes on the yields of AAA- and BBB-rated bonds

BGRADE equals one if a borrower has non-investment grade the month before loan origination. The rating is coming from S&P long-term debt rating at a monthly basis.

CAPITAL BK is the ratio of equity over risk-weighted assets

CHARGEOFFS BK is net charge off over risk weighted assets

CORP PURPOSES is one if the loan is for corporate purpose.

CREDIT LINE equals one if the loan is a credit line.

DEBT REPAY is one if the loan is for repayment of previous debt.

DECREASING is an indicator variable that takes one if the fed funds rate is lower compared to the previous quarter.

DEMAND WEAK is equal to one in the quarters a bank indicates that C&I loan demand was weak for reasons other than seasonal changes.

DEPOSITS BK is the ratio of deposits over assets.

DIV RESTRICT is equal to one if the borrower has to meet a dividend restriction.

EASING is equal to one in the quarters a bank indicates that its standards are easier than in the previous three months.

EX RET is the one year stock return over the market return.

L AGE is the natural log of a firm's age (in years).

L ASSETS BK is the natural log of bank assets at the quarter before loan was originated.

L AMOUNT is the natural log of loan amount in hundreds of millions of dollars.

LEVERAGE is debt over total assets.

L INTCOV is the natural log of one plus EBITDA over interest expense.

LIQUIDITY BK is liquidity over risk-weighted assets.

L LOAN SPD is the natural log of the all-in-drawn loan spread over LIBOR (in basis points) at origination.

L MATURITY is the natural log of the maturity of the loan in years.

LOW RATE is an indicator variable that takes one if the federal funds rate is lower than the sample median.

L SALES is the natural log of the firm's annual sales in hundred millions of US dollars.

MKTBOOK is the ratio of market to book value of the firm.

NWC is net working capital over debt.

P DEFAULT is the probability of default defined as the cumulative normal distribution of distance-to-default measure proposed by Bharath and Shumway (2008). See Appendix 1 for formal presentation.

PROF MARGIN is the ratio of net income over sales.

R&D is research and development expenses scaled by a firm's sales.

RISK TOL is equal to one in the quarters a bank indicates its lending standards are easier *and* that "increased tolerance for risk" was very important or somewhat important for easing the terms for C&I loans.

ROA BK is the bank's net income before taxes over risk weighted assets.

ROA VOL BK is the volatility of the bank's return on assets.

SECURED is equal to one if the loan is secured.

SLOPE YC is the difference between the yields of the five and one year zero coupon bond.

STOCK VOL is the one year stock return volatility using daily returns.

SUBDET BK is the fraction of the bank's subordinated debt to total assets.

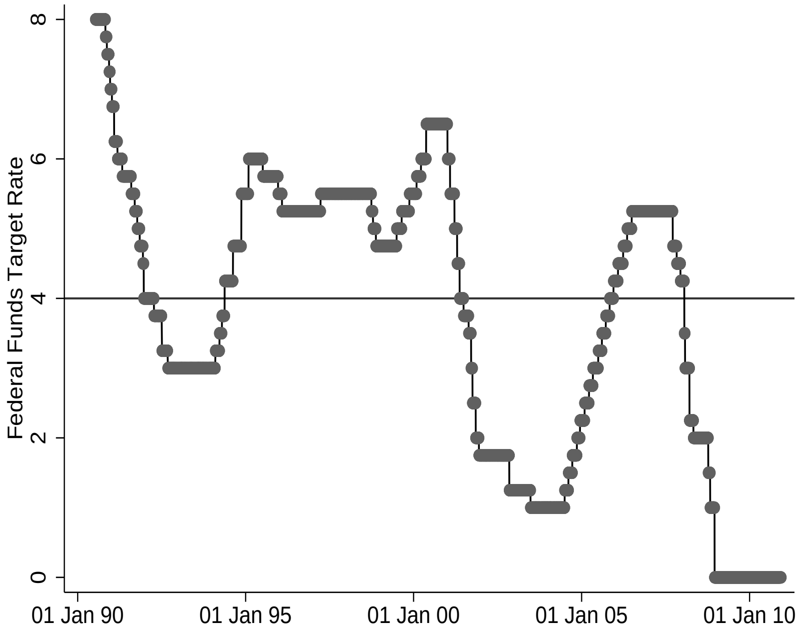
TANGIBLES is inventories plus plant, property, and equipment over total assets.

TERM LOAN is equal to one if a loan is a term loan.

UNRATED is equal to one for borrowers that do not have a credit rating.

WORK CAPITAL is one if the loan is for working capital.

Figure 1: Federal Funds (Target) Rate



Note: This graph shows federal funds target rate at the daily level as determined by the members of the Federal Open Market Committee. The rates below the horizontal line are classified as a low rate regime and above it as a high rate regime. The downward/upward sloping parts of the graph are periods of decreasing/increasing rates. For more details see Section 6.

Table 1: **SAMPLE CHARACTERISTICS**

	MEAN	ST.DEV	25th	MEDIAN	75th
			FIRM CONTROLS		
AGE	19.576	16.414	6.000	13.000	31.000
SALES (million $)	4069	14899	183.3	722	2748.2
LEVERAGE	0.324	0.244	0.147	0.299	0.444
TANGIBILITY	0.727	0.377	0.445	0.714	0.983
RD	0.045	0.561	0.000	0.000	0.012
ADVERTISING	0.011	0.037	0.000	0.000	0.006
L INTCOV	1.914	1.242	1.196	1.769	2.471
MKTBOOK	1.744	1.027	1.112	1.409	1.978
PROF MARGIN	-0.045	0.642	-0.006	0.032	0.072
NWC	6.074	23.474	0.031	0.428	1.468
EX RET	0.093	0.499	-0.172	0.058	0.328
STOCK VOL	0.033	0.019	0.020	0.028	0.041
P DEFAULT	0.040	0.111	0.000	0.000	0.005
RATED	0.437	0.496	0.000	0.000	1.000
I GRADE	0.237	0.426	0.000	0.000	0.000
B GRADE	0.199	0.399	0.000	0.000	0.000
			LOAN CONTROLS		
AMOUNT (million $)	204.282	560.664	20.000	64.000	190.000
LOAN SPD (bsp)	247.147	153.836	144.000	250.000	325.000
MATURITY (years)	4	2.290	2	4	5
CREDIT LINE	0.543	0.498	0.000	1.000	1.000
TERM LOAN	0.284	0.451	0.000	0.000	1.000
CORP PURPOSES	0.340	0.474	0.000	0.000	1.000
WORK CAPITAL	0.112	0.315	0.000	0.000	0.000
DEBT REPAY	0.117	0.321	0.000	0.000	0.000
SECURED	0.924	0.265	1.000	1.000	1.000
DIV RESTRICT	0.851	0.356	1.000	1.000	1.000
			BANK CONTROLS		
ASSETS BK (billion $)	584.187	626.16	90.801	272.426	1083.31
CAPITAL BK	8.261	2.435	6.898	7.998	9.372
DEPOSITS BK	0.653	0.182	0.576	0.675	0.779
SUBDEBT BK	0.014	0.013	0.000	0.013	0.024
LIQUIDITY BK	0.244	0.094	0.178	0.235	0.303
ROA BK	0.001	0.001	0.001	0.001	0.002
ROA VOL BK	0.002	0.002	0.000	0.001	0.002
CHARGEOFFS BK	0.001	0.001	0.000	0.001	0.001
AAA BK	0.018	0.132	0.000	0.000	0.000
AA BK	0.242	0.428	0.000	0.000	0.000
A BK	0.432	0.496	0.000	0.000	1.000
BBB BK	0.029	0.168	0.000	0.000	0.000
BELOW BBB BK	0.001	0.035	0.000	0.000	0.000
UNRATED BK	0.279	0.448	0.000	0.000	1.000
EASING	0.068	0.253	0.000	0.000	0.000
RISK TOL	0.047	0.212	0.000	0.000	0.000
DEMAND WEAK	0.280	0.499	0.000	0.000	1.000

Table 2: **LOAN SPREADS: FIRST RESULTS**
The dependent variable is L LOANSPD, the log of the all-in-drawn spread over LIBOR at origination. All variables are defined in Appendix 2. All models include year, quarter, and bank/bank-firm fixed effects. Standard errors are clustered at the bank level. *** denotes 1% significant level, ** denotes 5% significant level, and * denotes 10% significant level.

	(1)	(2)	(3)	(4)	(5)	(6)
LOW RATE	0.120***	0.121***	0.098***	0.089***	0.080***	0.086***
	(0.024)	(0.018)	(0.020)	(0.025)	(0.018)	(0.022)
B GRADE	0.824***	0.698***	0.385***			
	(0.054)	(0.053)	(0.054)			
UNRATED	0.549***	0.448***	0.314***			
	(0.046)	(0.047)	(0.068)			
P DEFAULT				1.254***	0.971***	0.723***
				(0.123)	(0.087)	(0.068)
L AGE	-0.083***	-0.080***	-0.203***	-0.205***	-0.165***	-0.202***
	(0.014)	(0.012)	(0.041)	(0.027)	(0.018)	(0.034)
L SALES	-0.136***	-0.087***	-0.116***	-0.203***	-0.122***	-0.140***
	(0.008)	(0.008)	(0.012)	(0.004)	(0.007)	(0.012)
LEVERAGE	0.255***	0.218***	0.332***			
	(0.030)	(0.026)	(0.043)			
TANGIBLES	-0.110***	-0.077***	-0.100**	-0.137***	-0.090***	-0.035
	(0.023)	(0.019)	(0.043)	(0.022)	(0.020)	(0.038)
R&D	-0.651***	-0.606**	-0.496	-0.747**	-0.638**	-0.557
	(0.228)	(0.237)	(0.409)	(0.290)	(0.289)	(0.402)
ADVERTISING	-0.800***	-0.741**	-0.899**	-0.453	-0.383	-0.601
	(0.287)	(0.292)	(0.384)	(0.288)	(0.290)	(0.532)
L INTCOV	-0.081***	-0.073***	-0.051***	-0.130***	-0.108***	-0.080***
	(0.007)	(0.008)	(0.010)	(0.016)	(0.013)	(0.013)
MKTBOOK	-0.110***	-0.101***	-0.077***	-0.146***	-0.120***	-0.101***
	(0.014)	(0.012)	(0.011)	(0.015)	(0.014)	(0.011)
PROF MARGIN	0.074***	0.062***	0.055**	0.067***	0.059***	0.053**
	(0.014)	(0.011)	(0.024)	(0.023)	(0.014)	(0.027)
NWC	-0.000	0.000	0.000	0.001*	0.001**	0.000*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
EX RET	-0.061***	-0.045***	-0.068***			
	(0.013)	(0.010)	(0.012)			
STOCK VOL	8.808***	7.160***	3.932***			
	(0.743)	(0.687)	(0.433)			
L AMOUNT		-0.070***	-0.034***		-0.077***	-0.032***
		(0.005)	(0.005)		(0.006)	(0.005)
L MATURITY		-0.011*	-0.004		0.003	-0.005**
		(0.006)	(0.003)		(0.007)	(0.003)
SECURED		0.175***	0.119***		0.310***	0.134***
		(0.021)	(0.012)		(0.017)	(0.011)
CREDIT LINE		-0.314***	-0.242***		-0.411***	-0.267***
		(0.046)	(0.035)		(0.065)	(0.031)
TERM LOAN		-0.067*	-0.111***		-0.108**	-0.124***
		(0.039)	(0.037)		(0.045)	(0.033)
DIV RESRICT		0.195***	0.107***		0.297***	0.127***
		(0.019)	(0.016)		(0.034)	(0.017)
CORP PURPOSES		-0.007	-0.030**		0.009	-0.021
		(0.019)	(0.015)		(0.022)	(0.017)

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Table 2—Continued

DEBT REPAY		-0.021	-0.037**		0.020	-0.015
		(0.014)	(0.017)		(0.016)	(0.018)
WORK CAPITAL		-0.015	-0.052***		0.018	-0.056***
		(0.020)	(0.020)		(0.024)	(0.017)
L ASSETS BK	-0.047	-0.039	-0.013	-0.046	-0.031	-0.025
	(0.049)	(0.049)	(0.071)	(0.045)	(0.045)	(0.072)
ROA BK	-2.000	1.563	-3.453	-3.683	-0.045	-0.971
	(6.579)	(7.006)	(10.722)	(9.052)	(9.524)	(12.452)
SUBDEBT BK	0.361	0.604	1.316	0.089	0.469	-0.534
	(1.767)	(1.499)	(1.599)	(2.019)	(1.731)	(1.545)
ROA VOL BK	-18.709**	-14.239**	-0.538	-13.894	-10.250	-0.987
	(8.303)	(7.207)	(8.769)	(8.625)	(6.911)	(8.121)
CHARGEOFFS BK	18.911**	18.067**	17.823	20.292**	17.355**	12.030
	(8.731)	(8.508)	(11.488)	(7.858)	(7.260)	(11.269)
LIQUIDITY BK	-0.006	-0.058	0.260	-0.161	-0.133	0.111
	(0.209)	(0.196)	(0.166)	(0.222)	(0.209)	(0.188)
CAPITAL BK	-0.013*	-0.013**	-0.006	-0.009	-0.012**	-0.008
	(0.007)	(0.007)	(0.007)	(0.006)	(0.005)	(0.008)
DEPOSITS BK	0.160	0.144	0.263**	0.198*	0.153	0.197*
	(0.121)	(0.118)	(0.103)	(0.112)	(0.110)	(0.117)
AA BK	-0.178**	-0.199***	-0.021	-0.052	-0.077	-0.101
	(0.072)	(0.070)	(0.086)	(0.066)	(0.065)	(0.082)
A BK	-0.208***	-0.235***	-0.032	-0.086	-0.118*	-0.096
	(0.067)	(0.063)	(0.084)	(0.063)	(0.062)	(0.079)
BBB BK	-0.171*	-0.206**	-0.014	-0.006	-0.063	0.002
	(0.095)	(0.092)	(0.107)	(0.092)	(0.089)	(0.090)
BELOW BBB BK	-0.029	-0.031	-0.062	0.077	0.075	-0.266
	(0.179)	(0.159)	(0.077)	(0.182)	(0.172)	(0.170)
UNRATED BK	-0.103	-0.118	-0.170*	0.087	0.043	-0.209**
	(0.096)	(0.087)	(0.096)	(0.102)	(0.091)	(0.093)
BBB SPREAD	0.407***	0.297***	0.453***	0.278***	0.176**	0.376***
	(0.072)	(0.065)	(0.059)	(0.096)	(0.083)	(0.076)
SLOPE YC	-0.000	0.002	0.019	0.000	0.020*	0.030**
	(0.009)	(0.010)	(0.012)	(0.009)	(0.011)	(0.014)
Year	Yes	Yes	Yes	Yes	Yes	Yes
Quarter	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes		Yes	Yes	
Bank-Firm FE			Yes			Yes
R^2	0.592	0.629	0.408	0.466	0.553	0.377
Observations	18,787	17,498	17,498	19,380	18,169	18,169

Table 3: **LOAN SPREADS AND INTERACTIONS: BASE RESULTS**
The dependent variable is L LOAN SPD, the log of the all-in-drawn spread over LIBOR at origination. All variables are defined in Appendix 2. All models include year, quarter, and bank/bank-firm fixed effects. Standard errors are clustered at the bank level. *** denotes 1% significant level, ** denotes 5% significant level, and * denotes 10% significant level.

	(1)	(2)	(3)	(4)	(5)	(6)
$LOW\ RATE$×BGRADE	-0.134***	-0.146***	-0.055**			
	(0.034)	(0.027)	(0.021)			
$LOW\ RATE$×UNRATED	-0.170***	-0.180***	-0.098***			
	(0.034)	(0.029)	(0.015)			
$LOW\ RATE$	0.229***	0.239***	0.146***	0.091***	0.086***	0.099***
	(0.038)	(0.029)	(0.027)	(0.028)	(0.019)	(0.023)
B GRADE	0.897***	0.775***	0.408***			
	(0.059)	(0.056)	(0.049)			
UNRATED	0.634***	0.538***	0.352***			
	(0.056)	(0.056)	(0.069)			
$P\ DEFAULT$				1.290***	1.057***	1.065***
				(0.154)	(0.126)	(0.117)
$LOW\ RATE$×$P\ DEFAULT$				-0.060	-0.146*	-0.504***
				(0.131)	(0.089)	(0.093)
Loan Controls		Yes	Yes		Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Quarter	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes		Yes	Yes	
Bank-Firm FE			Yes			Yes
R^2	0.594	0.631	0.409	0.461	0.553	0.378
Observations	18,787	17,498	17,498	19,380	18,169	18,169

Table 4: **ROBUSTNESS CHECKS**
The dependent variable is L LOAN SPD. All variables are defined in appendix 2. In columns (1) and (2) all variables are interacted with *LOW RATE*. In columns (3)-(6) the sample is split into large firms (sales higher than the sample median) and small firms (sales lower than the sample median). *** denotes 1% significant level, ** denotes 5% significant level, and * denotes 10% significant level.

			Large Firms	Small Firms	Large Firms	Small Firms
	(1)	(2)	(3)	(4)	(5)	(6)
P DEFAULT	1.066***	1.067***	1.566***	0.952***	1.160***	0.780***
	(0.132)	(0.107)	(0.252)	(0.103)	(0.178)	(0.146)
LOW RATE×*P DEFAULT*	-0.148*	-0.500***	-0.793***	-0.256***	-0.690***	-0.283**
	(0.087)	(0.097)	(0.244)	(0.087)	(0.136)	(0.111)
LOW RATE	-1.145*	0.078	0.111***	0.059**	0.102***	0.056*
	(0.652)	(0.496)	(0.026)	(0.027)	(0.029)	(0.030)
Loan Controls	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Quarter	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes		Yes	Yes		
Bank-Firm FE		Yes			Yes	Yes
R^2	0.561	0.388	0.628	0.373	0.466	0.235
Observations	18,169	18,169	9367	8,802	9,367	8,802

Table 5: **ROBUSTNESS CHECKS: PROBABILITY OF DEFAULT AFTER LOAN ORIGINATION**

The dependent variable is probability of default as defined in Appendix 1. Each regression includes a set of firm controls, year and firm fixed effects. The firm controls are defined in appendix 2. *After 1 year*, *After 2 years*, *After 3 years* is a categorical variable that takes one if the current year is one, two, or three years after the year of loan origination. The upper and lower panels identify loans originated in times of low and high interest rates, respectively. *** denotes 1% significant level, ** denotes 5% significant level, and * denotes 10% significant level.

	LOW RATES			
	First Loan	Second Loan	Median Loan	Last Loan
	(1)	(2)	(3)	(4)
After 1 year	-0.000	-0.001	-0.005	0.002
	(0.002)	(0.003)	(0.008)	(0.002)
After 2 years	-0.002	0.001	-0.012	0.005**
	(0.003)	(0.006)	(0.014)	(0.003)
After 3 years	-0.003	0.004	-0.010	0.009***
	(0.005)	(0.008)	(0.021)	(0.003)
Firm Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
R^2	0.060	0.121	0.231	0.156
Observations	11,531	6,996	2,516	12,720
	HIGH RATES			
After 1 year	-0.000	-0.001	0.005	0.004
	(0.002)	(0.002)	(0.005)	(0.004)
After 2 years	-0.003	-0.004	0.010	0.001
	(0.002)	(0.003)	(0.008)	(0.002)
After 3 years	-0.002	-0.005	0.018	-0.004*
	(0.003)	(0.003)	(0.012)	(0.002)
Firm Controls	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes
R^2	0.087	0.112	0.168	0.188
Observations	13,291	10,176	4,271	12,247

Table 6: **ROBUSTNESS CHECKS: ECONOMIC CONDITIONS**

The dependent variable is L LOAN SPD. All variables are defined in Appendix 2. In columns (1) and (2), *GDP* is the percent of quarterly GDP growth at an annual base. In columns (3) and (4), *NEG OUTPUT GAP* takes one if the difference between the actual and the estimated potential GDP is negative and zero otherwise. In columns (5) and (6), NBER RECESSION takes one if the loan is issued in a period of recession as defined by the National Bureau of Economic Research. In columns (7) and (8), CFNAI is a dummy variable that equals one if the Chicago Fed National Activity Index three-month moving average is less than -0.7 and zero other wise. *** denotes 1% significant level, ** denotes 5% significant level, and * denotes 10% significant level.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
P DEFAULT	0.998***	0.977***	1.085***	1.086***	1.066***	1.125***	1.121***	1.211***
	(0.121)	(0.113)	(0.171)	(0.167)	(0.133)	(0.139)	(0.142)	(0.153)
LOW RATE×*P DEFAULT*	-0.116*	-0.486***	-0.103	-0.464***	-0.512***	-0.144*	-0.123*	-0.504***
	(0.065)	(0.092)	(0.120)	(0.145)	(0.100)	(0.082)	(0.069)	(0.103)
LOW RATE	0.079***	0.096***	0.090***	0.103***	0.103***	0.088***	0.084***	0.096***
	(0.019)	(0.023)	(0.020)	(0.025)	(0.023)	(0.019)	(0.019)	(0.023)
GDP×*P DEFAULT*	0.019	0.051**						
	(0.015)	(0.025)						
GDP	-0.008***	-0.010***						
	(0.003)	(0.002)						
NEG OUTPUT GAP×*P DEFAULT*			-0.063	-0.100				
			(0.213)	(0.152)				
NEG OUTPUT GAP			-0.013	-0.017				
			(0.030)	(0.024)				
NBER RECESSION					-0.026	-0.017		
					(0.023)	(0.024)		
NBER RECESSION×*P DEFAULT*					-0.062	-0.253*		
					(0.084)	(0.137)		
CFNAI							0.065**	0.097**
							(0.026)	(0.038)
CFNAI×*P DEFAULT*							-0.327***	-0.473***
							(0.099)	(0.143)
Loan Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes		Yes		Yes		Yes	
Bank-Firm FE		Yes		Yes		Yes		Yes
R^2	0.554	0.381	0.552	0.378	0.551	0.378	0.553	0.380
Observations	18,169	18,169	18,169	18,169	18,169	18,169	18,169	18,169

Table 7: **ROBUSTNESS CHECKS:**
US LENDERS and CANADIAN BORROWERS

The dependent variable is L LOAN SPD. All variables are defined in Appendix 2. The sample is comprised of Canadian public firms and US lenders. *** denotes 1% significant level, ** denotes 5% significant level, and * denotes 10% significant level.

	(1)	(2)	(3)	(4)
LOW RATE×BGRADE	-0.319*	-0.257**	-0.319*	-0.406*
	(0.175)	(0.113)	(0.175)	(0.221)
LOW RATE×UNRATED	-0.026	-0.136	-0.026	-0.142
	(0.189)	(0.183)	(0.189)	(0.264)
LOW RATE	-0.029	-0.021	-0.029	-0.086
	(0.370)	(0.373)	(0.370)	(0.166)
B GRADE	1.507***	1.064***	1.507***	0.698***
	(0.111)	(0.104)	(0.111)	(0.164)
UNRATED	1.270***	0.689***	1.270***	0.591***
	(0.184)	(0.169)	(0.184)	(0.124)
Loan Controls	No	Yes	No	Yes
Firm Controls	No	No	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Quarter	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes
R^2	0.389	0.539	0.389	0.771
Observations	1,224	1,136	1,224	469

Table 8: **SECOND STAGE REGRESSIONS: LENDING STANDARDS**
The dependent variable is L LOAN SPD. $EASING_{RES}$ is the generalized residual from a first-stage probit regression with dependent variable that takes one if banks are easing their lending standards for approving applications for C&I loans or credit lines, and zero otherwise. All other variables are defined in Appendix 2. Standard errors are bootstrapped. *** denotes 1% significant level, ** denotes 5% significant level, and * denotes 10% significant level.

	(1)	(2)	(3)	(4)
LOW RATE	0.073***	0.084***	0.078***	0.100***
	(0.024)	(0.021)	(0.023)	(0.023)
P DEFAULT	1.000***	0.705***	1.147***	1.182***
	(0.050)	(0.062)	(0.095)	(0.115)
$EASING_{RES}$	0.014	0.003	0.007	-0.006
	(0.009)	(0.008)	(0.015)	(0.013)
$P\ DEFAULT \times LOW\ RATE$			-0.193	-0.645***
			(0.121)	(0.153)
$EASING_{RES} \times LOW\ RATE$			0.006	0.011
			(0.020)	(0.018)
$P\ DEFAULT \times EASING_{RES}$	0.034	0.102	1.178***	0.908**
	(0.087)	(0.080)	(0.334)	(0.451)
$EASING_{RES} \times LOW\ RATE \times P\ DEFAULT$			-1.223***	-0.791*
			(0.354)	(0.479)
Loan Controls	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Quarter	Yes	Yes	Yes	Yes
Bank FE	Yes		Yes	
Bank-Firm FE		Yes		Yes
R^2	0.569	0.394	0.570	0.397
Observations	15,943	15,943	15,943	15,943

Table 9: **SECOND STAGE REGRESSIONS: RISK TOLERANCE**
The dependent variable is L LOAN SPD. $RISKTOL_{RES}$ is the generalized residual from a first-stage probit regression with dependent variable risk tolerance that takes one if risk tolerance is an important reason for easing lending standards for approving applications for C&I loans or credit lines, and zero otherwise. All other variables are defined in Appendix 2. Standard errors are bootstrapped. *** denotes 1% significant level, ** denotes 5% significant level, and * denotes 10% significant level.

	(1)	(2)	(3)	(4)
$LOW\ RATE$	0.060***	0.084***	0.062**	0.105***
	(0.023)	(0.029)	(0.026)	(0.021)
$P\ DEFAULT$	0.970***	0.672***	1.044***	1.167***
	(0.066)	(0.107)	(0.091)	(0.133)
$RISK\ TOL_{RES}$	0.011	0.012	0.003	-0.006
	(0.010)	(0.010)	(0.020)	(0.021)
$P\ DEFAULT \times LOW\ RATE$			-0.092	-0.671***
			(0.106)	(0.160)
$RISK\ TOL_{RES} \times LOW\ RATE$			0.010	0.023
			(0.022)	(0.020)
$P\ DEFAULT \times RISK\ TOL_{RES}$	-0.189**	-0.033	1.117***	0.435
	(0.076)	(0.107)	(0.394)	(0.542)
$RISK\ TOL_{RES} \times LOW\ RATE \times P\ DEFAULT$			-1.395***	-0.445
			(0.385)	(0.545)
Loan Controls	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Quarter	Yes	Yes	Yes	Yes
Bank FE	Yes		Yes	
Bank-Firm FE		Yes		Yes
R^2	0.586	0.412	0.586	0.414
Observations	13,488	13,488	13,488	13,488

Table 10: **SECOND STAGE: DEMAND FOR LOANS**

The dependent variable is L LOAN SPD. $DEMAND_{RES}$ is the generalized residual from a first-stage probit regression with dependent variable that takes one if a bank considers demand for C&I loans from large and middle-market firms to be waek over the past three months for reasons other than seasonal variations. All variables are defined in Appendix 2. Standard errors are bootstrapped. *** denotes 1% significant level, ** denotes 5% significant level, and * denotes 10% significant level.

	(1)	(2)	(3)	(4)
LOW RATE	0.068**	0.096***	0.075***	0.113***
	(0.031)	(0.023)	(0.022)	(0.027)
P DEFAULT	0.973***	0.693***	1.033***	1.216***
	(0.057)	(0.113)	(0.069)	(0.145)
$DEMAND_{RES}$	0.004	0.003	-0.007	-0.006
	(0.006)	(0.007)	(0.008)	(0.009)
P DEFAULT×*LOW RATE*			-0.097	-0.700***
			(0.082)	(0.152)
$DEMAND_{RES}$×*LOW RATE*			0.025**	0.019
			(0.011)	(0.014)
P DEFAULT×$DEMAND_{RES}$	0.012	0.137	0.017	0.327**
	(0.071)	(0.090)	(0.111)	(0.147)
$DEMAND_{RES}$×*LOW RATE*×*P DEFAULT*			-0.016	-0.224
			(0.153)	(0.176)
Loan Controls	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes
Quarter	Yes	Yes	Yes	Yes
Bank FE	Yes		Yes	
Bank-Firm FE		Yes		Yes
R^2	0.584	0.415	0.587	0.417
Observations	14,409	14,409	14,409	14,409

Table 11: **LOAN SPREADS AND INTERACTIONS FOR DECREASING/INCREASING RATES**

The dependent variable is L LOAN SPD, the log of the all-in-drawn spread over LIBOR at origination. All variables are defined in Appendix 2. All models include year, quarter, and bank/bank-firm fixed effects. Standard errors are clustered at the bank level. *** denotes 1% significant level, ** denotes 5% significant level, and * denotes 10% significant level.

	(1)	(2)	(3)	(4)	(5)	(6)
$DECREASING \times BGRADE$	-0.105**	-0.066*	-0.054***			
	(0.046)	(0.038)	(0.019)			
$DECREASING \times UNRATED$	-0.146***	-0.122***	-0.031			
	(0.029)	(0.024)	(0.038)			
DECREASING	0.117***	0.096***	0.061***	0.039	0.044**	0.039*
	(0.032)	(0.023)	(0.020)	(0.027)	(0.021)	(0.020)
B GRADE	0.878***	0.739***	0.424***			
	(0.067)	(0.062)	(0.052)			
UNRATED	0.622***	0.516***	0.418***			
	(0.055)	(0.056)	(0.054)			
$P\ DEFAULT$				1.064***	1.449***	0.964***
				(0.162)	(0.207)	(0.161)
$DECREASING \times P\ DEFAULT$				-0.160	-0.301**	-0.379*
				(0.127)	(0.143)	(0.198)
Loan Controls		Yes	Yes		Yes	Yes
Firms Controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year	Yes	Yes	Yes	Yes	Yes	Yes
Quarter	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes		Yes	Yes	
Bank-Firm FE			Yes			Yes
R^2	0.608	0.640	0.410	0.474	0.558	0.374
Observations	16,387	15,277	15,277	16,841	15,812	15,812