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ABSTRACT

To study the presence of a risk-taking channel in the US, we build a comprehensive dataset from the syndicated corporate loan market and measure monetary policy using different measures, most notably Taylor (1993) and Romer and Romer (2004) residuals. We identify a negative relation between monetary policy rates and bank risk-taking, especially in the run up to the 2007 financial crisis. However, this effect is purely supply-side driven only when using Taylor residuals and an *ex ante* measure of bank risk-taking. Our results highlight the sensitivity of the potency of the risk-taking channel to the measures of monetary policy innovations.

Keywords: Bank risk; monetary policy; US commercial banks; Total loans; New loans

JEL classification: G21; G01; E43; E52

1. INTRODUCTION

A recent line of research suggests that there is a significant link between a monetary policy of low interest rates over an extended period of time and higher levels of risk-taking by banks. This link points to a different dimension of the monetary transmission mechanism, the so-called risk-taking channel of monetary policy transmission (Borio and Zhu 2008). In this paper we use unique information on individual loan facilities to assess the potency of this channel in the US, the country in which the financial turmoil of 2007 – 2008 began. The motivation for this exercise comes from the lively debate between advocates of the Fed's policy of exceptionally low interest rates in order to facilitate economic expansion in light of the crisis and the opponents of this view who claim that this policy is creating more risk appetite in the market, making another eventual bust in the US more likely (Diamond and Rajan 2009).

The risk-taking channel might be at work through three main mechanisms. The first is the search-for-yield mechanism, with low (nominal) interest rates increasing incentives for bank-asset managers to take on more risks (Rajan 2005). The second mechanism relates to the impact of low interest rates on real valuations, incomes, and cash flows. Low rates boost asset and collateral values while tending to reduce price volatility, which in turn downsize bank estimates of probabilities of default and encourage higher risk positions (Borio and Zhu 2008). In addition, low interest rates imply a higher value of banks' assets portfolios, thereby leading to a higher net worth that entices banks to assume greater risk positions (Stiglitz and Greenwald 2003, Adrian and Shin 2010). Unlike the first mechanism, an essential element of this proposition is that the risk-taking channel involves not only new assets (loans), but also the valuation of assets already present in bank portfolios.

Third, monetary policy could also affect risk-taking through the reaction function of the central bank to negative shocks. The commitment of a central bank for lower (future) interest rates in the case of a threatening shock reduces the probability of large downside risks, thereby encouraging banks to assume greater risk (transparency effect). It should be emphasized that this effect (also known as the Greenspan or Bernanke put) operates through the expected lower interest rates (should they be needed) rather than current low rates themselves. Its magnitude, however, depends on the current level of the policy rate. Anticipated interest rate reductions tend to correspond to a higher risk position when there is greater room for monetary expansion, i.e., when current rates are high (De Nicolò et al. 2010).

The existing empirical literature on the link between interest rates and bank risk in the US has been generally supportive of the risk-taking channel of monetary policy (De Nicolò et al. 2010, Maddaloni and Peydró 2011, Paligorova and Santos 2012, Dell'Ariccia, Laeven, and Suarez 2013, Altunbas, Gambacorta, and Marquéz-Ibáñez 2014). Since monetary policy instruments, bank risk and macroeconomic variables are possibly determined simultaneously, all researchers unanimously recognize that exogenous monetary policy is an essential ingredient for the proper econometric identification of the link between interest rates and bank risk-taking. To this end, they often consider simple rules to assess the overall stance of monetary policy. The most frequently used rule is the one introduced by Taylor (1993), which uses inflation and the output gap as inputs for federal funds rate decisions.

Despite its popularity, the usefulness of the Taylor rule has been criticized for its dependence on *ex post*, revised data, which do not take into account the information available to the policymakers in real time (Orphanides 2001). This informational problem is likely to be of great importance in assessing the precise impact of monetary policy on bank risk-taking. Furthermore, because Taylor rule involves only a small number of variables, it does not fully accommodate the fundamental changes in the Fed's monetary policy occurred in the late 2000s. Specifically, since December 2008 the federal funds rate has been essentially stuck at the zero lower bound (ZLB) and the Federal Open Market Committee (FOMC) has deployed the unconventional tools of forward guidance and quantitative easing. As discussed by Hakkio and Kahn (2014), in ZLB/unconventional monetary policy environments, simple rules are inadequate measures of monetary policy stance.

Our primary objective in this paper is to assess the previously reported potency of the risk-taking channel in the US, using alternative approaches in identifying the exogenous variation in monetary policy. First, we use Taylor-type rule residuals obtained by regressing the *shadow* federal funds rate (Krippner 2014) on output gap and inflation. The shadow rate is not constrained by the ZLB and incorporates both conventional and unconventional tools in its assessment of the overall stance of monetary policy. To further alleviate concerns about the endogeneity of monetary policy, we also compute state-specific Taylor residuals using again the shadow policy rate as the dependent variable and state-level data on output and inflation as regressors. Since the monetary policy pursued by the Fed is dependent on nationwide, aggregate measures of economic performance, changes in the US monetary policy would affect the individual states' economies, but the reverse would be less likely to hold.

Given the potential caveats of the Taylor approach, and unlike much of the existing literature, we also employ the identification strategy developed by Romer and Romer (2004) which allows recovering the unanticipated, exogenous component of monetary policy by using narrative evidence and the Fed's *real-time* information as captured by the Greenbook forecasts. To the extent that these data adequately summarize the Fed's private information set regarding its objectives and expectations, this approach eases concerns about the endogeneity between interest rates and economic conditions.

The aforementioned alternative, however, runs into difficulties once the ZLB becomes binding and unorthodox monetary policy measures are implemented (Lombardi and Zhu 2014). To account for the effect of unconventional policies adopted by the Fed in the post-2008 period, we also experiment with the effective monetary stimulus (EMS) rate put forth by Krippner

(2011, 2014). The EMS contains information from the entire yield curve and is defined as the integral over the difference of the shadow short rate expectations (over all horizons) to the neutral interest rate (Krippner 2014). A major advantage of the EMS is that it represents a consistent measure of monetary policy stance across different monetary regimes (conventional vs. unconventional). As such, it allows us to analyze monetary policy shocks also in times of unconventional monetary policy.

In estimating the effects of monetary policy on bank risk-taking, one also needs to meticulously account for two more identification challenges pertaining to: (i) the fact that although the risk-taking channel describes the incentives to engage primarily in *ex ante* riskier projects, most data sources do not distinguish between new and outstanding loans; and (ii) the need to disentangle movements in the risk-taking measure originating from demand and supply effects. Thus, the second objective of this paper is to contribute to our understanding of the risk-taking channel along these dimensions.

We address the first problem by building a novel loan-level data set bringing together information from four different databases. The primary source of loan-level data is the Dealscan database maintained by the Loan Pricing Corporation (LPC). The full sample consists of detailed financial data for more than 26,000 syndicated loan transactions from 1987 to 2012. To the best of our knowledge, we are the first to use disaggregated corporate loan data for the US for the purpose of studying the variation in the terms of *new* business lending around changes in the monetary policy stance, and particularly whether banks' risk appetites increase during monetary expansions. [1]

We construct two different measures of bank risk-taking. First, following the paradigm established by Ioannidou, Ongena, and Peydró (2015) on the Bolivian banking industry and Jiménez et al. (2014) on the Spanish banking industry, we collect data on the borrowers' bankruptcies (using information from the New Generations Research database) to estimate the probability of loan default in the current period conditional on survival until that period (i.e., the hazard rate). Given that this measure is in essence an *ex post* measure of bank risk, we also use an *ex ante* measure of banks' risk attitudes at the time a loan is issued. Specifically, we use the loan specific coupon spread, plus any one-time fees and recurring fees, measured as a markup over LIBOR (the so called all-in-spread drawn, AISD). All other things equal, this spread can be interpreted as an indicator of the loan specific default probability. If banks engage in funding riskier projects and charge higher loan spreads, as theory suggests, differences in loan spreads *across banks or time* should provide us with information about how banks' risk-taking incentives change in response to the monetary policy pursued. We see this *ex-ante* measure of bank risk-taking as an important contribution to the literature.[2]

The second identification problem stems from the need to disentangle changes in banks' lending activity (credit supply shifts) from changes in loan demand (credit demand shifts). The premise is that during protracted periods of low interest rates and improved economic conditions, riskier borrowers are able to demand more credit as a result of their higher asset and collateral values. Thus, the higher observed risk in bank portfolios may not necessarily be the sole outcome of an increase in banks' risk-taking appetites, but also the result of an increasingly riskier pool of borrowers. This issue is highlighted by the relevant studies of the bank-lending channel (e.g., Kashyap and Stein 2000).

We ease concerns on this problem in numerous ways and contribute to the existing literature by disentangling the impact of monetary policy rates on the risk of the supply of credit from changes in credit demand. First, the Dealscan database includes information on borrowers' creditworthiness (*Z*-score). To the extent that this measure accounts for the firms' riskiness, the effect of monetary conditions on loan risk should in principle be attributed to the origination of loans (i.e., banks' risk-taking). Nevertheless, the coefficient on the monetary policy variable may still include aggregate demand and supply effects, which cannot be reasonably disentangled. For this reason, we also consider how monetary policy affects a bank's ability to grant new loans (the bank balance sheet channel) and examine whether credit supply shocks are correlated with the monetary policy conditions. To this end, we further augment our data set by matching the loan-level and firm-level data with bank-balance sheet information from the Call reports and introduce a series of double interaction terms between monetary policy rates and bank capital and liquidity, while controlling for any unobserved time-invariant firm and bank characteristics. In this case, identification resides in assessing the heterogeneity in the reaction of banks to common monetary policy shocks, which should be supply driven. Finally, in order to identify the bank risk-taking channel at the *bank-firm* level, we interact the monetary policy rate with bank capital and firm risk (triple interaction terms). Triple interactions control exhaustively for the heterogeneous response of banks in supplying credit to riskier firms in times of loose of monetary policy.

In a nutshell, the empirical evidence from the benchmark measure of monetary policy conditions (Taylor rule residuals) supports the presence of a potent risk-taking channel, especially in the period leading up to the 2007 financial crisis, working primarily through bank capital. This finding, however, holds only for the *ex ante* proxy of bank risk-taking as measured by the corporate loan spreads. Furthermore, when using the Romer and Romer (2004) procedure we are not able to identify a potent risk-taking channel. Although the overall effect of the Romer and Romer shocks is negative and significant, the purely supply-side driven effects – seen from the double and triple interactions of monetary policy shocks with bank capital and firm risk – are statistically insignificant in most instances. A number of additional tests do not alter these key findings. These results further contribute to the ongoing debate on the effect of monetary policy on banks' risk-taking incentives, as they provide novel evidence regarding (i) the potency of the risk-taking channel in the US market for corporate loans, (ii) the significant sensitivity of bank risk-taking assessment to the measures of monetary policy innovations and bank risk-taking, and (iii) the importance of appropriately identifying that the presence of (any) bank risk-taking is supply (and not demand) driven.

The remainder of the paper is organized as follows. Section 2 outlines the related literature on the bank risk-taking channel. Section 3 discusses the data set and presents the empirical models to be estimated. Section 4 reports and discusses the empirical findings. Section 5 concludes.

2. RELATED LITERATURE

A number of recent theoretical works attempt to model the link between loose monetary policy and risks in banking through various channels including asset substitution and search-for-yield, risk-shifting, pro-cyclical leverage, the reaction function of central banks and market inefficiencies. Asset substitution occurs through the asset side of financial institutions' balance sheet. Namely, low levels of short-term interest rates tend to increase the share of riskier assets (relative to safer assets) in bank portfolios (De Nicolò et al. 2010). A similar mechanism emerges in the presence of sticky nominal return targets. Financial institutions, such as life insurance and pension funds, typically manage their assets with respect to nominal liabilities that are often characterized by predefined long-term fixed rates. This constraint induces bank managers to adopt search-for-yield strategies especially when short-term interest rates remain low for a prolonged period (Rajan 2005).

The risk-shifting channel refers to the effects that lower interest rates have on the liability side of banks' balance sheets. Valencia (2011) shows that, under limited liability, a drop in the policy rate reduces the cost of banks' liabilities, thereby raising their profitability and their incentive to engage in excessive leverage and risk-taking. Likewise, Dell'Ariccia, Laeven, and Marquez (2014) argue that when banks are allowed to adjust their capital structures, lower interest rates lead to greater leverage and higher risk. However, if the capital structure is fixed, the effect of the reduction in interest rates on bank monitoring depends on the degree of bank capitalization; well-capitalized banks increase risk, while highly levered banks may decrease it if loan demand is linear or concave.

Another channel through which more risk can be acquired is via the procyclicity of leverage advanced by Adrian and Shin (2010). According to this channel, ease monetary policy boosts up asset prices through valuation effects. Thus, leverage (defined as the ratio of total assets to equity) declines. Banks then hold *surplus capital* which they utilize by expanding both sides of their balance sheets, i.e., they acquire more, and potentially riskier assets by taking on additional leverage.

Monetary policy could also affect bank risk-taking through the expected reaction function of central banks to negative shocks (the so-called Greenspan put). Diamond and Rajan (2009) and Farhi and Tirole (2012) show that when agents anticipate a strong policy response by the monetary authorities in the event of a large threatening shock, they tend to increase leverage, take on more risks, and hoard less liquidity. To this end, Agur and Demertzis (2010) argue that central banks concerned with financial stability should engage in deeper but shorter-lived interest rate cuts when there are negative macroeconomic shocks.

Finally, another strand of the literature points to the role of market inefficiencies in an environment of falling interest rates and increasing asset prices. This reasoning relates bank risk-taking with mispriced collateral (Cociuba, Shukayev, and Ueberfeldt 2012), mispriced risk perceptions (Acharya and Naqvi 2012) and opaque regulatory environment (Dubecq, Mojon, and Ragot 2009). [3]

The empirical literature generally verifies the presence of a risk-taking channel. Jiménez et al. (2014) study the evolution of Spanish credits from 1988 to 2006 and find that an expansionary monetary policy affects the riskiness of banks' portfolios (prominently in the medium term) due to the higher collateral values and the search-for-yield. Ioannidou, Ongena, and Peydró (2015) use a Bolivian loans database and find that lower monetary policy rates spur the provision of new loans with higher probability of default, granted to riskier borrowers and with lower interest rate spreads.

A handful of studies investigate the presence of a risk-taking channel in the US using primarily micro-level datasets (De Nicolò et al. 2010, Paligorova and Santos 2012, Dell' Ariccia, Laeven, and Suarez 2013). De Nicolò et al. and Dell' Ariccia, Laeven, and Suarez find a negative association between monetary policy and *ex ante* risk-taking, especially for well-capitalized banks. This finding implies that the risk-taking channel depends on banking market conditions and factors that affect these conditions. In good times, for example, when most banks' charter values and capitalization are sufficiently high, monetary policy easing induces greater risk-taking, yet this relationship is less pronounced in times of financial distress. Similarly, Paligorova and Santos find that banks charge riskier borrowers (relative to safer ones) a smaller interest rate premium in times of expansionary monetary policy compared to periods of contractionary monetary policy, and that this interest rate discount is more prevalent among banks with greater risk appetite.

Finally, Altunbas, Gambacorta, and Marquéz-Ibáñez (2014) and Maddaloni and Peydró (2011) take a more international perspective and investigate the risk-taking channel of monetary policy using information for banks operating in the European Union and the US. The former study finds that unusually low monetary policy rates, over an extended period of time, increase bank risk, as measured by expected default frequencies. In a similar vein, Maddaloni and Peydró (2011) report robust evidence for the softening impact of low short-term interest rates on banks' lending standards; nevertheless, the impact of low long-term rates on lending standards is far less pronounced.

3. DATA AND EMPIRICAL IDENTIFICATION

For the purposes of the present study, the distinction between realized risk (on outstanding loans) and new risk (on new loans) is crucial since the risk-taking channel refers to banks' incentives to engage primarily in *ex ante* riskier projects. Therefore, it is important to examine how the terms of new business lending vary around changes in the monetary policy stance. In addition, we need to control for borrowers' demand of credit over time to accurately assess the supply shifts that characterize this mechanism.

To this end, we use data on all syndicated credit facilities granted to borrowers in the US from 1987 to 2012. We source these data from the Dealscan database maintained by the LPC. While LPC provides comprehensive information on loan characteristics (amount, maturity, LIBOR spread, etc.) it does not provide information on borrower characteristics. Therefore, LPC is matched with the Compustat database, which provides data on borrower financials, following the methodology adopted in Bharath et al. (2011). This lowers the number of observations from our initial sample of loans by about half. We enrich our data set with respect to lead arranger bank financials by drawing statement data from the Federal Deposit Insurance Corporation (FDIC) Call Reports. This matching process results in a final sample with detailed financial data for a maximum of 22,592 unique syndicated loan transactions for which all the main variables of our study are available. Brief descriptions of all variables, along with their summary statistics and bivariate correlation coefficients, are provided in Tables A1, A2, and A3 in the Appendix.

In the syndicated loan market, a loan is divided among more than one lender. Typically, the loan is originated by a lead bank, which sells pieces of the loan to other junior banks. The lead bank acts as the manager of the loan responsible for *ex ante* due diligence, *ex post* monitoring of the borrower, and for the pricing and the terms of lending (Ivashina 2009). In our sample the lead bank holds approximately 30% of the loan share. Lead banks have several motivations to syndicate loans, such as diversification of loan portfolios, avoidance of excessive single-name exposure in compliance with banking regulation, generation of additional fee income, and diversification of income sources (Dennis and Mullineaux 2000). Syndication also allows junior banks, which typically suffer from a lack of origination capabilities in certain types of transaction and geographical areas or industrial sectors, to fund loans. Furthermore, syndication allows banks to build closer relationships with borrowers in anticipation of future, more profitable business, such as treasury management, corporate finance, and advisory work (Altunbas and Gadanecz 2004).

These motivations should, however, be put into perspective with the two agency problems that characterize the syndicated loan market. The first is adverse selection, whereby the lead arranger has an incentive to sell the loans of the borrowers about whom it has negative private information while keeping long-run private profits from forming a customer relationship with them (Ivashina 2009). The second relates to moral hazard, whereby the lead arranger puts less effort in monitoring, especially when it retains a smaller loan portion. Thus, this is a caveat of the empirical analysis using data from the syndicated loan market and, as a remedy, we control for a number of loan characteristics that at least partially capture these dynamic agency problems.

To investigate how the changes in monetary policy affect banks' risk incentives, we employ two different loan-specific measures of risk. First, we use the pricing of newly-issued syndicated loans (measured by the all-in-spread drawn (AISD) over LIBOR) as an *ex ante* measure of their risk.[4] Following the reasoning of Ivashina (2009) and Aramonte, Lee, and Stebunovs (2015), corporate loan spreads embed private information about default risk, such as lenders' expected loss given default, and capture the intrinsic tolerance of banks to take on this risk. Thus, AISD describes the incentives to engage in risky projects before this risk materializes. Banks normally charge higher spreads on loans with a higher risk of default. Nevertheless, while loan credit quality does indeed influence spreads, so do many other factors. It has been shown in the literature that loan spreads depend on an array of factors that characterize borrowers' and lenders' financial strength and growth perspectives (e.g., Hubbard, Kuttner, and Palia 2002, Qian and Strahan 2007). It follows that if banks correctly assess the impact of all these factors at the time of loan origination and adjust accordingly the price and non-price terms of lending, then controlling for all these factors in our empirical specifications should allow us to investigate whether changes in (exogenous) monetary conditions directly modify banks' risk attitudes. Therefore, within this empirical setup, we examine whether banks tend to relax their lending standards (i.e., fund riskier projects and charge higher spreads) during periods of loose monetary conditions.

The second loan-specific measure of risk follows the paradigm of Ioannidou, Ongena, and Peydró (2015) and Jiménez et al. (2014) in using proportional hazard modelling (survival analysis) of the probability of loan default. Here we do not observe loan default, but we do obtain information on the date of a borrower's default during the duration of the loan through the New Generations Research database. This database contains information on all public firms that have filed for Chapter 11 bankruptcy protection since 1988. In this sense, we have information for virtually all the firms in our sample. The bankruptcy data are matched with Dealscan, Compustat and Call reports data through the 6-digit CUSIP number, i.e., the issuer code, and then directly based on firm name, location, and industry if no match is found (see also Cai, Saunders, and Steffen 2012). We are able to identify 854 such bankruptcies from 1987 to 2012.

For the estimation of the proportional hazard model we use the semiparametric method of Cox, but we verify that our results hold when we use parametric models with an exponential or a Weibull distribution (for an introduction to survival analysis, see Cleves et al. 2010). The hazard function determines the probability that borrower default will occur at a specific point in time *t*, conditional on the spell surviving until time *t*. Therefore, the hazard rate provides a per-period *ex post* measure of loan risk. Under this approach, our observations are right-censored, to remove the inconsistency of simple probit and logit models which arise from the fact that the probability of loan default does not uniformly correspond to the probability of default in each period (the hazard rate).

Our baseline empirical specification takes the following form:

$$LOANRISK_{i,f,b,t} = a_b + a_f + \beta \times monetary_{t-1} + \sum_{j=1}^{J1} \gamma_j \times loan_{j,i,f,b,t} + \delta \times borrower_{i,f,b,t-1} + \sum_{j=1}^{J2} \zeta_j \times bank_{j,i,f,b,t-1} + \varphi \times monetary_{t-1} \times bank_{i,f,b,t-1} + \varepsilon_{i,f,b,t} \quad (1)$$

Note that each observation in the analysis corresponds to a separate loan agreement; thus subscript *i* refers to the individual loan granted from bank *b* to borrower *f* at quarter *t*. Phrased differently, each loan facility and all other corresponding information from the four databases used to construct our sample are matched to a specific quarter during the period 1987q1 to 2012q4.

In the baseline equation (1), the loan-level risk (*LOANRISK*) is regressed on the lagged measure of the stance of monetary policy (*monetary*) and a set of controls. Specifically, *loan* is a set of *J1* loan-specific characteristics, *borrower* is the borrowing firm's Altman's (1968) modified *Z*-score and *bank* is a set of *J2* (lead) bank-specific characteristics (see section 3.2 for a detailed description of the control variables). The specification further loads in bank and borrower fixed effects represented by a_b and a_f, respectively. Finally, ε is the error term.

Our coefficient of interest is β, which captures the overall effect of monetary policy conditions on loan risk. If banks do indeed seek to take on more risk during periods of monetary policy expansion, then we should expect $\beta < 0$.[5] However, since β may be contaminated by credit demand shifts, we place more emphasis on the interaction terms between monetary policy rates and key bank characteristics, which account for the differential effect of bank capital and liquidity on the link between interest rates and loan risk. To this end, we are able to isolate the impact of monetary policy shocks on the *composition of the supply of credit*, and in particular on banks' risk appetite.[6] In subsequent specifications, we also interact the monetary policy variable with bank capital and borrower risk (triple interactions) to assess the compositional changes in the supply of credit at the *bank-firm* level. This is the essence of the identification strategy proposed by Jiménez et al. (2014).

Notably, to avoid the Moulton (1990) problem, the standard errors are clustered by quarter because the explanatory variable of interest (the monetary policy rate) varies by quarter and is common to all the loan-level observations in that quarter. However, we also check the robustness of our estimates by clustering the standard errors by bank and/or firm.

3.1. Monetary policy interest rates

The obvious choice to measure monetary policy would be to use the change in the real federal funds rate, computed as the difference between the nominal federal funds rate and the consumer price index (CPI) inflation rate. The federal funds rate is the primary tool used for implementing monetary policy and reflects the actual cost of bank refinancing. A first problem with this variable is that in the period following the subprime crisis the unconventional monetary policy tools are not accounted for. We account for this issue by resorting to the so-called shadow short rate. The shadow short rate is equal to the policy interest rate in non-zero lower bound/conventional monetary policy environments, but it can take on negatives values in zero lower bound environments.[7]

A more notable problem with the federal funds rate and the shadow short rate is that these variables are likely to be endogenous to the US macroeconomic conditions and, if this is indeed the case, the estimates will in part reflect the way in which the macroeconomic conditions affect banks' appetites for risk. To reduce this endogeneity, we experiment with alternative monetary policy rates. First, we use the Taylor rule residuals obtained by regressing the shadow short rate on output gap and inflation (Taylor 1993). In an alternative specification, we run this regression by US state to allow the Taylor rule residuals to have different regional effects on bank risk-taking (in a similar fashion to Dell'Ariccia, Laeven, and Suarez 2013). Subsequently, we match the residuals to banks based on the state in which banks are headquartered. The computation of state-specific Taylor rule residuals allows us to further alleviate the endogeneity concerns since the economic conditions in individual states are less likely to affect monetary policy. The Federal Reserve Act itself dictates that the FOMC's policies should be made "with regard to their bearing upon the *general* credit situation of the country" (FRA, section 12Ac).

Following Adrian and Shin (2008), we interpret the Taylor rule residual as discretionary monetary policy. A negative residual implies softening monetary policy conditions and vice versa. Taylor rule residuals can also be regarded as a means for signaling the Fed's intentions to the financial markets, thereby influencing banks' perceptions about the stance of monetary policy. In other words, the main advantage of Taylor rule residuals in our context is that most banks would take risks on the basis of their perception of whether the level of the federal funds rate (or shadow short rate after the subprime crisis) is lower than the rate implied by the Taylor benchmark.

However, the Taylor rule has been criticized on the grounds of replacing *ex ante* forecasts with *ex post* data (especially for output gap). For example, Orphanides (2001) suggests that the use of *ex post* data can distort the estimated monetary policy reaction functions. For this reason, we also employ the changes in the federal funds rate targeted by the FOMC at their scheduled meetings and use real time data. We follow the two-step procedure outlined by Romer and Romer (2004). In the first step, we derive a federal funds rate target series. Romer and Romer use narrative evidence to determine the change in the federal funds rate targeted by the FOMC during their scheduled meetings (approximately eight per year). Their constructed series spans the period 1969-1996 and is allegedly unaffected from any transitory shocks to supply and demand in the reserve market. We expand the original Romer and Romer target series by appending the FOMC's announced target federal funds rate changes for the 1997-2007 period.[8] In the second step, the targeted federal funds rate change is regressed upon the Greenbook forecasts for real output (GNP/GDP) growth, inflation (GNP/GDP implicit deflator – chain weighted price index) and unemployment over horizons of up to two quarters. The precise regression estimated is:

$$\Delta ff_m = a + \beta \times ff_{m-1} + \sum_{i=-1}^{2} \gamma_i \times \Delta\tilde{y}_{mi} + \sum_{i=-1}^{2} \delta_i \times \tilde{\pi}_{mi} + \theta \times \tilde{u}_{m0} + \sum_{i=-1}^{2} \lambda_i \times \left(\Delta\tilde{y}_{mi} - \Delta\tilde{y}_{m-1,i}\right) + \sum_{i=-1}^{2} \eta_i \times \left(\tilde{\pi}_{mi} - \tilde{\pi}_{m-1,i}\right) + \varepsilon_m \qquad (2)$$

where the dependent variable is measured at a meeting-by-meeting frequency as indicated by subscript *m*. The subscript *i* denotes the quarter of the forecast relative to the meeting date. In particular, we regress the change in the targeted funds rate around FOMC meeting *m* (Δff_m) on the level of the target federal funds rate prior any changes associated with meeting *m* (ff_{m-1}), on the one and two quarter ahead forecasts of real output growth ($\Delta\tilde{y}_{mi}$) and inflation ($\tilde{\pi}_{mi}$), as well as the real-time backdata of the previous period and the forecast for the current period. We also include revisions in the forecasts relative to the previous round of forecasts (e.g., $\Delta\tilde{y}_{mi} - \Delta\tilde{y}_{m-1,i}$) and control for recent economic conditions by including the current unemployment rate ($\tilde{u}_{m0}$).

The regression residuals (ε_m) are the targeted federal funds rate changes, which are orthogonal to the Federal Reserve's information set. Because the data used in equation (2) correspond to FOMC meetings, the residuals also correspond to FOMC meetings. We then aggregate the residuals to a quarterly basis to examine how these monetary policy shocks affect lending standards. We assign each shock to the quarter in which the corresponding FOMC meeting occurred. If there is more than one meeting in a quarter, we sum the shocks.

We should note, however, that the Romer and Romer (2004) measure of monetary policy conditions focuses very much on unanticipated shocks, which are by definition changes related to expectations. Under the theory of the risk-taking channel, banks mostly formulate their risk-taking incentives based on perceptions about the observed level of interest rates given the macroeconomic conditions. Thus, the Romer and Romer shocks, even though better at incorporating expectations, are inferior to the Taylor rule residuals if banks shape their risk-taking decisions based on observed and not expected monetary policy conditions.

As a sensitivity test, we use the effective monetary stimulus (EMS) rate put forth by Krippner (2011, 2014). This measure is the total area between the expected path of the shadow short rate truncated at zero and a neutral rate estimated by a continuous-time Gaussian affine term structure model. A higher value indicates more monetary stimulus (i.e., a larger and/or longer time of the expected policy rate below the neutral rate). The EMS is theoretically appealing because it is based on the zero lower bound-constrained policy rate, and it is comparable across both the non-zero lower bound and the zero lower bound environments. Thus, by combining the current and expected components of actual policy rates, the EMS brings together elements from both the Taylor rule residuals and the Romer and Romer shocks.

3.2. Other covariates

As noted above, in order to identify the risk-taking channel of monetary policy we need to control for a number of factors that may also affect loan risk. The control variables can be categorized in three broad groups: loan-specific controls, borrower-specific controls, and lead-bank characteristics. Under loan characteristics, we include the number of lenders, the deal amount, the time to maturity, the requirement of performance pricing and collateral provisions, and the use of financial covenants. The first three variables are continuously quantifiable, whilst the last three are qualitative in nature. We calculate dummies for the qualitative variables, i.e., they take the value of one if there is any provision or covenant assigned to the loan and zero otherwise.

With respect to borrower-specific characteristics, we focus on borrower's credit risk as measured by Altman's (1968) modified *Z*-score, with higher values implying higher creditworthiness.[9] The third set of control variables attempts to measure the lead lenders' financial state, as well as their capacity and willingness to supply additional loans. Thus, we introduce *capital* (the ratio of total equity capital over total assets) and *liquidity* (ratio of bank liquid assets over total assets). Bank capital is the most theoretically sound measure of the bank's agency problems (Holmstrom and Tirole 1997). The related literature yields contradictory results regarding the risk-taking effects of bank capital. On the one hand, Dell' Ariccia, Laeven, and Suarez (2013) and Dell'Ariccia, Laeven, and Marquez (2014) find that banks with higher capital buffers are more prone to risk-taking as these banks decrease monitoring when facing a drop in the reference interest rate. On the other hand, there is evidence that banks with a lower capital ratio take on higher risk as they do not fully internalize loan losses (Jiménez et al. 2014, Ioannidou, Ongena, and Peydró 2015). Finally, more liquid assets may prompt bank managers to indulge in risk-taking (Acharya and Naqvi 2012). Both borrower- and bank-specific characteristics enter the estimated equations in lagged form (lagged one quarter) to avoid endogeneity bias arising from reverse causality.[10]

To absorb any remaining borrower and lender heterogeneity and thus to further alleviate credit demand concerns, we include bank- and firm-fixed effects. As in Jiménez et al. (2014), this identification resides in comparing changes in loan risk while controlling for the specific characteristics of the associated firms and banks. This is quite important because it helps to account for credit demand and credit supply forces that could bias the coefficients of interest. As our sample includes a number of cases where one firm borrows more than one time in the same quarter, we could further include borrower*quarter fixed effects. However, in this case identification occurs from a limited number of firms and, hence, we do not prefer to use this strategy.

4. EMPIRICAL ANALYSIS AND RESULTS

Table 1 reports the results from the estimation of equation (1). All specifications are estimated using OLS and include firm fixed effects to reduce the effect of demand-side forces, and bank fixed effects to account for time-invariant bank characteristics affecting the spreads. To provide inference for the main effect of the monetary policy variables at the mean of the bank characteristics included in the interaction terms we de-mean all variables included in the interaction terms and use the interaction terms of the transformed variables (i.e., we mean-center the variables).

In column I the coefficient of monetary policy shocks (Taylor rule residuals) is negative and statistically significant (at the 5% level), which suggests that corporate loan spreads increase with monetary policy expansion, albeit this overall effect is not necessarily purely driven by supply-side forces. In addition, the economic significance of the coefficient in column I is relatively modest. Specifically, a one standard deviation decrease in monetary policy shocks (equal to 2.09) would suggest an increase in risk premium of 7.46 basis points (-3.572*2.09). This is a relatively small effect compared to the standard deviation of loan spreads of 129 basis points. More importantly, the coefficient on the interaction term *Taylor rule*bank capital* is positive and significant (at the 10% level), suggesting that poorly capitalized banks respond more strongly in their risk-taking to accommodative monetary policy conditions over the full sample period. An interpretation for this effect is that banks with lower capital have more incentives to ease their lending standards after experiencing an increase in their own net worth. This finding is in line with the recent works of Jiménez et al. (2014) and Altunbas, Gambacorta, and Marquéz-Ibáñez (2014).

In column II we interact the Taylor rule residuals with bank liquidity (instead of bank capital) and the results are not indicative of a risk-taking channel running through liquidity. Subsequently, we repeat the exercise of the first two columns for the Taylor rule residuals by state, with the results being qualitatively similar, albeit the interaction term of the Taylor rule with bank capital gains somewhat in statistical significance. Further, the relevant coefficients gain in economic and statistical significance when we focus on the period 2001q4-2007q2 (columns V-VIII). This result is intuitive as this is the period that the risk-taking channel is mostly at work due to the prolonged period of low interest rates. Similar to the findings for the full sample period, the interaction terms *Taylor rule by state*bank capital* are positive and statistically significant, whereas the equivalent terms with bank liquidity are statistically insignificant.

[Insert Table 1]

In the regression equations reported in Table 2 we use the Romer and Romer (2004) shocks as the monetary policy variable. Data availability on this variable constrains our sample to the period 1987q1 - 2007q4. Monetary policy conditions continue to exert a statistically significant negative impact on loan spreads, and this effect is similar in magnitude to the one reported in Table 1. The coefficient on the Romer and Romer variable in column I, for example, indicates that a one standard deviation decline in monetary policy shocks (equal to 0.33) results in an increase in loan spreads by 7.95 basis points (-24.101*0.33).

However, the overall effect of monetary policy conditions on loan risk loses its statistical significance when constraining our period to 2001q4 - 2007q2. Further, and more importantly, in all four equations the interaction terms between the Romer and Romer shocks and bank characteristics are statistically insignificant. Overall, in this exercise we are unable to identify any significant bank balance sheet effects and hence our results question the purely supply-side effect of monetary policy on bank risk-taking. Thus, in our baseline models, different measures of monetary policy stance yield different findings concerning the presence of a risk-taking channel.

[Insert Table 2]

In Table 3 we add into our empirical specification double and triple interaction terms among the monetary policy variables, bank capital, and borrower risk (*Z*-score). The triple interactions control for banks' cross sectional heterogeneity in supplying credit to riskier firms when interest rates are low (i.e., accounting for the fact that the risk-taking channel involves changes in the credit supply at the *bank-firm* level). We focus on bank capital as this is the bank characteristic with the most significant bearing on the decisions of bank managers on lending (as in Jiménez et al. 2014).

Overall, and similar to the results in Tables 1 and 2, the findings in Table 3 provide support for the risk-taking channel of monetary policy only when using the Taylor rule residuals (either the US-wide or the ones by state). Specifically, four important findings emerge from Table 3. First, the linear term of all the monetary policy variables continues to imply a negative effect of monetary policy on loan spreads. Second, in times of monetary policy expansion, banks commit more credit to riskier borrowers as evidenced by the positive and statistically significant coefficient on the double interaction *monetary policy*firm Z-score* in all specifications. Third, the bank risk-taking effect of a lower monetary rate is further strengthened for lowly capitalized banks when we use the Taylor rule or the Taylor rule by state. The estimated coefficients on the corresponding triple terms are negative and statistically significant at the 1% level. However, once more, the results are less supportive for the presence a risk-taking channel when we employ the Romer and Romer (2004) shocks as our measure of monetary policy stance (columns V and VI): the coefficients on the triple interactions are statistically insignificant in both instances. Fourth, the above three findings are also evidenced in the run up to the 2007 financial crisis (columns II, IV, and VI), as the magnitude of the coefficients on the single, double, and triple interaction terms is similar to that reported for the full sample period.

[Insert Table 3]

We further inquire into the finding that different measures of monetary policy yield different results on the potency of the risk-taking channel by using three additional measures and the approach of Table 3. First, we use as our monetary policy measure dummy variables that take the value one for the periods during which the Taylor rule residuals or Romer and Romer shocks are below their means. This would imply that the risk-taking channel works only in periods of monetary easing. The results of this exercise, reported in columns I and II of Table 4 for the Taylor rule residuals and Romer and Romer shocks, respectively, are very similar to the equivalent ones of Table 3.

Second, we multiply our monetary policy variables with time since these variables are below their mean values. A negative coefficient on this variable would imply that the longer the accommodative monetary policy, the more negative the impact of monetary policy on banks' risk-taking. Again, our results (reported in columns III and IV) are qualitatively and quantitatively similar to those of Table 3.

Third, we use the effective monetary stimulus (EMS) rate put forth by Krippner (2014) as our measure for the stance of monetary policy. For expositional brevity, we divide the original EMS series by 100 to produce estimates comparable to the Taylor rule and the Romer and Romer residuals. The results, reported in column V are very similar to the ones reported for the Romer and Romer shocks, with the triple interaction term being statistically insignificant. The fact that this measure of monetary policy brings together the observed element of the Taylor rule residuals and the expectations element of the Romer and Romer shocks and that results are closer to those of the Romer and Romer shocks highlights the potential role of expectations in assessing exogenous monetary policy shocks and their concomitant effects on banks' risk-taking incentives. If banks formulate their risk-taking decisions based on observed monetary policy conditions, whereas the Fed reacts to factors other than those incorporated in the standard Taylor rule (such as expectations of future macroeconomic conditions), then our findings indicate that there is a discrepancy between the actual reaction function followed by policymakers (i.e., the Fed) and the rule perceived by the private sector agents (i.e., banks). In other words, private sector agents may use a more restricted information set than the Fed, leading to different predictions about subsequent interest rate changes. As such, these informational constraints imply that the US banks may increase their exposure to risk (as evidenced by the Taylor rule residuals) simply because of their limited ability to accurately assess the future path of monetary policy.

[Insert Table 4]

Our findings so far provide evidence in favor of a potent risk-taking channel only when the Taylor residuals are used to measure monetary policy innovations. Up to this point we have used an *ex ante* measure of risk-taking (AISD). In Table 5 we examine whether expansionary monetary conditions induce banks to grant more credit to firms that default *ex post*. To this end, we use the proportional hazard model of Cox and regress the probability of borrower default on the same set of loan, borrower, and bank characteristics. For expositional brevity we present coefficient estimates instead of hazard rates. Since firm risk is incorporated in the computation of the dependent variable, we do not consider triple interactions with firm *Z*-score as in Tables 3 and 4.

In column I the coefficient on *Taylor rule* for the full sample period is positive, suggesting that expansionary monetary policy actually diminishes the hazard rate on new loans. This finding may be justified on the grounds that borrowers are able to improve their risk profiles over the course of their loans when facing more accommodative monetary conditions. However, this coefficient rules out the presence of a risk-taking channel. In contrast, the coefficient on *Taylor rule* carries a negative sign in the run up to the 2007 financial crisis (column II), indicating that credit supply factors emerge in times of prolonged monetary easing. The same result is prevalent in column IV for the *Taylor rule by state*. Nevertheless, none of the double interaction terms *monetary policy* * *bank capital* in columns II and IV are statistically significant, thereby casting doubt on the role of bank characteristics on *ex post* risk-taking. The results for the Romer and Romer residuals in the last two columns are also unsupportive of a risk-taking channel when using an *ex post* measure of risk. The same results prevail if we use a probit or a logit model (results available on request).

[Insert Table 5]

5. CONCLUSIONS

Many commentators and researchers have argued that the prolonged period of low interest rates in the 2000s is one main culprit for the excessive buildup of risk in the US banking industry in the run up to the global financial crisis of 2007. Using a recent line of theoretical and empirical literature as a springboard, this paper sheds further light on the effects of US monetary policy on the risk-taking decisions of US banks over the last two decades. We build a novel loan-level data set by combining information from four different databases on loan, borrower, bank, and firm-bankruptcy characteristics.

By bringing together data with information on the loan facilities, firm and bank characteristics, and firms' bankruptcies during the duration of the loan facility from four respective databases, we find an important variation in our results based on the measures used to proxy monetary policy shocks and bank risk-taking. Specifically, we find that *ex ante* risk-taking by banks (as measured by corporate loan spreads) is negatively associated with expansionary monetary conditions measured by the Taylor rule residuals. The potency of the risk-taking channel is more evident during the period leading up to the 2007 subprime crisis, and the channel seems to work primarily through the lending strategies of the less capitalized banks. However, we can only partially verify the robustness of this key finding when using an *ex post* measure of bank risk-taking or the Romer and Romer (2004) identification strategy for exogenous monetary conditions. In particular, although the results from these exercises provide some evidence for the negative overall effect of monetary policy rates on the risk of newly issued loans, they fail to attribute this effect to purely credit supply factors. A number of additional tests do not alter these key findings.

Overall, our results indicate the necessity to control for any observable and unobservable credit demand factors when analyzing the impact of monetary policy changes on bank risk-taking. Within this empirical setup, our findings question the potency of the risk-taking channel in the US market for corporate loans, and more importantly, highlight the sensitivity of this type of assessment to the measure of monetary policy innovations. A possible explanation for our diverse findings is that banks face informational constraints when assessing the future path of monetary policy conditions because they typically have a more restricted information set than the Fed. This, in turn, suggests that further transparency on the part of the Fed, such as making its Greenbook forecasts publicly available on a more frequent basis, could improve the ability of banks to more accurately assess the future path of monetary policy and help dampen their risk-taking incentives to perceived policy surprises.

A fruitful extension to our work should consider loans to the housing market, which was the main vehicle through which the subprime crisis originated. Furthermore, the means through which monetary and regulatory authorities are coordinated so as to understand the sources of systemic risk, develop new monitoring tools, and implement policy measures to reduce macro-prudential risks, remain understudied. We leave these issues for future research.

APPENDIX

Table A1
Variable definitions and sources

A. Dependent variables	
Spread over LIBOR	Describes the amount the borrower pays in basis points over LIBOR for each dollar drawn down. It adds the spread of the loan with any annual (or facility) fee paid to the bank group. The variable is calculated for each syndicated loan. Data are from Dealscan.
Probability of firm default	Probability that the firm (borrower) defaults during the period of the loan. Obtained directly from the estimation of the semiparametric Cox's proportional hazards model.
B. Explanatory variables	
a) Monetary policy variables	
Taylor rule	The residuals of the regression of the shadow short rate (data are from Krippner 2014) on output gap and CPI inflation rate.
Taylor rule by state	The residuals of the regression of the shadow short rate (data are from Krippner 2014), on state income and inflation, applied to the state where the bank is headquartered.
Romer & Romer	The measure of unanticipated monetary policy shocks, constructed using the methodology proposed by Romer and Romer (2004).
Effective monetary stimulus (EMS)	The EMS summarizes the current and expected path of the actual or zero lower bound-constrained rate relative to an estimate of the neutral interest rate (see Krippner 2014).
Data are from Romer & Romer (2004), own calculations based on FOMC meetings and Greenbook forecasts, Datastream, Leo Krippner's website, and the Federal Reserve Bank of St. Louis.	
b) Loan-level variables	
Number of lenders	The total number of all lenders of the syndicated loan.
Deal amount	The deal's total amount in million dollars (in logs).
Time to maturity	A calculation of how long (in months) the facility will be active from signing date to expiration date (in logs).
Performance pricing provisions	A dummy variable representing whether the loan has performance pricing provisions.
Collateral provisions	A dummy variable representing whether the loan is secured with collateral.
Financial covenants	A dummy variable representing whether the loan has financial covenants.
Data are from the Dealscan database.	
c) Firm-level variables	
Firm *Z*-score	*Z*-score is the modified Altman's (1968) *Z*-score (= (1.2*Working Capital+1.4*Retained Earnings+3.3*EBIT+0.999*Sales)/Total Assets). It measures the borrower's default risk.
Data are from Compustat.	
d) Bank-level variables	
Bank capital	The ratio of total equity capital to total assets
Bank liquidity	The ratio of liquid assets to total assets.
Data are from the FDIC Call Reports.	

Table A2
Descriptive statistics of the main variables used in the empirical analysis

Variable	Obs.	Mean	Std. dev.	Min.	Max.
Spread over LIBOR	229,682	177.38	129.09	-16.00	2,250.00
Taylor rule	229,682	0.00	2.09	-5.21	3.86
Taylor rule by state	229,682	0.00	3.04	-7.41	3.98
Romer & Romer	187,621	0.03	0.33	-0.96	0.77
Effective monetary stimulus	229,682	11.29	8.50	-1.17	28.36
Number of lenders	229,682	13.35	11.42	1.00	291.00
Deal amount	229,682	5.81	1.34	-3.15	10.92
Time to maturity	229,682	3.69	0.69	0.00	6.24
Firm *Z*-score	102,903	1.75	1.28	-50.53	16.64
Bank capital	210,238	0.09	0.03	-0.01	0.67
Bank liquidity	175,838	0.03	0.04	0.00	0.57

Notes: The table reports the number of observations, along with the mean, standard deviation, minimum and maximum for the main variables used in the empirical analysis based on new loans. Formal definitions of the variables are provided in Table A1.

Table A3
Correlation coefficients between the main explanatory variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
Spread over LIBOR (1)	1.00												
Romer & Romer (2)	-0.02	1.00											
Taylor rule (3)	-0.18	-0.31	1.00										
Taylor rule by state (4)	-0.19	-0.29	0.88	1.00									
Number of lenders (5)	-0.29	0.02	0.09	0.10	1.00								
Deal amount (6)	-0.30	0.01	0.02	0.02	0.63	1.00							
Time to maturity (7)	0.24	0.15	-0.03	0.16	-0.02	0.04	1.00						
Perf. pricing provisions (8)	-0.19	0.00	0.10	0.09	0.23	0.20	0.11	1.00					
Collateral provisions (9)	0.33	0.03	0.06	0.06	-0.02	-0.02	0.25	0.21	1.00				
Financial covenants (10)	0.04	-0.06	0.11	0.12	0.11	0.06	0.14	0.61	0.42	1.00			
Firm *Z*-score (11)	-0.19	0.00	0.04	0.05	-0.09	-0.09	-0.01	0.07	-0.08	0.01	1.00		
Bank capital (12)	0.16	0.04	-0.28	-0.30	-0.07	-0.05	0.02	0.00	0.00	0.00	0.00	1.00	
Bank liquidity (13)	-0.04	0.03	0.11	0.11	0.09	-0.02	0.03	0.07	0.04	0.06	0.03	0.08	1.00

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FOOTNOTES

[1] Other researchers on the US banking sector approach the issue at hand using aggregate data for new loans from bank lending surveys (De Nicolò et al. 2010, Maddaloni and Peydró 2011), balance sheet information on listed banks (Altunbas, Gambacorta, and Marquéz-Ibáñez 2014), or confidential data on individual banks' loan ratings from the Federal Reserve's Survey of Terms of Business Lending (Dell' Ariccia, Laeven, and Suarez 2013).

[2] Dell' Ariccia, Laeven, and Suarez (2013) construct an *ex-ante* measure of bank risk-taking using confidential and thus unobservable data on banks' assessments of risk at the time the loan is issued. Our measure differs from theirs in the sense that ours is based on the bank's *observable* assessment of risk at the time of loan origination.

[3] Bruno and Shin (2015) investigate the international dimension of the risk-taking channel and construct a model in which banks intermediate dollar funds to local borrowers that hold local currency assets. They find that lowering policy interest rates in major financial centers can increase risk-taking in other countries due to the feedback loop between increased leverage of global banks and capital flows amid currency appreciation for capital recipient economies.

[4] AISD measures the interest rate spread plus any one-time and recurring fees associated with the loan (Ivashina 2009, Bharath et al. 2011).

[5] Although a reduction in the policy rate is expected to translate into a decline in lending rates (the interest rate pass-through), the decline in interest rates on corporate loans may not be proportional to the decline in the policy rate due to the private information about borrowers' default risk collected by the lead bank. As a result, loan spreads may be higher during periods of loose monetary policy indicating banks' willingness to provide credit to riskier borrowers.

[6] The related literature delivers different predictions on the sign of the estimated coefficients of the relevant interaction terms. For instance, Jiménez et al. (2014) argue that the risk-taking channel should be more evident among the poorly capitalized banks as these banks face stronger moral hazard problems, i.e., little capital at stake. In other words, the coefficient on the interaction between bank capital and monetary policy rates should be positive. In contrast, Dell' Ariccia, Laeven, and Marquez (2014) suggest that this coefficient should be negative because well capitalized banks tend to reduce monitoring in periods of monetary policy easing.

[7] Krippner (2011, 2014) and Bullard (2012) thoroughly discuss the shadow short rate as an indicator of the stance of monetary policy.

[8] Bluedorn and Bowdler (2011) argue that although the narrative evidence used by Romer and Romer (2004) is informationally richer than the announced target series, the pooling of the two is acceptable given the increasing transparency in policy intentions during the last two decades. The sample is restricted to meetings through the end of 2007 simply because the Greenbook forecasts are released with an at least five years delay. This results in the loss of some observations on loan deals for the period 2008-2012. This also implies that there is no need to account for unconventional monetary policy in this framework.

[9] We opt for excluding other borrower-specific characteristics because the components of the *Z*-score and the presence of borrower fixed effects should in principle account for all observed and unobserved firm heterogeneity potentially emanating from the firm-balance sheet channel.

[10] For a similar set of bank-level controls in risk equations see *inter alia* Delis and Kouretas (2011), Laeven and Levine (2009), Bessler and Kurmann (2014) and Delis and Karavias (2015).

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