Why Does the Yield Curve Predict GDP Growth? The Role of Banks*

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November 1, 2022

Abstract

We provide evidence suggesting a causal relationship between the slope of the yield curve and future economic activity through bank lending. Using granular data on banks, we show that a steeper yield curve associated with higher term premiums (rather than higher expected short rates) boosts bank profits and lending over the next four quarters, thereby stimulating economic activity. Intuitively, a higher term premium represents higher expected profits on maturity transformation, which is at the core of banks' business model, and therefore incentivizes lending. This effect is stronger for banks with less stringent risk controls. We rationalize our findings in a portfolio model for banks.

Keywords: predictive power of the yield curve; term spread; term premium; bank lending; bank profitability.
JEL classifications: E44, E52, E58.

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1 Introduction

The slope of the yield curve has proved to be an enduring predictor of economic activity, but it is not entirely clear where its predictive power comes from.[1] One plausible explanation is that long-term interest rates aggregate investors' predictions about the future state of the economy: if investors foresee a slowdown in the economy, they would expect the central bank to respond by lowering the short-term interest rate in the future. The expectation of lower short rates in the future would reduce, all else equal, long-term rates, resulting in a smaller slope of the curve today than it would be otherwise. Under this explanation, the slope of the yield curve would reflect, but not cause, future recessions. However, another plausible explanation is that the slope contains information beyond simple reflections of investors' expectations about the future economy. This alternative explanation hence opens up the possibility for the slope to exert causal influence on future economic activity through different potential channels that have not yet been fully explored in the literature.[2]

In this paper, we argue that the slope affects banks' lending decisions hence *causing* changes in future economic activity. We provide evidence, together with a simple banking model along the lines of Gertler and Kiyotaki (2015), of a channel that works as follows. Banks' main business model consists of maturity transformation, whereby they take on short-term liabilities, such as bank deposits and wholesale borrowing, to fund longer-term assets, such as securities and bank loans. The difference between the long rate and the average future short rates—the term premium—represents the excess returns banks can expect to earn for bearing a given amount of duration risks associated with the maturity mismatch. All else equal, a larger term premium imply higher expected profits to banks' credit provision activities funded by shorter-term borrowing and hence incentivize them to hold more longer-term assets, including by making more loans. The increased supply of bank credit can be expected, in turn, to boost economic growth through the well-documented "credit channel" by which bank-dependent firms benefiting from increased borrowing can invest and grow relatively more (Bernanke and Gertler, 1995).

Our empirical strategy relies on three main data sources. First, we examine the level effect of higher term premium on bank profitability (net interest margins, return on equity, and return

[1] Early studies documenting the predictive power of the yield curve include, among others, Harvey (1989, 1993), Estrella and Hardouvelis (1991), Stock and Watson (1989), Hamilton and Kim (2002a), and Ang et al. (2006).

[2] Previous studies present evidence that the slope of the yield curve contains more information about future economic activity than expectation of future short rates (Hamilton and Kim (2002a), Wright (2006), and Jardet et al. (2013b)) or median survey forecasts (Rudebusch and Williams (2009)), but do not elaborate on the casual implications of such information.

on assets) and bank loan growth using quarterly balance sheet data for individual banks from the merger-adjusted U.S. Call Reports. Second, we use survey data from the Senior Loan Officer Opinion Survey (SLOOS) with quarterly information on changes in credit standards and demand large banks (assets>2bn). For this part of the analysis, we use term premium series from two commonly-used affine term structure models, in particular the 5-year term premium from Kim and Wright (2005) (baseline) and that from Adrian et al. (2013) (robustness). Third, we study banks' lending decisions using a loan-level dataset of new originations from the largest U.S. banks (assets>50bn). These data are drawn from the Federal Reserve (FR) Y-14Q data collection effort, which gathers information about bank-firm loan exposures and detailed financial information about borrowers from banks subject to supervisory stress tests. The Y-14Q data represent the lending activities of very large bank-holding companies (BHCs) accounting for the majority of outstanding loan commitments in the U.S. banking sector (Caglio et al., 2021). We use (i) loans originated during the period of up to six quarters around the "taper tantrum" event to examine the lending decisions of banks with differential ex-ante ability to take advantage of the sharp increase in the term premium, and (ii) end-year firm financials to study the investment behavior of firms borrowing from such banks.

Our findings can be summarized as follows. We start by showing with aggregate time-series data that a higher term premium is associated with higher bank profits and bank loan supply in the near future, after controlling for short rate changes and expected future economic growth. Motivated by this evidence, we study a dynamic portfolio model in which banks are subject to incentive and deposit leverage constraints, charge a spread on deposits, and are subject to exogenous interest rate and term premium shocks. In equilibrium, banks choose a leveraged exposure to long-term loans funded with short-term deposits. A positive term premium shock, by increasing the return to maturity transformation and hence bank profitability, can be expected to relax the financing constraint and incentive more bank lending in the periods after the shock. This response is stronger for less constrained banks, because those banks are better able to expand their balance sheets than the more constrained banks. Consistent with the implications of model, we show that (i) banks have higher loan growth and higher profits, on average, following an exogenous increase in the term premium; and (ii) banks that are less constrained, in the sense that they have less stringent risk management practices (as captured by lower values of the risk management index of Ellul and Yerramilli (2013) or higher CAMELS management scores), increase lending relatively more following an increase in the term premium. In addition, focusing on the taper tantrum episode, we show that the lending boost generated by a rise in the term premium is associated with better performance of exposed firms: In firm-level regressions, we show that nonfinancial firms borrowing from ex-ante less constrained banks have higher investment rates subsequently.

Our estimates suggest that the level and differential effects of the term premium on banks' lending decisions and firms' investment rates are both statistically significant and economically meaningful. A 100 basis point (bps) increase in the term premium is associated with bank loan growth, NIMs, and ROE that are higher by 1.9 ppts, 11 bps, and 96 bps respectively; these effects are sizeable when compared with the average loan growth, NIMs and ROE of 3.8%, 1.0%, and 2.3%, respectively. Furthermore, in the six quarters following the taper tantrum, a bank with stringent risk management controls (at the 75th percentile of the risk management index distribution) originated loans that were smaller by 15% compared to a bank with permissive risk management controls (at the 25th percentile of the distribution). Over the two years following the taper tantrum, a firm borrowing from a bank with more stringent controls (above-mean risk management index) had an investment ratio lower by 4.6 percentage points (or 22% of the mean) than a firm borrowing from a bank with more lax controls (below-mean risk management index).

We face two endogeneity problems in our empirical analysis. First, long-term yields are forward looking and contain information about the future economic outlook. A stronger economic outlook may cause both a steeper yield curve now and higher bank lending in the future, without the former contributing to the latter. We take several steps towards addressing this issue. To start with, (i) we directly control for survey forecasts of future economic growth and the excess bond premium, a measure of investor sentiment or risk appetite in the corporate bond market (Gilchrist and Zakrajšek, 2012); and (ii) across bank-level specifications, we employ an instrumental variable strategy that isolates foreign demand-driven shocks to bond risk premia that are unlikely driven by stronger expected future economic growth. Specifically, we instrument changes in the term premium with foreign official (eg. central banks) holdings of U.S. Treasury securities (normalized by U.S. GDP). The identifying assumption is that changes in foreign official holdings of Treasuries are driven by reserve management and foreign exchange intervention needs rather than the U.S. economic outlook or other factors driving the supply of U.S. government debt. We show that this instrumental variable is a strong predictor of the term spread and term premium, after controlling for contemporaneous short rate and macro variables. Finally, (iv) we identify a period when the term premium increased unexpectedly and examine bank lending decisions around this period using more granular, loan-level data. In particular, we study the "taper tantrum" episode following the May 22, 2013 speech by Federal Reserve chairman Ben Bernanke regarding the tapering of asset purchases at some future date. This speech was accompanied by a sharp increase in the term premium that market commentary did *not* attribute to an improving economic outlook, and thus provides a laboratory for tighter identification.

The second endogeneity problem is that an increase in bank lending may reflect stronger credit demand by borrowers rather than stronger credit supply by banks, as these quantities are jointly determined and can be driven by common macroeconomic shocks. To disentangle supply and demand forces, we use two strategies. First, in bank-level analyses we control for a wealth of macroeconomic factors and direct survey measures of changes in loan demand. Second, we exploit granular lending data at the bank-borrower level and control for borrower-specific credit demand, following the approach of Khwaja and Mian (2008) and Jiménez et al. (2020). Specifically, we examine how the growth rate of credit *to the same firm in a given quarter*, over a period of several quarters before and after the "taper tantrum" speech, varies across banks with different abilities to take advantage of the rise in the term premium. This heterogeneity in banks' abilities to capture the term premium is motivated by the theoretical model, where more constrained banks react less to an increase in term premium. We capture this heterogeneity using two different indicators of risk management quality at banks—the risk management index of Ellul and Yerramilli (2013) and the management score of the CAMELS supervisory rating. Intuitively, we think that a bank with less stringent risk management practices is more likely to take advantage of a higher term premium and issue more new loans. We also include control for standard determinants of banks' lending decisions used in prior literature.[3]

Our work contributes to two strands of literature. First, we contribute to the literature on the predictive power of the yield curve for future economic growth (Harvey, 1988; Estrella and Hardouvelis, 1991; Hamilton and Kim, 2002b; Favero et al., 2005; Ang et al., 2006; Rudebusch et al., 2006; Jardet et al., 2013a). Our contribution is to emphasize the role of banks and to document one specific channel through which a higher term premium boosts the economy—by incentivizing banks to engage in more maturity transformation and increase lending. Adrian et al. (2019) uses aggregate data to explore a similar channel where monetary policy tightening flattens the yield curve and reduces banks' net interest margins and credit supply. By contrast, our paper uses both bank- and loan-level data coupled with an instrumental variable strategy and a case study

[3] We include controls such as bank capital, balance sheet size, the share of securities in total assets to capture potential valuation effects from changes in the yield curve as in Chakraborty et al. (2020) and Rodnyansky and Darmouni (2017), the intensity of bank-firm relationships (to allow for endogenous matching between banks and firms, as in Schwert (2018) and Chodorow-Reich (2014)), among others.

of an unanticipated increase in the term premium to mitigate endogeneity problems associated with the forward-looking nature of long-term yields.

Second, this paper contributes to the literature on banks' exposure to interest rate risks and the implications for monetary policy transmission (Begenau et al., 2015; Di Tella, 2020; Haddad and Sraer, 2020; Drechsler et al., 2021a; Gomez et al., 2021). Most of these studies focus on the level of the short rate. Alessandri and Nelson (2015) and Paul (2020) examine the link between the slope of the yield curve and bank profits, but do not study the effect on bank lending. English et al. (2018) show that bank equity prices fall after increases in the level of interest rates or a steepening of the yield curve, but do not examine bank lending decisions nor the effects of the term premium component. By contrast, this paper explores how changes in the slope of the yield curve, in particular the term premium component, affect bank profitability and loan supply.

Our findings suggest that financial intermediaries are an important channel through which the entire yield curve, not just the short end, affects the economy, with implications for policy. Asset purchases have became a standard tool that global central banks employ to provide monetary accommodation when the short rate is near its effective lower bound, and they are typically thought of as operating by reducing term premia and long-term yields (Krishnamurthy and Vissing-Jorgensen (2011)). In turn, lower term premia boost the values of security holdings that are marked-to-market on bank balance sheets, raising bank net work and supporting the ability to lend—a phenomenon that Brunnermeier and Sannikov (2014) dubbed as *stealth recapitalization* and was empirically documented, among others, by Rodnyansky and Darmouni (2017) for the United States and Acharya et al. (2019) for the Euro area. Our results suggest that when calibrating those purchases, central banks may want to consider the potential negative effects on bank profits and bank lending implied by the channel documented here.

2 A first look at aggregate time-series data

We take a first look at the aggregated data and examine how term spreads are related to future economic growth, bank profitability, and lending. In particular, we run the following time series regressions:

$$Z_{t,t+4} = \alpha + \beta_1 \Delta y_t^1 + \beta_2 \left(y_t^{20} - y_t^1 \right) + \gamma X_t + \varepsilon_{t,t+4} \tag{1}$$

$$Z_{t,t+4} = \alpha + \beta_1 \Delta y_t^1 + \beta_2 \left(y_t^{20,eh} - y_t^1 \right) + \beta_3 \, y_t^{20,tp} + \gamma X_t + \varepsilon_{t,t+4} \tag{2}$$

where y_t^n denotes the n-quarter yields, $y_t^{20,eh} \triangleq \sum_{i=0}^{19} y_{t+i}^1$ represents the average expected short rates over the next five years, and $y_t^{20,tp} \triangleq y_t^{20} - y_t^{20,eh}$ is the 5-year term premium. We measure the term spread as the difference between the 5-year Treasury yield and the 3-month T-bill yield, where the 5-year yield is chosen to match the average maturity of banks' assets. In the second specification, we decompose the term spread into a term premium component ($y_t^{20,tp}$), which represents compensation to investors for bearing the interest rate risks over this horizon; and the expectations component of the spread ($y_t^{20,eh} - y_t^1$), which reflects expected changes in the short rate over the next five years and is computed as the difference between the term spread and the term premium estimates. Term premium estimates come from a no-arbitrage term structure model developed by Kim and Wright (2005).[4]

To control for the current and expected future macro conditions, we include in X_t the median forecasts of one-year ahead real GDP growth from the Survey of Professional Forecasters and the excess bond premium from Gilchrist and Zakrajšek (2012). The dependent variable $Z_{t,t+4}$ is the 4-quarter ahead real GDP growth, 4-quarter ahead real bank loan growth, three measures of bank profitability—NIMs, ROE, and ROA—and a bank lending standard index over the next 4 quarters, which represents the net share of banks that report easing lending standards in the SLOOS.[5] Estimates are based on Ordinary Least Squares (OLS).

Table 2 presents the regression estimates. Two conclusions emerge. First, the term spread consistently predicts higher future GDP growth, bank loan growth (whether or not we include off balance sheet undrawn credit lines), and bank profitability, after controlling for short rate changes and additional macroeconomic factors. Second, in most specifications, the term premium component of the term spread is statistically significant in predicting these outcome variables. These results, which we interpret as predictive in nature, suggest a possible additional channel through which term spreads predict future growth that goes beyond mere expectations about the future state of the economy. We hypothesize this is a *banking channel* by which a rise in the term premium incentivizes banks to invest in longer-term assets so as to take advantage of higher expected excess returns. In the following sections, we present a simple portfolio model for banks to develop the intuition for this channel, and present the identification strategies to empirically

[4] For the time series analysis, we use the following sources. We obtain the Fama 3-month yield and Fama-Bliss 1- to 5-year zero coupon Treasury yields from Center for Research in Security Prices (CRSP). The excess bond premium comes from the Federal Reserve Board's website. All other macro variables (such as GDP deflator, real GDP growth), the Kim and Wright (2005) term premium estimates and the aggregate banking sector variables (total loans, NIM, ROE, and ROA) come from Federal Reserve Economic Data (FRED). Data on 1-year ahead real GDP growth and GDP deflator come from the Survey of Professional Forecasters on the website of the FRB Philadelphia.

[5] More details about the SLOOS and data definitions are included in Appendix A.

document the channel.

3 A bank's portfolio allocation model

3.1 Model setup

We present a dynamic partial equilibrium banking model with the objective of understanding how fluctuations in term premium affect banks' lending decisions. To this end, we use a simple setup with a representative banker taking prices as given and maximizing the value of the bank.

State of the economy. Time is continuous and denoted by $t > 0$. There is a pricing kernel, capturing the state of the economy, $m_t > 0$,

$$\frac{\mathrm{d}m_t}{m_t} = -r_t \mathrm{d}t - \kappa_t \mathrm{d}W_{r,t} - g\mathrm{d}W_{\kappa,t}, \tag{3}$$

with

$$\mathrm{d}r_t = \lambda_r \left(\bar{r} - r_t\right) \mathrm{d}t + \sigma_r \sqrt{r_t} \mathrm{d}W_{r,t}, \tag{4}$$

$$\mathrm{d}\kappa_t = \lambda_\kappa \left(\bar{\kappa} - \kappa_t\right) \mathrm{d}t + \sigma_\kappa \mathrm{d}W_{\kappa,t}, \tag{5}$$

where $W_{r,t}$ and $W_{\kappa,t}$ are aggregate Brownian motions representing interest rate (r_t) shocks and term premium (κ_t) shocks, respectively.[6] We assume the instantaneous correlation between $W_{r,t}$ and $W_{\kappa,t}$ is $\varphi_{r\kappa}$.

Prices. We use the pricing kernel (3) to price long-term loans. To simplify the analysis and avoid keeping track of the entire maturity structure of loans when solving the bank's problem, we assume there is a single loan paying coupons $\tau e^{-\tau t}$ each instant. Additionally, we assume loans cannot be defaulted.[7] We denote the loan price by $P_t^{(\tau)}$, which is given by the discounted present value of its dividends:

$$P_t^{(\tau)} = E_t \left[\int_t^\infty \frac{m_s}{m_t} \tau e^{-\tau(s-t)} \mathrm{d}s \right]. \tag{6}$$

and is a function of the state variables, r and κ. Using Feymann-Kac we solve the conditional

[6] The interest rate model we use is similar to that of Cox et al. (1985).

[7] Assuming a constant and non-zero default probability do not change the analysis. The model could be extended with a time varying default probability to loans.

expectation as a partial differential equation:

$$\frac{1}{P^{(\tau)}}-\tau-r+\frac{P_r^{(\tau)}}{P^{(\tau)}}E\left[\mathrm{d}r\right]+\frac{1}{2}\frac{P_{rr}^{(\tau)}}{P^{(\tau)}}E\left[dr^2\right]+\frac{P_\kappa^{(\tau)}}{P^{(\tau)}}E\left[\mathrm{d}\kappa\right]+\frac{1}{2}\frac{P_{\kappa\kappa}^{(\tau)}}{P^{(\tau)}}E\left[\mathrm{d}\kappa^2\right]+\frac{P_{\kappa r}^{(\tau)}}{P^{(\tau)}}E\left[\mathrm{d}\kappa\mathrm{d}r\right]= -cov_t\left(\frac{\mathrm{d}m}{m}\frac{\mathrm{d}P^{(\tau)}}{P^{(\tau)}}\right),$$

where the term premium is given by

$$\mathrm{E}_t\left[\frac{\mathrm{d}P_r^{(\tau)}}{P^{(\tau)}}\right]-r_t\equiv -cov_t\left(\frac{\mathrm{d}m}{m}\frac{\mathrm{d}P^{(\tau)}}{P^{(\tau)}}\right)=\kappa_t\frac{P_r^{(\tau)}}{P^{(\tau)}}\sigma_r\sqrt{r}+g\frac{P_\kappa^{(\tau)}}{P^{(\tau)}}\sigma_\kappa+\left(\frac{P_r^{(\tau)}}{P^{(\tau)}}\sigma_r\sqrt{r}g+\frac{P_\kappa^{(\tau)}}{P^{(\tau)}}\sigma_\kappa\kappa_t\right)\varphi_{r\kappa}. \tag{7}$$

Banks. Banks take prices as given and can trade 3 instruments: long-term loans, deposits, and fed funds. The balance sheet is given by

$$n_t+\widetilde{b}_t=x_t^{(\tau)}P_t^{(\tau)}+b_t, \tag{8}$$

where n_t is the wealth of the bank, $x_t^{(\tau)}$ is the number of loans at price $P_t^{(\tau)}$, while b_t and $\widetilde{b}_t$ are the value of the fed funds and deposit accounts, respectively. The only difference between deposits and fed funds is that banks pay a lower rate on deposits than the federal fund rate. That is, the fed funds account follows

$$\mathrm{d}b_t=r_tb_t\mathrm{d}t,$$

and the deposit account follows

$$\mathrm{d}\widetilde{b}_t=\phi\left(r_t\right)\widetilde{b}_t\mathrm{d}t,$$

with $\phi\left(r_t\right)\leq r_t$ representing the fact that banks have market power in the deposit market and pay a rate lower than the fed fund rate (Drechsler et al., 2017, 2021b).[8] The evolution of bank's wealth is then given by

$$\begin{aligned}\mathrm{d}n_t &= x_t^{(\tau)}\mathrm{d}P_t^{(\tau)}+\mathrm{d}b_t+\mathrm{d}\widetilde{b}_t,\\ &= \left[r_tn_t+\left(\phi\left(r_t\right)-r_t\right)\widetilde{b}_t\right]\mathrm{d}t+P_t^{(\tau)}x_t^{(\tau)}\left(\frac{\mathrm{d}P_t^{(\tau)}}{P_t^{(\tau)}}-r_t\mathrm{d}t\right).\end{aligned}$$

Banks' optimization. We follow the basic banking structure proposed in Gertler and Kiyotaki (2015) (henceforth GK15). Banks pay dividends exogenously with a Poisson probability λ. As

[8] We specify the function $\phi\left(r_t\right)$ below.

argued in GK15, the purpose of this simple dividend policy is to avoid banks growing out of their incentive constraint. The bank's problem is to maximize the expected discounted value of the dividends using, as in GK15, the aggregate stochastic discount factor

$$V_t = \max_{\left\{x_t^{(\tau)}, \widetilde{b}_t\right\}} E_t \int_t^{\infty} \frac{m_s}{m_t} \lambda e^{-\lambda(s-t)} n_s \mathrm{d}s,$$

subject to

$$\mathrm{d}n_t = \left[r_t n_t + (\phi(r_t) - r_t)\, \widetilde{b}_t\right] \mathrm{d}t + P_t^{(\tau)} x_t^{(\tau)} \left(\frac{\mathrm{d}P_t^{(\tau)}}{P_t^{(\tau)}} - r_t \mathrm{d}t\right), \tag{9}$$

$$V_t \geq \rho P_t^{(\tau)} x_t^{(\tau)}, \tag{10}$$

$$\widetilde{b}_t \leq -\delta n_t. \tag{11}$$

Constraint (10), as in GK15, is an incentive constraint motivated by a moral hazard problem and implies that the value of the bank V_t has to be greater than or equal to a fraction ρ of the bank's total assets, $P_t^{(\tau)} x_t^{(\tau)}$. Restriction (11) is a leverage constraint on deposits. Because banks can earn a positive spread on deposits, $r_t - \phi(r_t)$, they will have incentive to issue as many deposits as possible to buy reserves. To avoid this outcome, we impose a leverage limit.

Recursive formulation. We write the problem recursively

$$0 = \max_{\left\{x_t^{(\tau)}, \widetilde{b}_t\right\}} m_t \lambda e^{-\lambda t} n_t \mathrm{d}t + E_t\left[\mathrm{d}\left(m_t e^{-\lambda t} V_t\right)\right], \tag{12}$$

subject to (9), (10), and (11). Because the objective function and the constraints are linear in net worth, we guess $V_t = \psi_t n_t$. The variable $\psi_t(\kappa_t, r_t)$ represents the bank's marginal value of wealth or "Tobin's Q" (see GK15). Then, the problem can be written as the following partial differential equation for $\psi_t(\kappa_t, r_t)$:

$$0 = \max_{\left\{x_t^{(\tau)}, \widetilde{b}_t\right\}} \frac{\lambda - \lambda\psi_t}{\psi_t} + E_t\left[\frac{\mathrm{d}m}{m}\right] + E_t\left[\frac{\mathrm{d}n}{n}\right] + E_t\left[\frac{\mathrm{d}\psi}{\psi}\right] + E_t\left[\frac{\mathrm{d}\psi}{\psi}\frac{\mathrm{d}n}{n}\right] + E_t\left[\frac{\mathrm{d}\psi}{\psi}\frac{\mathrm{d}m}{m}\right] + E_t\left[\frac{\mathrm{d}m}{m}\frac{\mathrm{d}n}{n}\right],$$

subject to (9), (10), and (11).

3.2 Model calibration and solution

We solve for a numerical specification in which the incentive and deposit leverage constraints are always binding. This means $V_t = \rho P_t^{(\tau)} x_t^{(\tau)}$ and $\widetilde{b}_t = -\delta n_t$. As discussed in GK15, the incentive constraint is always binding long as the risky asset yields a positive excess return equilibrium. Additionally, the leverage constraint on deposits is always binding because the deposit spread $r - \phi(r)$ is always positive.

Calibration. We calibrate the processes r_t and κ_t using simulated method of moments to match the statistical properties of the short interest rate and term premium that we use in the regressionsr. More precisely, we set the parameters $\{\overline{r}, \overline{\kappa}, \sigma_r, \sigma_\kappa, \lambda_r, \lambda_\kappa\}$ to match the mean, the standard deviation, and persistence of the time series of the short-term interest rate and term premium we use described in the empirical section. For simplicity, we set the correlation between term premium and interest rate shocks to be zero.

For banks, we calibrate the parameters primarily following the literature. In particular, we set the values of λ and ρ to be the same as GK15, and we set c to match the same average Tobin's Q in GK15. We use the deposit spread from Drechsler et al. (2021b), who show that an increase in the short rate by 100 bps translates into an increase in the average deposit rate by 35 bps.

Numerical results: policy functions. Figure 1 shows the model's solution. All the panels in the figure have the state variable κ_t, which drives term premium fluctuations, in the horizontal axis. Each panel display a solid blue line, representing the solution when the short rate r is at its mean, as well as a dashed yellow line and a dotted red line, representing solutions when r is two standard deviations above or below its mean, respectively.

The upper-left panel shows the term premium, given in equation (7). A more negative κ corresponds to a higher term premium. Intuitively, this is because as the diffusion component of the stochastic discount factor (κ) becomes larger in magnitude, an interest rate shock affects valuations relatively more. Hence, a more negative κ translates into higher term premium and lower marked-to-market loan prices. In addition, as shown by the difference between the yellow dashed and the red dotted line, the term premium is also affected by the level of rate because the interest rate becomes more volatile (i.e., higher quantity of risk) as the level of rate increases.[9]

The upper-right panel shows banks' marginal value of wealth (or "Tobin's Q"), $\psi = V/n$. A higher ψ means banks value an extra unit of wealth relatively more. Notice a higher ψ corresponds

[9] The fact that the level of rates affect the volatility of rates and hence the quantity of risk is a mechanical implication of the square root model.

to states in which the term premium is high and the marked-to-market value of loan prices are low.

The middle-left panel shows the expected return on wealth, given by

$$\mu_{n,t} \equiv E\left[\frac{\mathrm{d}n_t}{n_t}\right] = r_t\left[1 + (1-\phi)\,\delta\right] + \alpha_t TP_t\left(\kappa_t, r_t\right),$$

where $TP_t\left(\kappa_t, r_t\right)$ is the term premium. The expected return on wealth is increasing in the level of term premium as well as in the level of interest rates. This is because a higher term premium translates into a higher expected excess return on lending (and hence future profits) while a higher level of rates translates into higher profits from deposit making. Additionally, as shown in the middle-right panel, banks' leverage on loans, $\alpha_t = x_t^{(\tau)} P_t^{(\tau)} / n_t$, is also increasing in term premium. This is because α is pinned down by the incentive constraint, and therefore is proportional to ψ. Together, higher leverage and higher term premium implies a higher expected excess return on wealth when κ is low.

Finally, the bottom two panels show the solutions for bank lending. The level of lending is pinned down by the incentive constraint. That is, the total value of the loan portfolio is given by

$$L_t = P_t^{(\tau)} x_t^{(\tau)} = \frac{V_t}{\rho} = \frac{1}{\rho}\psi_t n_t.$$

Then, applying Ito's lemma to L_t, we have that lending growth is[10]

$$\frac{\mathrm{d}L_t}{L_t} = \frac{\mathrm{d}\psi_t}{\psi_t} + \frac{\mathrm{d}n_t}{n_t} + \frac{\mathrm{d}\psi_t}{\psi_t}\frac{\mathrm{d}n_t}{n_t}. \tag{13}$$

The drift of (13) represents the expected loan growth,

$$\mu_{L,t} \equiv E_t\left[\frac{\mathrm{d}\psi_t}{\psi_t}\right] + E_t\left[\frac{\mathrm{d}n_t}{n_t}\right] + E_t\left[\frac{\mathrm{d}\psi_t}{\psi_t}\frac{\mathrm{d}n_t}{n_t}\right], \tag{14}$$

and is shown in the lower-left panel of Figure (1). The second term on the right hand side of equation (14) is the expected return on wealth and, as discussed above, is increasing in term premium. However, the first term, $E_t\left[\frac{\mathrm{d}\psi_t}{\psi_t}\right]$, is decreasing in term premium. This is because ψ itself is increasing in term premium but stationary; therefore, when term premium increases, ψ also rises but is expected to mean revert to its original lower level in the future, hence displays a negative expected change. In our calibration, the effect from an increase in expected return on wealth more than offsets that increase in ψ, and the expected loan growth rises with term

[10] The level of loans is non-stationary.

premium. Intuitively, this means that even though a higher term premium reduces loans prices (through a higher Tobin's Q) and causes banks to become relatively more constrained (through a lower $E_t\left[\frac{d\psi_t}{\psi_t}\right]$), both of which would dampen lending growth, a higher expected future excess return on loans would incentive banks to increase their lending in the near future.

On impact, though, a negative shock to κ causes a slight decrease in the amount of loans. This is because the diffusion component associated with κ shocks, $\sigma_{L\kappa,t}$, displayed in the lower-right panel, is slightly positive. The diffusion $\sigma_{L\kappa,t}$ is given by

$$\sigma_{L\kappa,t} \quad = \quad \left(\frac{\psi_\kappa}{\psi} + \alpha_t \frac{P_\kappa^{(\tau)}}{P^{(\tau)}}\right)\sigma_\kappa \tag{15}$$

In equation (15), the derivative ψ_κ is negative (i.e., higher κ, lower term premium and hence lower ψ) while the derivative P_κ is positive (i.e., higher κ, lower term premium, hence higher loan prices). In the baseline calibration, the marked-to-market losses in loans due to an increase in κ, P_κ, dominates and $\sigma_{L\kappa,t}$ is positive.

Numerical results: impulse responses. Figure 2 shows the impulse-response functions to a negative shock in κ that causes an approximately 100bps increase in term premium and lower loan prices. Banks increase their leverage (top right panel), and both the expected return on wealth (i.e., future profitability) and the loan growth increase. These dynamics are relatively less pronounced for banks that are more constrained, represented by the red dashed lines, because those banks are less able to benefit from the higher expected excess returns on maturity transformation.

In Sections 4 and 5, we use bank- and loan-level datasets to test the predictions of the model, specifically the following two testable implications:

Testable implication 1 *Banks respond to higher expected excess returns on maturity transformation by increasing the supply of new loans.*

Testable implication 2 *Less constrained banks are better positioned to take advantage of higher expected excess returns on maturity transformation and increase the supply of new loans more than banks with tighter financing constraints.*

4 How do banks react to term premia: Bank-level evidence

Identifying the effect of term premia on bank behaviors is subject to two econometric problems.

First, other variables, such as economic growth expectations or uncertainty, might affect both term premia and bank behaviors at the same time, potentially leading to a omitted variable bias if those variables are not included in the regressions. To alleviate this concern, we include survey expectations of future growth in all regressions. Furthermore, we use survey responses from the SLOOS to directly control for changes in loan demand as reported by senior bank loan officers. However, one might still worry that survey expectations and loan officers' reports of changes in loan demand do not fully capture the true expectations of agents in the economy. In this section, we take an instrumental variable (IV) approach (described in detail below) and try to isolate variations in term premia that are due to factors arguably unrelated to the domestic economy.

Second, bank lending is jointly determined by borrower demand and bank credit supply. Although survey growth expectations and the instrumental variable help control for aggregate borrower demand related to changing economic outlooks, variations in *idiosyncratic* borrower demand may still potentially influence our results. To allay this concern, in Section 5 we use loan-level data to examine bank lending behavior around the unanticipated rise of term premia during the taper tantrum period, and control for quarterly changes in borrower loan demand with borrower$\times$quarter fixed effects.

4.1 The instrumental variable

The instrument variable we focus on is the foreign official (i.e. central banks) holdings of Treasury securities, measured in par amount and normalized by GDP. We argue that foreign official Treasuries holdings are unlikely to be correlated with U.S. economic conditions based on evidence from a large literature on the effects of foreign investor demand for U.S. Treasury securities on Treasury yields (see, e.g., Bernanke et al. (2004), Warnock and Warnock (2009), Beltran et al. (2013), Kaminska and Zinna (2020), and Ahmed (2021)). These studies postulate that demand by foreign investors, especially foreign reserve managers and other official accounts, are primarily driven by their foreign reserve management and foreign exchange intervention needs rather than profit motives.[11] Recently, Tabova and Warnock (2021) use annual confidential surveys on security-level foreign holdings of U.S. Treasuries to compare returns to different types of investors and find evidence that foreign officials are less price sensitive than domestic and foreign private investors. Therefore, variations in foreign official holdings can be viewed as exogenous shocks to the demand

[11] See also the literature on capital inflows into the U.S. from foreigners seeking U.S. assets to store value, e.g., Caballero and Krishnamurthy (2009) and Caballero et al. (2008) and explanations related to the global savings glut, summarized in Bernanke (2005).

for U.S. Treasuries that would affect Treasury yields and term premia.[12]

We show that our instrument is a strong predictor of the term spread and term premia in Table 3, where we regress the 3-month/5-year term spread and the 5-year Kim-Wright term premium on the foreign official holdings measure, together with the short rate either alone or with additional macro variables. The estimates show that higher demand by foreign official investors for Treasury securities is associated with statistically significant lower term spreads (columns 1-2) and lower term premia (columns 3-4), after controlling for the current macro conditions.

4.2 Results

In Table 4 we report our main results based on bank-level data on a quarterly frequency and the longest time periods afforded by the data availability. The goal is to test the model's implication 1 based on the instrumental variable strategy outlined above by relating bank profitability and lending outcomes to changes in the term premium. To this end, we show specifications where the expectations and the term premium components of the term spread enter separately. We use the following specification akin to the time-series regression in Section 2 but estimated in data at the bank-quarter level:

$$Z^i_{t,t+4} = \alpha_i + \beta_1\, \Delta y^1_t + \beta_2 \left(y^{20,eh}_t - y^1_t \right) + \beta_3\, y^{20,tp}_t + \tau X_t + \gamma Z_{it} + \varepsilon^i_{t,t+4} \qquad (16)$$

where the dependent variable $Z^i_{t,t+4}$ is the 4-quarter ahead loan growth at bank i (excluding and including off-balance sheet corporate credit lines), three measures of bank profitability—NIMs, ROE, and ROA—and a dummy variable that takes value +1 for banks reporting that they eased lending standards, zero if they left them unchanged, and -1 if they tightened them. The vector of macro controls X_t includes short-rate changes, excess bond premium, realized real GDP growth and GDP deflator inflation, and survey forecasts of one-year ahead real GDP growth and GDP deflator inflation. Notice that we aim to identify the coefficient on $y^{20,tp}_t$ and therefore cannot include time fixed effects (we do so in Sections 4.3 and 5 where we examine heterogeneity by bank risk constraints). Instead, we include interacted bank$\times$season fixed effects (for quarters 1, 2, 3 and 4) which span bank fixed effects (α_i). Furthermore, we include a vector of standard bank-level determinants of lending and profits Z_{it} including: bank size (log-assets), capital ratio, and

[12] Our approach is similar to Krishnamurthy and Vissing-Jorgensen (2015), who use the rapid increase in foreign official holdings of Treasuries since the early 1970s as a shock to the supply of Treasuries available to private investors given that foreign official holdings are unlikely to be correlated with U.S. economic conditions.

securities-to-asset ratio. The ratio of securities to assets aims to capture potential valuation effects from changes in the yield curve—for instance, that a decline in long-term rates would increase the value of assets that are marked to market in a bank's balance sheet and boost earnings, hence capital (see, e.g., Chakraborty et al. (2020) and Rodnyansky and Darmouni (2017)).

In Appendix C we report summary statistics on the time-series and bank balance-sheet variables used in this section.

Effects on bank lending and profits The IV estimation results shown in Table 4 indicate that a higher term premium induced by lower foreign official demand for Treasury securities is followed by significantly higher bank lending and bank profits over the following four quarters. Across specifications, the coefficient estimates on the term premium are statistically significant at conventional levels. Furthermore, the first-stage F-test for instrument relevance is above 100, suggesting a strong instrument (Lee et al., 2022). In terms of economic magnitude, the estimates indicate that a 100 bp increase in the term premium is associated with an increase in loan growth by 1.9 percent (column 1) and in bank NIMs, ROA and ROE by 11, 96, and 7 bps (columns 3–5), respectively. These effects are economically sizeable given that over the sample period the average loan growth and profitability metrics were 3.8% and, respectively, 1%, 2.3% and 0.2%. By contrast, the expectations component is less important in predicting those variables (with coefficient estimates insignificant in one specification) but indicates, across most specifications, that expectations of higher short rates are generally associated with lower bank lending and profits.

Changes in the composition of bank assets Table 5 examines how banks adjust the composition of their assets between fixed-rate vs floating-rate categories. Following a foreign demand-induced increase in the term premium, the share of fixed-rate assets among all loans and securities remains unchanged (column 1), as the higher share of fixed rate securities (column 3) on the bank's balance sheet is offset by a lower share of fixed-rate loans (column 2). The lower share of fixed-rate loans is mostly driven by residential mortgage loans (column 4). The coefficient estimates on the lagged term premium in column 5 show that banks reduce the spreads between fixed-rate and floating rate mortgages, suggesting that the lower share of fixed-rate residential loans as term premia rise is likely driven by lower borrower demand for fixed-rate loans rather than by a lower bank supply of such loans.

Changes in bank asset and liability growth In Table 6 we examine the link between changes in the term premium and the growth rate of other components of the banks' balance sheets. The estimates indicate that a higher term premium due to lower demand from foreign official investors for Treasury securities boosts growth in banks' securities holdings (column 2). This increase is financed mainly by an expansion of non-deposit liabilities (column 5), while deposits are little changed (column 4). Book equity also grows over the subsequent year (column 6), consistent with our baseline findings that a rise in the term premium increases bank profits.

Alternative estimate of the term premium Here we verify that the main results are not driven by the choice of term structure model and repeat the analysis using term premium series from Adrian et al. (2013) (ACM).[13] Table IA-1 shows that our instrumental variable, the ratio of foreign official Treasury security holdings (normalized by GDP), has strong explanatory power for the ACM 5-year term premium estimates above and beyond the short rate, similar to the baseline result for the Kim-Wright term premium estimates (from Table 3). The estimates in Table IA-2 show that our baseline results (in Table 4) are robust to using the ACM term premium estimates.

4.3 Role of bank risk constraints

We now examine the model prediction 2 that the response of bank lending to a term premium shock is more pronounced for less constrained banks. We measure bank constraints with two indicators of the stringency of internal risk controls, which are meant to capture the ease with which the bank can deploy its capital to take advantage of an increase in expected excess returns. First, we use the management component of a bank's supervisory CAMELS score. The CAMELS rating system is on a scale from 1 to 5, with higher values indicating weaker performance. A higher management score indicates more lax bank management practices and hence a bank that is more likely to exhibit risk-seeking behaviors. Numerous studies show that CAMELS supervisory scores contain useful information for supervisory and public monitoring of commercial banks and have predictive power for bank conditions (see, e.g., Berger and Davies (1998); Flannery (1998); Lopez (1999); Berger et al. (2000)). Recently, Gaul et al. (2021) show that the management component of the CAMELS score, which is our focus, is associated with more risk-taking at the bank level.

Second, we use the risk management index (RMI) developed by Ellul and Yerramilli (2013) to measure the strength and independence of the risk management function of banks. This index

[13] The data are obtained from the NY Fed's website.

measures the strength of the risk management function within a given bank by combining information from a large number of variables capturing the importance of the risk officers and their activities. Such variables include indicators for whether the bank has a chief risk officer (CRO), if the CRO is an executive and how its pay compares with the CEO, the average experience of risk committee members and the frequency with which this committee meets. The RMI is available on a yearly basis during 1994–2014 for a subset of bank holding companies (we are able to match 1324 BHCs to the Call Report data and 20 BHCs to the Y-14Q data). Ellul and Yerramilli (2013) show that banks with higher RMIs on the eve of the 2007–08 global financial crisis took less tail risk and performed better during the crisis. This index is available only annually at the bank holding companies (BHCs) level for a shorter sample period from 1994 to 2014.

To examine the validity the model prediction 2, in the baseline specifications we interact the term premium with the two measure of bank constraints.[14] The results are reported in Table 7 where panel (A) refers to the management component of a bank's supervisory CAMELS score and panel (B) refers to the RMI. The estimates show that an increase in term premium induced by higher foreign official demand for Treasuries is associated with greater loan growth at banks with a higher CAMELS management score relative to other banks (columns 1–2). The NIMs, ROE, and ROA of those banks also appear to rise relatively more in response to higher term premia, with all estimates being statistically significant at conventional levels (columns 3–5).[15]

Panel B of Table 7 reports the results using the RMI as a proxy for risk constraints (with higher values indicating less stringent internal risk controls and thus greater ability to take advanage of an increase in the term premium). The results are qualitatively similar to those in panel (A), with the expected signs, and the profit responses are statistically significant (columns 4–5), but the lending responses are statistically weaker (columns 1–2).

5 Taper Tantrum case study: Loan-level evidence

In this section we test the model's prediction 2 using granular data on bank-firm lending relationship from the FR Y-14Q dataset.[16] A key advantage of the loan-level data is that it allows us to examine

[14] The advantage of this approach compared to our previous specifications is that we can now include quarterly fixed effects to absorb all macro shocks affecting all banks at the same time.

[15] The coefficient on the interaction of the term premium with the CAMELS score is positive in column 6, but is insignificant, likely because of the reduced sample of only 161 banks that we are able to match between the SLOOS and the CAMELS dataset.

[16] Our analysis is based on a download of the Y-14Q data in May 2021.

bank lending decisions following a change in the term premium while holding borrower-level loan demand constant each quarter (with borrower×quarter fixed effects, see Khwaja and Mian (2008) and Jiménez et al. (2020)). From the Y-14Q data we extract information on individual loans that were originated by reporting banks to nonfinancial domestic firms in a window of between four and six quarters around 2013:Q2, when the Taper Tantrum started. For more details on the Y-14Q dataset, see Appendix B.

For identification, we estimate bank lending responses during the Taper Tantrum period, when bond yields and term premia surged unexpectedly (Chari et al., 2021). More precisely, we exploit the unexpected nature of the Taper Tantrum that followed the May 22, 2013 speech by Federal Reserve chairman Ben Bernanke—announcing that the Fed would start tapering asset purchases at some future date—as a "shock" to the term premium. Figure 3 depicts the marked and sustained rise in long-term Treasury yields driven by an increase in the term premium in the quarters following this event. Identification of the term premium effect on bank lending hinges on the assumption that the tapering announcement was not driven by an improving outlook of the U.S. economy. Indeed, anecdotal evidence suggests that market commentators were skeptical about the economic outlook around that time and believed that the Fed's reaction function was becoming less accommodating.

We specify the following regression model:

$$\begin{aligned} Loan\ amount_{bjt} = {} & \beta_1 Post_t \times Risk\ constraints_b + \beta_2 Relationship\ length_{bj} + \\ & + \gamma_1' \mathbf{X}_{bt} + \gamma_2' \mathbf{X}_{bt} \times Post_t + \gamma_3' \mathbf{Z}_{bj} + \alpha_b + \delta_{jt} + \varepsilon_{bjt} \end{aligned}$$

where $Loan\ amount_{bjt}$ refers to loan size for newly originated loans by bank b to firm j in quarter t and $Post_t$ is a dummy variable that takes value one starting in 2013:Q3 (and zero before 2013:Q2). The estimation period refers to four, five, or six quarters around 2013:Q2 and all loans originated during 2013:Q2 are dropped for the "after" period to be clearly delineated from the "before" period. Similar to the bank-level regression, we control for key determinants of bank lending (X_{bt}) including bank size (log-assets), capital, and securities-to-asset ratio, both in levels and in interactions with the $Post_t$ dummy. Crucially, we include a pair-level variable (Z_{bj}) to capture the intensity of the borrowing relationship and account for potential endogenous matching between banks and firms (Schwert, 2018; Chodorow-Reich, 2014), owing, for instance due to bank specialization (Paravisini et al., 2015).[17] The specification adds bank fixed effects and interacted

[17] Ideally, we would prefer to include interacted bank×firm fixed effects to address this problem, but our sample periods are too short (ranging between 8 and 12 quarters) and average loan duration is five years, which makes it difficult to observe multiple new originations by a given bank to the same borrower and thus to allow the inclusion of

borrower×quarter fixed effects to control for time-varying loan demand at the firm level (Khwaja and Mian (2008); Jiménez et al. (2020)). The estimates are obtained using OLS with standard errors that are clustered at the bank-firm level. Consistent with model prediction 2, we expect β_1 to be negative for the RMI and positive for the CAMELS management score, such that banks with less stringent internal risk controls exhibit larger lending volumes.

Results: Role of bank risk constraints The regression estimates are reported in Table 8 and indicate a robust and statistically significant negative relation between the stringency of risk controls, a proxy for the bank's attitude towards risk-taking, and the supply of bank loans, in the period of the taper tantrum. This relationship is statistically significant after controlling for key bank characteristics that determine lending, their interactions with the *Post* dummy, and relationship intensity. As was the case for our bank-level evidence on the role of risk constraints, these findings support the model's implication 2.

Real effects Lastly, we ask whether the credit expansion experienced by less constrained banks translates into better firm-level outcomes. For this purpose, we use end-year firm balance sheet information from the Y14-Q dataset to examine the investment behavior of firms that were ex-ante differentially exposed to the Taper Tantrum event. Specifically, we relate firm-level investment rate (one or two years after the Taper Tantrum speech) to the firms' past reliance on lenders with different exposure to the Taper Tantrum via their risk-taking attitudes, and standard determinants of firm investment. We specify the following regression and estimate it on firm-level data covering 2013–2014 or, alternatively, 2013–2015:

$$Investment\ Rate_{jt} = \beta_1 Post_t \times Bank\ RMIj + \gamma_1' \mathbf{Z}_{jt} + \gamma_2' \mathbf{Z}_{jt} \times Post_t + \\ + \delta_j + \theta_t + \varepsilon_{jt}$$

where the dependent variable is the investment rate, computed as the capital expenditure of firm j in year t divided by lagged $(t-1)$ capital stock, $Post_t$ is a dummy variable taking value one in 2014 (and zero in 2013), or alternative, one in 2014–2015 and zero for 2013. Furthermore, $Bank\ risk\ aversion_j$ is the firms' exposure to the rise in term premia during the Taper Tantrum via their borrowing relationships with banks exhibiting different attitudes towards risk-taking. This exposure is computed as the average RMI across a firm's lenders weighted by those lenders' share

pair fixed effects.

of total bank debt outstanding of the firm (both variables at end-2012 to predate the Taper Tantrum). The vector of firm controls $\mathbf{Z}_{jt}$ includes size (log-assets), leverage (total debt/assets), cash holdings (% assets), tangible assets (% assets), interest coverage ratio (EBITDA/interest expense), sales growth (as a proxy for future growth opportunities), and a dummy variable for listed firms, in levels and interactions with $Post_t$. To control for yearly geographic and sectoral shocks, we include commuting zone fixed effects, industry fixed effects, and their interactions. The coefficient of interest is β_1 which we expect to be negative, supporting the prediction that firms borrowing from banks more willing to take risks had higher investment rates as the term premium rose (and received more credit from those banks) than other firms.

The results, reported in Table 9, provide support for this prediction. The coefficient estimates on $Post_t \times Bank\ RMIj$ are negative and statistically significant across specifications, regardless of the time horizon examined, suggesting that firms borrowing from banks with less stringent risk controls had higher investment rate after the Taper Tantrum compared to other firms. These estimates are also statistically significant, indicating, using the coefficients in columns 2–3, that a firm borrowing from a bank with below-average RMI had an investment ratio that was higher by 4.6 ppts (or 22% of the mean) than a firm borrowing from a bank with above-average RMI.

6 Conclusion

This paper presents evidence that bank lending and profitability go up following an unexpected increase in the term premium, and more so for banks that are less risk averse. These findings are consistent with prediction from a portfolio choice model for banks and point to one potential explanation for the long-documented predictability of the slope of the yield curve for future economic growth. Namely, when the yield curve steepens due to higher term premia, banks expand their balance sheet to provide more credit. The increased supply of bank credit can be expected to boost the overall economy through the usual credit channels. That said, we do not quantify the effect of changes in the yield curve on aggregate borrowing, which requires accounting for possible substitutions by borrowers to other sources of credit, or on aggregate economic growth. We leave those questions to future research.

Appendix

A SLOOS Description

In this section we describe the quarterly survey data on the basis of which we construct the net share of banks that report easing lending standards (used in the time-series analysis in Section 2) and indicator variables for banks that report easing lending standards (used in the bank-level analysis in Section 4).

The Senior Loan Officer Opinion Survey on Bank Lending Practices (SLOOS) is a quarterly survey that has been conducted since the 1980s and collects information on changes in bank lending standards and loan demand across loan categories. To measure lending standards, we record the response as 1 if the bank reports easing lending standards “considerably” or “somewhat”, 0 if the bank reports lending standards as remaining basically unchanged, and -1 if the bank reports tightening lending standards “considerably” or “somewhat”. For loan demand, we record the response as 1 if the bank reports demand as “substantially” or “moderately” stronger, 0 if the bank reports demand being about the same, and -1 if the bank reports demand as “substantially” or “moderately” weaker.

In the baseline bank-level regressions (Section 4) we use the variables as defined above. In the aggregate time-series regressions (Section 2) we compute the net share of banks that report easing standards (defined as the difference between the fraction of banks that report easing standards “substantially” or “moderately” and the fraction of banks that report tightening standards “substantially” or “moderately”). Given that separate questions about lending standards are asked for each loan category (C&I loans to large and small firms, commercial real estate loans, mortgages, and consumer loans), we follow Bassett et al. (2014) and Glancy et al. (2020) and aggregate each banks’ responses across these loan categories using outstanding loan balances banks reported in the most recent Call Report as weights.

In results not reported, we checked that our results are robust to using series adjusted for borrower demand following the approach in Bassett et al. (2014).

B FR Y-14Q Data Description

Our loan-level data come from the supervisory FR Y-14Q H.1 schedule “Wholesale credit risk” collected by the Federal Reserve from banks that are subject to stress tests and have at least \$50 billion over the period covering the taper tantrum case study in Section 5 (that is, 2012–2015). These are the largest banks in the U.S. banking system and together account for nearly 80% of total banking assets. The data represent individual C&I loans outstanding between each reporting bank and individual borrowers that have unique tax identifiers which enables us to trace their borrowing activities across banks and time. Our regression sample, which comprises only new loan originations to nonfinancial (domestic) firms, contains 38 BHCs that are matched, on main commercial bank in the BHC, to balance sheet data from the U.S. Call Report.

Despite a minimum reporting threshold of $1 million for loans outstanding, the Y-14Q data cover a large share of U.S. banks' corporate lending commitments—in particular, roughly three-quarters of total U.S. C&I loans (Crosignani et al., 2021; Favara et al., 2021). To estimate the economic relevance of the borrowers observed in the dataset, Caglio et al. (2021) combine the data with the U.S. Flow of Funds and show that the Y-14Q borrowers account for 60% of nonfinancial business debt liabilities.

The data contain detailed information about each loan contract, including the total loan commitment (in US$), drawn amount (utilization rate) for credit lines, and additional loan terms (such as whether the loan is a credit line or term loan, fixed vs. floating rate, interest rate, loan spread, loan maturity, collateral type and value, and loan performance). The data lacks information on covenants. A unique feature of the data is that it includes banks' assessments of borrower risk, in particular each borrower's internal risk rating. This internal risk rating is mapped by the FRB Chicago to the standard Standard and Poor's (S&P) ten-point scale. The data also include additional firm financial information, including industry and location (down to the zipcode where the loan is extended), total assets, total debt, cash holdings, and sales growth.

Additional information and detailed variable list for the FR Y-14Q data are available on the Federal Reserve website.

C Summary Statistics

Tables A-1 and A-2 report summary statistics for data used in bank-level analysis, and, respectively, the loan- and firm-level analyses.

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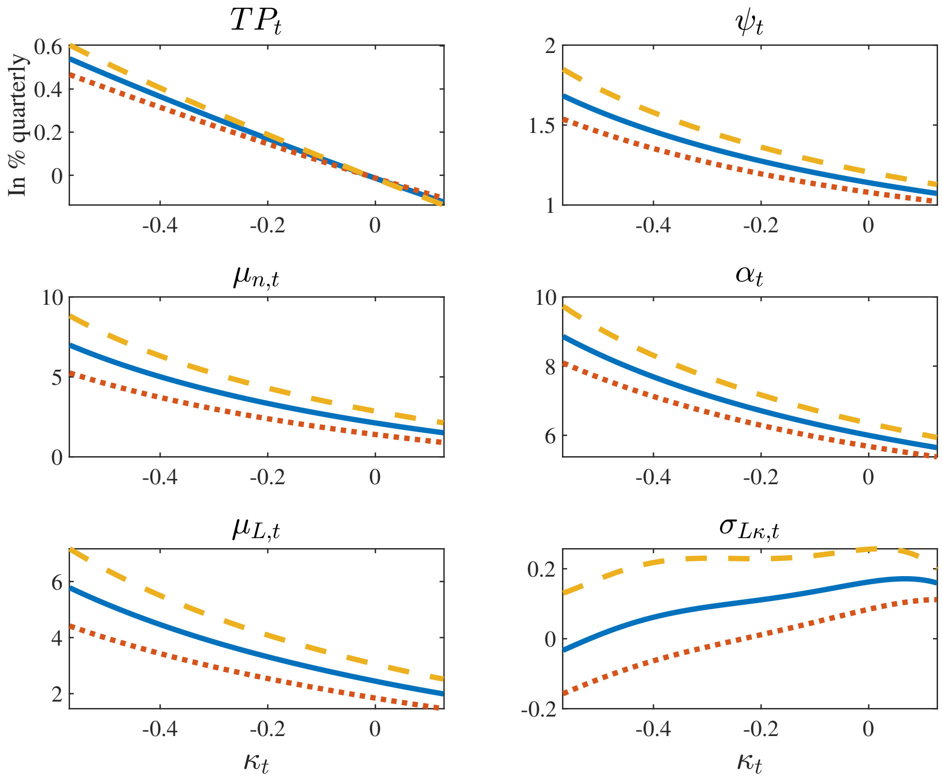
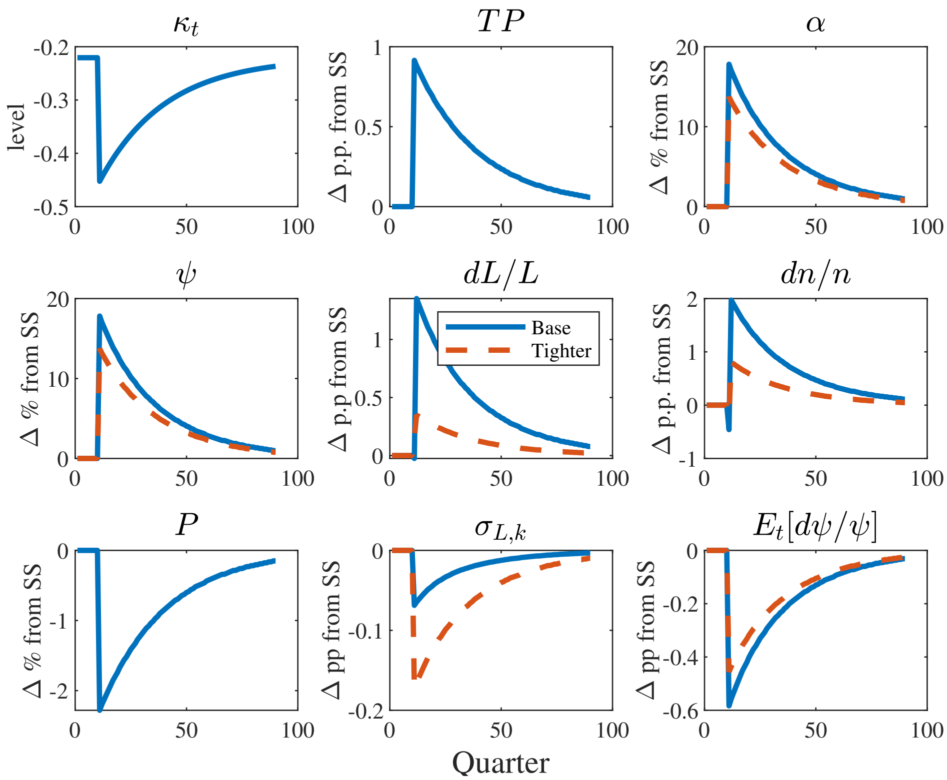
Figures

Figure 1: Model solution



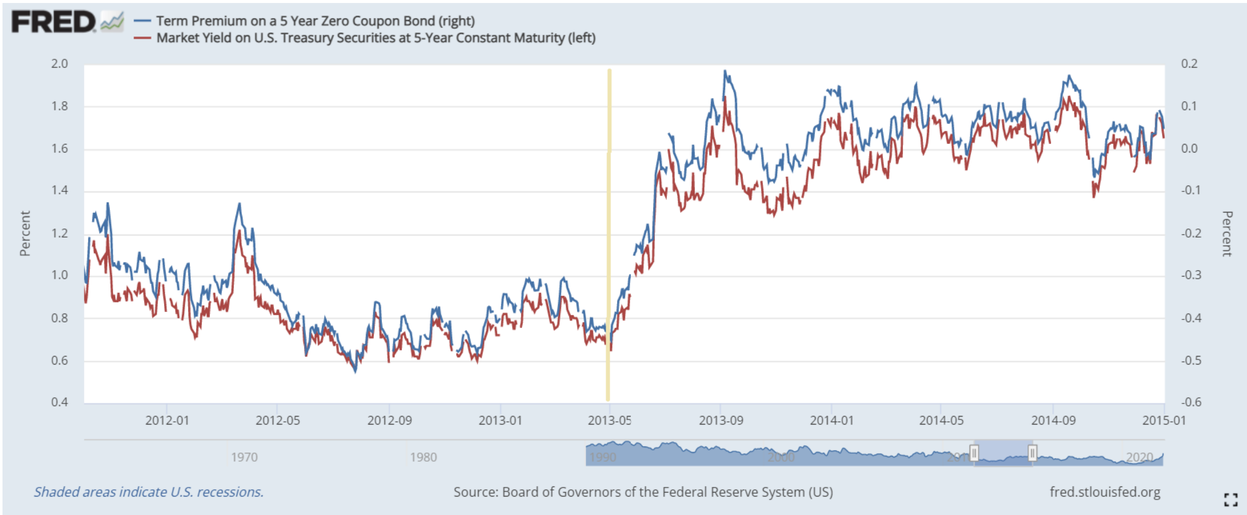
This figure shows the model's solution across the κ_t (term premium) dimension (horizonal axis) for three levels of the state variable r_t (the short rate). The solid line is when r_t is at its unconditional mean, the dashed (dotted) line is when r_t is two standard deviations above (below) its mean.

Figure 2: Impulse responses to a κ shock in the model



This figure shows the model's impulse-responses to a κ_t shock that causes roughly a 100bps increase in term premium. The red-dashed lines are the responses of the model with tighter leverage constraints (δ=1.25 and ρ=0.5).

Figure 3: Rise in Treasury yields and the term premium during Taper Tantrum



This figure depicts the rise in market yields on 5-year Treasury securities and in the 5-year term premium during the Taper Tantrum episode following May 2013 (yellow vertical line). Source: FRED.

Tables

Table 1: Model Calibration

		Value	Description	Source
1. $r-$process				
	$\bar{r}$	0.0115	Mean r	SMM
	λ_r	0.0241	AC(1) r	SMM
	σ_r	0.0071	Volatility r	SMM
2. $\kappa-$process				
	$\bar{\kappa}$	-0.2206	Mean κ	SMM
	λ_κ	0.0332	AC(1) κ	SMM
	σ_κ	0.0299	Volatility κ	SMM
3. Banks				
	λ	0.013	Dividend payout intensity	GK15
	ρ	0.19	Seizure rate	GK15
	ϕ	0.35	deposit spread	Drechsler et al. (2021b)
	c	0.003	Fixed cost	avg. Tobin's Q in GK15
	δ	1.75	Deposit constraint	

The model calibration is described in the text.

Table 2: A first look at the aggregate data: Time-series evidence

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	**Real GDP growth**$_{t,t+4}$		**Bank loan growth**$_{t,t+4}$		**NIM**$_{t,t+4}$	
3m5y term spread$_t$	0.64**		0.87**		0.03	
	(0.31)		(0.44)		(0.03)	
Term premium$_t$		1.03**		0.89**		0.11***
		(0.46)		(0.41)		(0.03)
Expectations$_t$		0.58*		0.87*		-0.01
		(0.31)		(0.47)		(0.04)
Δ Short rate$_t$	-0.15	-0.13	0.06	0.06	-0.02	-0.03
	(0.29)	(0.29)	(0.20)	(0.21)	(0.03)	(0.03)
Observations	183	183	183	183	140	140
R-squared	0.34	0.37	0.60	0.60	0.87	0.89
start	1973q1	1973q1	1973q1	1973q1	1984q1	1984q1
end	2019q4	2019q4	2019q4	2019q4	2019q4	2019q4
Macro controls	Y	Y	Y	Y	Y	Y

	(7)	(8)	(9)	(10)	(11)	(12)
Dependent variables	**ROE**$_{t,t+4}$		**ROA**$_{t,t+4}$		**Share banks easing standards**$_{t,t+4}$	
3m5y term spread$_t$	1.56**		0.13**		0.15**	
	(0.66)		(0.06)		(0.06)	
Term premium$_t$		1.65**		0.09		0.09*
		(0.70)		(0.06)		(0.06)
Expectations$_t$		1.42**		0.15**		0.18***
		(0.71)		(0.06)		(0.06)
Δ Short rate$_t$	0.52	0.51	0.05	0.05	0.02	0.03
	(0.49)	(0.47)	(0.04)	(0.04)	(0.04)	(0.04)
Observations	140	140	140	140	109	109
R-squared	0.48	0.48	0.58	0.59	0.64	0.68
Sample start	1985m3	1985m3	1985m3	1985m3	1992m12	1992m12
Sample end	2019m12	2019m12	2019m12	2019m12	2019m12	2019m12
Macro controls	Y	Y	Y	Y	Y	Y

This table reports OLS regressions in monthly time series. The dependent varibles are 4-quarters ahead real GDP growth, bank loan growth, bank profitability (NIM, ROA, and ROE), and the net share of banks that report easing lending standards. All specifications include the following controls, all lagged: short rate (3-month tbill yield) change, 1-year ahead real GDP forecasts, and excess bond premium; and lagged dependent variables. Robust and kernel-based autocorrelation-consistent standard errors in parentheses. *p<.1; **p<.05; ***p<.01.

Table 3: Effect of instrumental variable on term spreads and term premiums

	(1)	(2)	(3)	(4)
Dependent variables	3-month/5-year term spread		Kim-Wright 5-year term premium	
Foreign official Treasury holdings at par value-to-GDP ratio	-0.05***	-0.08***	-0.03***	-0.07***
	(0.01)	(0.01)	(0.01)	(0.01)
Short rate	-0.19***	-0.28***	0.08***	0.07***
	(0.03)	(0.04)	(0.02)	(0.02)
Observations	240	187	234	187
R-squared	0.20	0.63	0.19	0.62
Sample start	1960q1	1973q1	1961q3	1973q1
Sample end	2019q4	2019q4	2019q4	2019q4
Additional macro controls	N	Y	N	Y

This table reports OLS estimates of contemporaneous time series regressions of the 3-month/5-year term spread and the 5-year term premium (estimated using the Kim and Wright (2005) model), respectively, on the instrumental variable (Foreign official holdings of Treasury securities at par value, normalized by GDP) and the short rate (3-month T-bill yield). Regressions in (2) and (4) add additional macro controls including real GDP growth, GDP deflator inflation, 1-year ahead real GDP growth and GDP deflator inflation forecasts from SPF, and the excess bond premium. Robust and kernel-based autocorrelation-consistent standard errors in parentheses. *p<.1; **p<.05; ***p<.01

Table 4: Term premium, bank lending, and profitability—IV estimates in bank-level data

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	Loan growth (excl. CLs)$_{t,t+4}$	Loan growth (incl. CLs)$_{t,t+4}$	NIM$_{t+4}$	ROE$_{t+4}$	ROA$_{t+4}$	Bank eases lending standard$_{t,t+4}$
Term premium$_t$	1.90***	1.38**	0.11***	0.96***	0.07***	8.68**
	(0.69)	(0.68)	(0.01)	(0.13)	(0.01)	(4.03)
Expectations$_t$	0.15	-0.56*	-0.01**	-0.18**	-0.01*	14.75***
	(0.35)	(0.29)	(0.01)	(0.07)	(0.01)	(2.13)
Δ Short rate$_{t-4,t}$	-0.04	-0.48**	0.01*	0.10**	0.01**	3.38**
	(0.20)	(0.19)	(0.00)	(0.05)	(0.00)	(1.32)
Observations	1,640,917	749,809	1,101,648	1,154,509	1,154,523	5,287
R-squared	0.15	0.14	0.35	0.06	0.08	0.41
start	1973q4	1991q1	1984q1	1983q1	1983q1	1991q2
end	2019q4	2019q4	2019q4	2019q4	2019q4	2019q4
Bank controls	Y	Y	Y	Y	Y	Y
Macro controls	Y	Y	Y	Y	Y	Y
Bank$\times$Seasonal FE	Y	Y	Y	Y	Y	Y
First-stage F test	102.7	217.5	112.7	170.8	170.8	239.2

This table reports IV (second stage) estimates from a regression of bank loan growth (excluding and including credit lines), profitability (NIM, ROE, ROA) and a dummy varible taking value one for banks that report lending standards, on the term premium and expectations component of the term spread. All specifications include lagged dependent variables and the following controls, all lagged: short rate changes, real GDP growth, GDP deflator inflation, 1-year ahead real GDP growth and GDP deflator inflation forecasts, and excess bond premium. The specification in column 6 also controls for lagged loan demand (defined as a dummy variable taking value one if the bank reported an increase in loan demand). Bank controls include lagged size (log-assets), capital ratio, and securities-to-asset ratio. All specifications include interacted bank$\times$seasonal fixed effects for quarters 1, 2, 3 and 4. The instrument is the foreign official holdings of Treasury securities at par value, normalized by GDP. Standard errors double-clustered by bank and quarter in parentheses. *p$<$.1; **p$<$.05; ***p$<$.01.

Table 5: Term premium and bank asset composition: Fixed vs. floating-rate

	(1)	(2)	(3)	(4)	(5)	(6)
	Δ Fixed-rate share$_{t,t+4}$					
Dependent variables	all loans and securities	loans	securities	residential	non-residential	Δ 30-year FRM/ 5-year ARM spread$_{t,t+4}$
Term premium$_t$	-0.54	-0.57	0.50*	-0.66**	-0.28	-26.65*
	(0.47)	(0.53)	(0.29)	(0.25)	(0.54)	(14.53)
Expectations$_t$	-0.94***	-0.94***	-0.57***	-0.42***	-0.93***	-25.43***
	(0.27)	(0.31)	(0.16)	(0.14)	(0.32)	(8.30)
Δ Short rate$_{t-4,t}$	-0.70***	-0.59**	-0.68***	-0.43***	-0.67***	-3.15
	(0.22)	(0.23)	(0.16)	(0.12)	(0.25)	(3.92)
Observations	500,370	497,106	486,438	492,075	500,130	5,881
R-squared	0.06	0.05	0.13	0.07	0.06	0.19
start	1998q2	1998q2	1998q2	1998q2	1998q2	2001q1
end	2019q4	2019q4	2019q4	2019q4	2019q4	2019q4
Bank controls	Y	Y	Y	Y	Y	Y
Macro controls	Y	Y	Y	Y	Y	Y
Bank$\times$Seasonal FE	Y	Y	Y	Y	Y	Y
First-stage F test	146.5	146	144.6	145	146.6	164.2

This table reports IV (second stage) estimates from a regression of changes in the fixed-rate shares of different components of bank assets and changes in the spread between the 30-year fixed rate mortgage (FRM) and the 5-year adjustable-rate mortgage (ARM) rates on the term premium and expectations component of the term spread. All specifications include lagged dependent variables and the following controls, all lagged: short rate changes, real GDP growth, GDP deflator inflation, 1-year ahead real GDP growth and GDP deflator inflation forecasts, and excess bond premium. Bank controls include lagged size (log-assets), capital ratio, and securities-to-asset ratio. All specifications include interacted bank$\times$seasonal fixed effects for quarters 1, 2, 3 and 4. The instrument is the foreign official holdings of Treasury securities at par value, normalized by GDP. Standard errors double-clustered by bank and quarter in parentheses. *p$<$.1; **p$<$.05; ***p$<$.01.

Table 6: Term premium and balance sheet growth rates

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	$\text{assets}_{t,t+4}$	$\text{securities}_{t,t+4}$	$\text{liabilities}_{t,t+4}$	$\text{deposits}_{t,t+4}$	non-deposit $\text{liabilities}_{t,t+4}$	book $\text{equity}_{t,t+4}$
Term premium_t	0.46	3.41***	1.76***	0.13	25.35***	2.77***
	(0.45)	(1.20)	(0.48)	(0.50)	(4.29)	(0.85)
Expectations_t	-0.75***	-1.91**	-1.18***	-0.78***	-6.95***	-0.03
	(0.25)	(0.89)	(0.25)	(0.28)	(1.72)	(0.36)
Δ Short $\text{rate}_{t-4,t}$	-0.31**	-1.26***	-0.26	-0.43**	2.71**	0.08
	(0.14)	(0.45)	(0.16)	(0.17)	(1.18)	(0.20)
Observations	1,661,723	590,269	1,048,554	1,657,595	1,046,250	1,046,594
R-squared	0.10	0.01	0.08	0.09	0.06	0.02
start	1973q2	1995q1	1984q1	1973q2	1984q1	1984q1
end	2019q4	2019q4	2019q4	2019q4	2019q4	2019q4
Bank controls	Y	Y	Y	Y	Y	Y
Macro controls	Y	Y	Y	Y	Y	Y
Bank×Seasonal FE	Y	Y	Y	Y	Y	Y
First-stage F test	102.4	270.7	115.7	102.2	117.4	118

This table reports IV (second stage) estimates from a regression of different balance sheet components' growth rates on the term premium and expectations component of the term spread. All specifications include lagged dependent variables and the following controls, all lagged: short rate changes, real GDP growth, GDP deflator inflation, 1-year ahead real GDP growth and GDP deflator inflation forecasts, and excess bond premium. Bank controls include lagged size (log-assets), capital ratio, and securities-to-asset ratio. All specifications include interacted bank×seasonal fixed effects for quarters 1, 2, 3 and 4. The instrument is the foreign official holdings of Treasury securities at par value, normalized by GDP. Standard errors double-clustered by bank and quarter in parentheses. *p<.1; **p<.05; ***p<.01.

Table 7: Term premium, bank lending and profitability: The role of bank constraints

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	Loan growth (excl. CLs)$_{t,t+4}$	Loan growth (incl. CLs)$_{t,t+4}$	NIM$_{t,t+4}$	ROE$_{t,t+4}$	ROA$_{t,t+4}$	Bank eases lending standard$_{t,t+4}$
(A) CAMELS management score						
Term premium$_t$ × CAMELS Mgmt Score$_t$	1.29***	1.36***	0.01***	0.35***	0.03***	1.81
	(0.40)	(0.39)	(0.00)	(0.11)	(0.01)	(3.07)
Observations	146,660	145,691	148,129	148,128	148,129	817
R-squared	0.12	0.12	0.07	0.03	0.03	0.12
Sample start	1994q1	1994q1	1994q1	1994q1	1994q1	1994q2
Sample end	2019q4	2019q4	2019q4	2019q4	2019q4	2019q4
Term premium×Bank controls	Y	Y	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y	Y	Y
Quarter FE	Y	Y	Y	Y	Y	Y
First-stage F test	250.7	249.7	250.7	250.7	250.7	180.7
(B) Risk management index (RMI)						
Term premium$_t$ × RMI$_t$	-6.61	-8.87	-0.16*	-4.50***	-0.28*	6.50
	(7.11)	(7.68)	(0.08)	(1.28)	(0.16)	(16.07)
Observations	11,217	10,771	12,589	12,589	12,589	621
R-squared	0.04	0.04	0.08	0.02	0.01	0.14
Sample start	1994q1	1994q1	1994q1	1994q1	1994q1	1996q1
Sample end	2014q4	2014q4	2014q4	2014q4	2014q4	2014q4
Term premium×Bank controls	Y	Y	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y	Y	Y
Quarter FE	Y	Y	Y	Y	Y	Y
First-stage F test	96.42	86.21	94.47	94.47	94.47	120.8

This table reports IV (second stage) estimates from a regression of bank loan growth (excluding and including credit lines), profitability (NIM, ROE, ROA) and a dummy variable taking value one for banks that report lending standards, on the term premium interacted with two indicators of bank risk constraints: the CAMELS management score (panel A) and the risk management index of Ellul and Yerramilli (2013) (panel B). The two indicators are available on a yearly basis and are assumed constant across the quarters in a year. Bank controls include lagged size (log-assets), capital ratio, and securities-to-asset ratio; all these characteristics interacted with the lagged term premium (coefficients not shown). All specifications include interacted bank×seasonal fixed effects for quarters 1, 2, 3 and 4. The instrument is the foreign official holdings of Treasury securities at par value, normalized by GDP, and interacted with the CAMELS management score (panel A) or the risk management index (panel B). Standard errors double-clustered by bank and quarter in parentheses. *p<.1; **p<.05; ***p<.01.

Table 8: Term premium and bank lending: Loan-level evidence

	(1)	(2)	(3)	(4)	(5)	(6)
No. quarters around 2013:Q2	Four	Five	Six	Four	Five	Six
Dependent variable	Log(loan amount)					
Risk management index × Post	-0.372***	-0.358***	-0.219**			
	(0.109)	(0.110)	(0.106)			
CAMELS Mgmt score × Post				0.093	0.271***	0.291***
				(0.087)	(0.082)	(0.078)
Size × Post	0.075***	0.071***	0.080***	0.046	-0.002	-0.003
	(0.018)	(0.019)	(0.018)	(0.038)	(0.036)	(0.034)
Capital × Post	-0.019*	-0.036***	-0.033***	-0.018	-0.049***	-0.047***
	(0.011)	(0.012)	(0.012)	(0.016)	(0.017)	(0.016)
Securities-to-assets × Post	-0.011**	-0.012***	-0.011**	-0.001	-0.006	-0.007*
	(0.004)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)
Relationship length (log)	0.078***	0.075***	0.054***	0.102***	0.094***	0.072***
	(0.009)	(0.010)	(0.009)	(0.015)	(0.014)	(0.013)
Observations	20,914	29,127	34,491	15,906	20,551	24,781
R-squared	0.747	0.857	0.850	0.611	0.722	0.722
Bank controls	Y	Y	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y	Y	Y
Firm×Year:Quarter FE	Y	Y	Y	Y	Y	Y

This table reports OLS estimates from a regression of bank loan volume (log) on the interaction of proxies for bank risk constraints (RMI and CAMELS managment score, respectively) with a *Post* dummy that takes value one after 2013:Q2, and zero otherwise. The data are at the loan level, refer to new loan originations to nonfinacial firms, and cover the four, five, or six quarters before and after 2013:Q2. All specifications include the following bank controls: size (log-assets), capital ratio, and securities-to-asset ratio in levels and interacted with the Post dummy. Relationship length is defined as the number of quarters since the first loan is observed in a given bank-firm pair (log). All specifications include bank fixed effects and firm×quarter fixed effects to control for time-varying loan demand. Standard errors clustered by bank-firm in parentheses. *p<.1; **p<.05; ***p<.01.

Table 9: Term premium and firm-level real effects

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Investment rate (Capex/L.Capital Stock)					
	2013 vs. 2014			**2013 vs. 2014-2015**		
Bank risk management index × Post	-0.045***	-0.047***	-0.047**	-0.048***	-0.046***	-0.046***
	(0.015)	(0.016)	(0.019)	(0.013)	(0.014)	(0.016)
Observations	7,404	7,404	7,404	14,955	14,955	14,955
R^2	0.711	0.713	0.713	0.644	0.645	0.645
Firm controls×Post		Y	Y		Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Commuting zone FE	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
Commuting zone×Industry FE			Y			Y

This table reports OLS estimates from a firm-level regression of the investment rate on the interaction of proxies for bank risk constraints (RMI) averaged across the lenders that a given firm borrows from; and with a *Post* dummy that takes value one in 2014 (columns 1-3) or 2014–2015 (columns 4-6), and zero otherwise. Bank risk management index is computed at the firm level as the share of the firm's CCAR bank debt from high (above-median) RMI banks (at end-2013). The data are at the firm level for year-end. All specifications include the following firm controls (coefficients not shown): size (log-assets), leverage (total debt/assets), cash holdings (% assets), tangibility (tangible assets in % of total assets), interest coverage ratio, firm sales growth (as a proxy for future growth opportunities), and a dummy variable that takes value one for listed firms. Columns 3 and 6 include all the firm controls interacted with the *Post* dummy (coefficients not shown). All specifications include firm fixed effects, year fixed effects, commuting zone fixed effects, industry (two-digit NAICS classification) fixed effects, and in columns 3 and 6, interacted commuting zone×industry fixed effects to control for shocks affecting all firms in the same commuting zone and/or industry and year. Standard errors clustered by firm in parentheses. *p<.1; **p<.05; ***p<.01.

Table A-1: Summary statistics for bank-level analyses

	No. Obs.	Std. Dev.	Mean	25th perct.	Median	75th perct.
Table 4						
loan growth (excl. CLs)$_{t,t+4}$	1676286	0.146	0.038	-0.043	0.03	0.106
loan growth (incl. CLs)$_{t,t+4}$	815610	0.138	0.046	-0.027	0.036	0.105
NIM$_{t+4}$	1187417	0.002	0.01	0.009	0.01	0.011
ROE$_{t+4}$	1241676	0.038	0.023	0.016	0.027	0.039
ROA$_{t+4}$	1241688	0.003	0.002	0.002	0.003	0.004
Bank eases lending standards$_{t,t+4}$	5977	0.287	-0.069	-0.182	0	0.044
RHS variables (over loan growth (excl. CLs) regression sample)						
Term premium$_t$	1676286	0.008	0.012	0.007	0.013	0.017
Δ short rate$_{t-4,t}$	1676286	0.019	-0.001	-0.012	0	0.011
Expectations$_t$	1676286	0.012	-0.001	-0.006	0	0.008
E_t^{SPF} Δ Real GDP$_{t,t+4}$	1676286	0.011	0.028	0.023	0.028	0.033
Δ Real GDP$_{t-4,t}$	1676286	0.022	0.028	0.016	0.031	0.042
E_t^{SPF} Δ GDP deflator inflation$_{t,t+4}$	1676286	0.02	0.04	0.022	0.036	0.055
Δ GDP deflator inflation$_{t-4,t}$	1676286	0.025	0.039	0.02	0.03	0.058
Excess bond premium$_t$	1676286	0.473	0.079	-0.224	-0.013	0.259
Instrument variable (over loan growth (excl. CLs) regression sample)						
For. Off. Treasury holdings-to-GDP$_t$	1676286	0.058	0.054	0.02	0.03	0.053
Table 5						
Δ fixed-rate share $_{t,t+4}$						
All loans and securities	547308	0.062	0.003	-0.024	0.002	0.03
Loans	543181	0.068	0.005	-0.025	0.004	0.034
Securities	535241	0.094	0	-0.02	0	0.022
Residential	539136	0.073	0.002	-0.02	0.001	0.024
Non-residential	547065	0.071	0.003	-0.029	0.002	0.035
Δ 30-year FRM/5-year ARM spread $_{t,t+4}$	9572	0.679	-0.011	-0.379	-0.062	0.333
Table 6						
Δ balance sheet growth rates $_{t,t+4}$						
Assets	1684631	0.105	0.032	-0.025	0.021	0.073
Securities	646614	0.298	0.004	-0.133	-0.012	0.125
Liabilities	1133855	0.12	0.035	-0.028	0.02	0.076
Deposits	1679507	0.114	0.032	-0.03	0.019	0.075
Non-deposit liabilities	1131754	0.69	0.038	-0.24	-0.006	0.27
Book equity	1131883	0.132	0.031	-0.013	0.033	0.078
Table 7						
Log assets$_t$	146660	1.159	6.362	5.573	6.26	7.027
Capital-to-asset$_t$	146660	.037	0.106	.084	.098	.119
Securities-to-asset$_t$	146660	.151	0.245	.131	.227	.339
CAMELS Mgmt Score$_t$	146660	.9	1.890	1	2	2
RMI$_t$	11217	.288	0.563	.348	.511	.714

This table reports summary statistics for variables used in regressions reported in Tables 4 to 7.

Table A-2: Summary statistics for loan- and firm-level analyses

	No. Obs.	Std. Dev.	Mean	25th perct.	Median	75th perct.
Table 8						
Loan amount (log)	34491	1.989	15.591	14.509	15.761	16.973
Size (log-assets)	34491	1.279	6.050	4.791	5.877	7.276
Capital ratio	34491	0.015	0.115	0.105	0.113	0.124
Securities-to-assets	34491	0.046	0.176	0.159	0.182	0.205
Relationship length (log)	34491	1.483	1.440	0.000	1.386	2.708
RMI (2012)	34491	0.234	1.136	0.987	1.106	1.306
CAMELS Mgmt Score (2012)	21350	0.491	2.593	2.000	3.000	3.000
Table 9						
Investment rate	86251	0.352	0.223	0.000	0.051	0.282
Firm's bank RMI	18346	0.430	0.710	0.189	1.000	1.000
Firm size (log-assets)	130146	2.359	16.911	15.598	16.569	17.940
Firm leverage (debt/assets)	118134	0.298	0.346	0.103	0.298	0.517
Firm cash holdings (% assets)	130726	15.960	12.420	1.636	6.717	16.842
Firm tangible assets (% assets)	128065	18.465	90.695	91.847	99.706	100.000
Interest coverage ratio	121180	0.854	0.418	0.025	0.089	0.297
Firm sales growth	123345	45.558	15.825	-0.330	7.570	19.324
1: Public firm	149432	0.154	0.024	0.000	0.000	0.000

This table reports summary statistics for variables used in regressions reported in Tables 8 and 9. For Table 9 the summary statistics correspond to the 2013–2014 sample period.

Internet Appendix

IA.I Robustness to alternative term premium measures

Table IA-1: Effect of instrumental variable on term spreads and term premiums—with alternative ACM term premium measure

	(1)	(2)
Dependent varible	ACM 5-year term premium	
Foreign official Treasury holdings	-0.04***	-0.05***
at par value-to-GDP ratio	(0.01)	(0.01)
Short rate	0.12***	0.08***
	(0.02)	(0.02)
Observations	234	187
R-squared	0.60	0.82
Sample start	1961q3	1973q3
Sample end	2019q4	2019q4
Additional macro controls	N	Y

This table reports OLS estimates of contemporaneous regressions of the 5-year term premium (estimated by Adrian et al. (2013)) on the instrumental variable (Foreign official holdings of Treasury securities at par value, normalized by GDP), the short rate (3-month T-bill yield) and, in (2), additional macro controls including real GDP growth, GDP deflator inflation, 1-year ahead real GDP growth and GDP deflator inflation forecasts from SPF, and the excess bond premium. Robust and kernel-based autocorrelation-consistent standard errors in parentheses. *p<.1; **p<.05; ***p<.01

Table IA-2: Baseline regression—with alternative ACM term premium measure

	(1)	(2)	(3)	(4)	(5)
Dependent variables	Loan growth (excl. CLs)$_{t,t+4}$	Loan growth (incl. CLs)$_{t,t+4}$	NIM$_{t,t+4}$	ROE$_{t,t+4}$	ROA$_{t,t+4}$
Term premium$_t$	2.93***	2.23**	0.13***	1.11***	0.08***
	(1.07)	(1.05)	(0.03)	(0.22)	(0.02)
Expectations$_t$	0.74*	-0.40	-0.04***	-0.36**	-0.02*
	(0.43)	(0.47)	(0.01)	(0.15)	(0.01)
Δ Short rate$_{t-4,t}$	0.25	-0.06	0.02***	0.20***	0.02***
	(0.27)	(0.37)	(0.01)	(0.07)	(0.01)
Observations	1,640,917	749,809	1,101,663	1,154,524	1,154,538
R-squared	0.14	0.13	0.27	0.04	0.06
Sample start	1973q4	1991q1	1984q1	1983q1	1983q1
Sample end	2019q4	2019q4	2019q4	2019q4	2019q4
Bank controls	Y	Y	Y	Y	Y
Macro controls	Y	Y	Y	Y	Y
Bank×Seasonal FE	Y	Y	Y	Y	Y
First-stage F test	36.99	34.51	30.02	43.68	43.80

This table reports IV (second stage) estimates from a regression of bank loan growth (excluding and including credit lines) and profitability (NIM, ROE, ROA) on the term premium (from Adrian et al. (2013)) and expectations component of the term spread. All specifications include lagged dependent variables and the following controls, all lagged: short rate changes, real GDP growth, GDP deflator inflation, 1-year ahead real GDP growth and GDP deflator inflation forecasts, and excess bond premium. The specification in column 6 also controls for lagged loan demand (defined as a dummy variable taking value one if the bank reported an increase in loan demand). Bank controls include lagged size (log-assets), capital ratio, and securities-to-asset ratio. All specifications include interacted bank×seasonal fixed effects for quarters 1, 2, 3 and 4. The instrument is the foreign official holdings of Treasury securities at par value, normalized by GDP. Standard errors double-clustered by bank and quarter in parentheses. *p<.1; **p<.05; ***p<.01.