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

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Abstract

We provide evidence on the effect of the slope of the yield curve on economic activity through bank lending. Using detailed data on banks' lending activities coupled with term premium shocks identified using high-frequency event study or instrumental variables, we show that a steeper yield curve associated with higher term premiums (rather than higher expected short rates) boosts bank profits and the supply of bank loans. Intuitively, a higher term premium represents greater expected profits on maturity transformation, which is at the core of banks' business model, and therefore incentivizes bank lending. This effect is stronger for ex-ante more leveraged banks. 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; event study; instrumental variable.

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 foresaw 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. Another plausible explanation is that the slope contains information beyond investors' expectations about the future state of the economy. This alternative explanation opens up the possibility for the slope to affect future economic activity through different channels that have not yet been fully explored in the literature.[2]

In this paper, we argue that the slope of the yield curve affects banks' lending decisions through an *expected profitability channel*, which 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 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 implies higher expected profits to banks' lending activities funded by shorter-term borrowing and hence incentivizes them to hold more longer-term assets, including by making more loans. A higher supply of bank credit can be expected, in turn, to boost economic growth through the well-documented "credit channel" through which bank-dependent firms can invest and grow relatively more (Bernanke and Gertler, 1995).

We provide extensive empirical evidence consistent with the expected profitability channel, which we motivate with a banking model along the lines of Gertler and Kiyotaki (2015). We start by showing with aggregate time-series data that a higher term premium is associated with higher subsequent bank profits and loan growth after controlling for short rate changes and expected future economic growth. Motivated by this evidence, we study a dynamic portfolio model in

[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. (2013)) or median survey forecasts (Rudebusch and Williams (2009)), but do not elaborate on the casual implications of such information.

which banks are subject to financing 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, with banks subject to more stringent financing constraints choosing higher leverage (lower capital ratio), all else equal. A positive term premium shock, by increasing the expected return to maturity transformation and, hence, expected bank profitability, can be expected to relax the financing constraint and boost bank lending in the periods after the shock. Furthermore, given that banks' expected return on wealth (profits) is proportional to their leverage multiplied by the term premium, more leveraged banks have higher exposure to the term premium and show a stronger response to term premium fluctuations.

As we take the model's testable hypotheses to the data we face a critical identification challenge, namely that long-term yields are forward looking and contain information about the future economic outlook which may confound the effects of the term premium. In particular, a stronger economic outlook may induce both a steeper yield curve today and higher bank lending in the future, and may cause an omitted variable bias if the economic outlook is correlated with the term premium. To address this issue, we employ three empirical identification strategies. First, we exploit a measure of high-frequency term premium shocks computed from changes in the Kim and Wright (2005) term premium on FOMC event days. We employ this measure across most of our specifications at the bank and loan level. In addition, we control for expectations of future short rates, computed as the difference between the term spread and the term premium shocks (or alternatively survey-based growth forecasts) and for short-rate shocks based on high-frequency identification (Kuttner, 2001). We show our estimates using identified term premium shocks are similar to, but economically larger, than those based on simple levels of term premium estimates.

Second, we employ an instrumental variable strategy that isolates foreign demand-driven shocks to term premiums that are unlikely driven by stronger economic outlook. Our instrumental variable is the foreign official 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 foreign central banks' reserve management and FX intervention needs rather than the U.S. economic outlook or other factors driving the supply of U.S. government debt. We show this instrumental variable is a strong predictor of the term premium, after controlling for the short rate and other macro variables. Our results are invariant to excluding China's holdings of U.S. Treasuries from the instrumental variable and to controlling for survey-based growth forecasts and the excess bond premium, a measure of risk appetite (Gilchrist and Zakrajšek, 2012).

Third, we identify a period when the term premium increased sharply and unexpectedly, and examine differential lending responses to the rise in the term premium depending on banks' ex-ante leverage. In particular, we study the "taper tantrum" episode following the May 22, 2013 speech by Chair Ben Bernanke regarding the Federal Reserve's intention to start tapering asset purchases under its quantitative easing program at some future date. This speech was followed by a steep and persistent rise in the term premium. Even though market commentary generally did not attribute the announcement to an improving economic outlook, and, if anything, market participants saw the Fed's reaction function as less accommodative than expected, it is still possible that the decision to reduce the pace of asset purchases reflected expectations of a brighter outlook. Therefore, when we analyze the lending decisions of banks with different degrees of leverage, we control for banks' own forecasts of one-year ahead GDP growth both before and after the start of the taper tantrum.

The empirical analysis brings together two main data sources: (a) a long-run panel dataset on bank balance sheets and (b) a shorter-span bank-firm loan-level dataset matched with bank- and firm-level balance sheet information. First, we examine the effect of term premiums on bank loan growth and bank profitability (net interest margins and return on equity) using quarterly balance sheet data for individual banks from the U.S. Call Reports over 1994–2019. Second, we study banks' lending decisions in response to term premium shocks using a loan-level dataset from the Federal Reserve (FR) Y-14Q data collection effort. This dataset contains information about bank-firm loan-level exposures of large bank-holding companies subject to supervisory stress tests, which account for the majority of loan commitments in the U.S. banking sector. We use these data for two analyses: First, we use loans originated during a period of several quarters around the taper tantrum event to study the lending decisions of banks and the ex-post performance of their borrowers. Second, we zoom out from the taper tantrum episode and use the entire period between 2013Q1 and 2019Q4 to study the effect of term premium shocks on bank lending and profitability and to establish more general patterns.

The granularity of our data also allows us to mitigate the potential concern that an increase in bank lending following a rise in the term premium reflects 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, in lending specifications that employ the Y-14Q loan-level data, we control for time-varying borrower-specific credit demand with interacted borrower$\times$quarter fixed effects, 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 start of the taper tantrum, varies across banks with different levels of exante leverage. Furthermore, we control for the standard determinants of bank lending, including for the intensity of the borrowing relationship to account for potential endogenous matching between banks and firms (Schwert, 2018; Chodorow-Reich, 2014). We also include bank size, the share of core deposits in total liabilities, and the share of securities in total assets in levels and interacted with the term premium, as well as interactions of bank leverage with the short rate and growth expectations.[3]

Our findings can be summarized as follows. Consistent with the implications of model, we show that (i) banks have higher loan growth and higher profits, on average, following an increase in the term premium; and (ii) banks with higher leverage (lower capital ratios) increase lending relatively more following an increase in the term premium.[4] Focusing on the taper tantrum episode, we show the rise in the term premium is associated with a lending boost on the extensive and intensive margins: lower-capital banks are more likely to grant new loans, and for approved loans they increase loan volumes and reduce spreads more than other banks. These credit effects affect the real economy: In firm-level regressions, we show that nonfinancial firms borrowing from ex-ante more leveraged banks have higher investment rates subsequently. We also show that the credit supply effects around the taper tantrum period generalize to the longer time period spanning 2013Q1–2019Q4. Additionally, we document that more leveraged banks respond to a positive term premium shock by increasing the maturity of their lending portfolios (in loan-level data) and by increasing their maturity gap (in bank-level data).

Our estimates of the level and heterogeneous effects of the term premium on banks' lending decisions and firms' investment rates are both statistically significant and economically meaningful. Focusing on instrumental variable estimates, a one standard deviation increase in the term premium, representing 50 basis points (bps), is associated with bank loan growth, net interest margins (NIMs), and return on equity (ROE) that are higher by 1.1 percentage points (ppts), 4 bps, and 32 bps, respectively; these effects are sizable when compared with the average loan growth, NIMs and ROE of 3.8%, 1.0%, and 2.3% over the sample period. Furthermore, in the four quarters

[3] The interactions between securities holdings and components of the yield curve slope are meant to capture potential valuation effects from changes in long-term interest rates as in Chakraborty et al. (2020) and Rodnyansky and Darmouni (2017). Such valuation changes, if anything, would work against us finding positive lending effects from a rise in the term premium, as a steepening of the yield curve would reduce the value of securities held by banks and hence their net worth. Controlling for the share of securities in banks' assets is also intended to capture potential "portfolio rabalancing" actions associated with a lowering of term premiums after quantitative easing, see, e.g., Bottero et al. (2022).

[4] Our main analysis uses the term premium series from the Kim and Wright (2005) term structure model but are invariant to term premium estimates from alternative models such as Kim and Priebsch (2020) and Adrian et al. (2013).

after the start of the taper tantrum, a bank with higher leverage (with capital ratio at the 25th percentile of the distribution) originated loans that were larger by 11% and less expensive by 7 bps compared to a bank with lower leverage (with capital ratio at the 25th percentile). Over the two years following the taper tantrum, a firm borrowing from more leveraged banks (with average exposure to its banks' capital at the 25th percentile) had an investment rate higher by close to 2 ppts than a firm borrowing from less leveraged banks (with exposure to the 75th percentile).

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., 2013). Our contribution is to emphasize the role of financial intermediaries and to document one specific channel through which a higher term premium may boost the economy—an expected profits channel that incentivizes banks to engage in more maturity transformation and increase loan supply. Adrian et al. (2019) explore a similar channel through which monetary policy tightening at the short end flattens the yield curve and reduces credit supply by compressing net interest margins. Our paper differs in two major ways. First, we focus on the role of the term premium as the component of the term spread that generates the expected profits channel. Second, we bring together granular data and several identification strategies to mitigate endogeneity problems associated with the forward-looking nature of long-term yields and to isolate a causal mechanism for the forecasting power of the term spread.

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., 2021; Gomez et al., 2021). Most studies in this literature focus on the level of the short rate. Alessandri and Nelson (2015) and Paul (2023) examine the link between the slope of the yield curve and bank profits, but do not assess the effects on bank lending and the real economy. 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. We complement these papers by exploring how changes in the slope of the yield curve affect not only bank profitability but also the supply of bank credit and the investment decisions of bank-dependent firms. Our work further emphasizes the importance of decomposing yields into expectations and term premium components for understanding the channels through which financial intermediaries react to changes in long term rates.

Our findings suggest that banks 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 premiums and long-term yields (Krishnamurthy and Vissing-Jorgensen, 2011). In turn, lower term premiums 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) called *stealth recapitalization* and was documented, among others, by Chakraborty et al. (2020), Acharya et al. (2019) and Rodnyansky and Darmouni (2017). 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 expected bank profitability 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, and in particular the term premium component, are related to future economic growth, bank profitability, and lending. In particular, we run the following predictive regressions:

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

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

where y_t^n denotes the n-quarter yields, $y_t^{20,eh} \triangleq E_t \sum_{i=0}^{19} y_{t+i}^1$ 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 the no-arbitrage term structure model in Kim and Wright (2005) and is our baseline term premium series in the paper. To control for current and expected future macro conditions, we include in $\mathbf{X}_t$ the median forecasts of one-year ahead real GDP growth from the Survey of Professional Forecasters (SPF) and the excess bond premium

(Gilchrist and Zakrajšek, 2012). The dependent variables $Z_{t,t+4}$ are the four-quarter ahead real GDP growth and real bank loan growth, and two measures of bank profitability (NIMs and ROE).

Table 2 presents the regression estimates, based on Ordinary Least Squares (OLS), and offers two takeaways. First, the term spread consistently predicts higher future GDP growth, bank loan growth, and bank profitability, after controlling for short rate changes and concurrent macroeconomic factors. Second, across specifications, the term premium component of the term spread is statistically significant (at conventional levels) in predicting these outcome variables. These results suggest a possible channel through which term spreads predict future growth that goes beyond mere expectations about the future state of the economy. We hypothesize this is an expected bank profitability 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 section, we present a portfolio model for banks to develop the intuition for this channel and describe the identification strategies to empirically document the channel.

3 Model

3.1 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 maximizes the value of the bank, subject to financing constraints.

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

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

with

$$\begin{aligned} \mathrm{d}r_t &= \lambda_r \left(\bar{r} - r_t\right) \mathrm{d}t + \sigma_r \sqrt{r_t} \mathrm{d}W_{r,t}, \\ \mathrm{d}\kappa_t &= \lambda_\kappa \left(\bar{\kappa} - \kappa_t\right) \mathrm{d}t + \sigma_\kappa \mathrm{d}W_{\kappa,t}, \end{aligned}$$

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, with an instantaneous correlation of $\varphi_{r\kappa}$.[5]

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, corresponding to a duration of $1/\tau$. Additionally, we assume loans cannot be defaulted on.[6] We denote the loan price by $P_t^{(\tau)}$, which is given by the discounted present value of its dividends:

$$P_t^{(\tau)} = E_t \int_t^{\infty} \frac{m_s}{m_t} \tau e^{-\tau(s-t)} \mathrm{d}s. \tag{4}$$

and is a function of the state variables, r and κ. Using Feymann-Kac we solve the conditional expectation as a partial differential equation:

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

where the term premium is given by

$$-cov_t\left(\frac{\mathrm{d}m}{m}\frac{\mathrm{d}P^{(\tau)}}{P^{(\tau)}}\right) = \left(\kappa_t\frac{P_r^{(\tau)}}{P^{(\tau)}}\sigma_r\sqrt{r} + g\frac{P_\kappa^{(\tau)}}{P^{(\tau)}}\sigma_\kappa + \left(\frac{P_r^{(\tau)}}{P^{(\tau)}}\sigma_r\sqrt{r}g + \frac{P_\kappa^{(\tau)}}{P^{(\tau)}}\sigma_\kappa\kappa_t\right)\varphi_{r\kappa}\right)\mathrm{d}t. \tag{5}$$

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

$$n_t + \widetilde{b}_t = x_t^{(\tau)} P_t^{(\tau)} + b_t, \tag{6}$$

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 funds rate. That is, the fed

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

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

funds account follows

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

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 federal funds rate (Drechsler et al., 2017, 2021).[7] The evolution of bank's wealth is then given by

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

where c is a parameter that captures the cost, as a share of wealth, of running the deposit franchise.

Banks' optimization problem. We follow the basic banking structure proposed in Gertler and Kiyotaki (2015) (henceforth GK15). Banks pay dividends exogenously with a Poisson probability λ. As argued in GK15, the purpose of this simple dividend policy is to avoid banks growing out of their incentive constraint. We assume a new group of bankers use the net worth as initial capital to restart operations.[8] The bank's problem is to maximize the expected discounted value of the dividends using 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

$$\mathrm{d}n_t = \left(r_t n_t - \left(\phi\left(r_t\right) - r_t\right)\widetilde{b}_t - c n_t\right)\mathrm{d}t + P_t^{(\tau)} x_t^{(\tau)} \left(\frac{\mathrm{d}P_t^{(\tau)}}{P_t^{(\tau)}} - r_t \mathrm{d}t\right), \quad (7)$$

$$V_t \geq \rho P_t^{(\tau)} x_t^{(\tau)}, \quad (8)$$

$$\widetilde{b}_t \leq \delta n_t. \quad (9)$$

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

[8] In general equilibrium models, banks pay an aggregate dividend and receive a different amount of resources as startup capital in other to obtain an invariant distribution of wealth in the economy. In our partial equilibrium setup, however, the wealth distribution is not determined and hence we assume that all dividend payments are used as startup capital, without loss of generality.

Constraint (8), 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, $P_t^{(\tau)} x_t^{(\tau)}$. 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 constraint on deposits, denoted by (9).

Recursive formulation. We write the problem recursively

$$0 = \max_{\left\{x_t^{(\tau)}, \widetilde{b}_t\right\}} m_t \lambda e^{-\lambda t} n_t \mathrm{d}t + E_t \left[\mathrm{d}\left(m_t e^{-\lambda t} V_t \right) \right], \tag{10}$$

subject to (7), (8), and (9). Because the objective function and the constraints are linear in net worth, the solution takes the form of $V_t = \psi_t n_t$. 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 $\psi_t(\kappa_t, r_t)$:

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

subject to (7), (8), and (9).

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 as long as the risky asset yields a positive excess return in 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 empirical part of the paper. More precisely, we set the parameters $\{\bar{r}, \bar{\kappa}, \sigma_r, \sigma_\kappa, \lambda_r, \lambda_\kappa\}$ to match the mean, the standard deviation, and persistence of the time series of the short-term interest rate and term premium as 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. (2021), who show that an increase in the short rate by 100 bps translates into an increase in the average deposit rate by 35 bps. Finally, we set δ to 2.85, which is the average short-term deposits-to-total equity capital ratio in the Y9-C database.

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 displays 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 (5). 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 the short rate because r_t becomes more volatile as the level of rate increases, thus increasing the quantity of interest-rate risk.[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 that a higher ψ corresponds to states in which the term premium is higher and the marked-to-market value of loan prices are lower.

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

$$\mu_{n,t} \equiv E\left[\frac{\mathrm{d}n_t}{n_t}\right]/\mathrm{d}t = r_t\left[1 + (1-\phi)\,\delta\right] - c + \alpha_t TP_t\left(\kappa_t, r_t\right), \tag{11}$$

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

[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 that we assume for the short-term interest rate.

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 the term premium. This is because α is pinned down by the incentive constraint, and therefore is proportional to ψ, which is increasing in term premiums as discussed earlier. 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]

$$\frac{\mathrm{d}L_t}{L_t} = \frac{\mathrm{d}\psi_t}{\psi_t} + \frac{\mathrm{d}n_t}{n_t} + \frac{\mathrm{d}\psi_t}{\psi_t} \frac{\mathrm{d}n_t}{n_t}. \tag{12}$$

The drift of (12) represents the expected loan growth,

$$\mu_{L,t} \equiv E_t \left[\frac{\mathrm{d}\psi_t}{\psi_t} \right] + E_t \left[\frac{\mathrm{d}n_t}{n_t} \right] + E_t \left[\frac{\mathrm{d}\psi_t}{\psi_t} \frac{\mathrm{d}n_t}{n_t} \right], \tag{13}$$

and is shown in the lower-left panel of Figure (1). The second term on the right hand side of equation (13) is the expected return on wealth and, as discussed above, is increasing in term premium. However, the first term, the expected change of Tobin's Q, $E_t \left[\frac{\mathrm{d}\psi_t}{\psi_t} \right]$, 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 when term premium increases. In our calibration, the effect from an increase in expected return on wealth more than offsets that from an expected decrease in ψ. Thus, the expected loan growth rises with term premium.[11] Intuitively, this means that even though a higher term premium reduces loan prices and causes banks to become relatively more constrained (i.e., banks' marginal valuation of a unit of wealth, ψ, increases), both of which would dampen lending growth, a higher expected future excess return on loans would dominate and incentivize banks to increase their lending in the near future.

On impact, though, a negative shock to κ_t (i.e., an increase in the term premium) causes a slight decrease in the amount of loans. This is because the diffusion component associated to κ_t shocks,

[10] We study loan growth because the level of loans is non-stationary.

[11] The third term of equation (13), $E_t \left[\frac{\mathrm{d}\psi_t}{\psi_t} \frac{\mathrm{d}n_t}{n_t} \right]$, is relatively small and does not materially affect the results.

$\sigma_{L\kappa,t}$, displayed in the lower-middle panel, is slightly positive. The diffusion $\sigma_{L\kappa,t}$ is given by

$$\sigma_{L\kappa,t} = \left(\frac{\psi_\kappa}{\psi} + \alpha_t \frac{P_\kappa^{(\tau)}}{P^{(\tau)}} \right) \sigma_\kappa. \tag{14}$$

In expression (14), the derivative ψ_κ is negative (i.e., higher κ_t means a lower term premium and,hence, a lower ψ) while the derivative P_κ is positive (i.e., higher κ, lower term premium, and, hence, higher loan prices). In the baseline calibration, the marked-to-market losses in loans due to an increase in κ_t, that is $P_\kappa > 0$, dominates and $\sigma_{L\kappa,t}$ is positive.

Numerical results: Impulse responses. Figure 2 shows the model's impulse-responses functions to a negative shock to κ that causes an approximately 100 basis points increase in the term premium. We study the responses of the model in the baseline calibration (shown in blue) as well as for different values of ρ—the parameter capturing the strength of the incentive constraint (8)—with the objective of studying the model's predictions for banks with different characteristics. In particular, banks with a lower ρ translates into a higher level of leverage. Intuitively, banks that have a lower ρ have to commit a smaller fraction of assets to show depositors that they will not run away with depositors' money, hence those banks can take higher leverage on average. [12]

As elaborated in the discussions above about the policy functions, an increase in the term premium increases banks' return on wealth (middle-right panel) and, as a consequence, increases loan growth (middle-center panel). On impact, though, loan growth and returns on wealth are slightly negative because of the marked-to-market losses in the loans' portfolio as loan prices decline when the shock hit. However, because expected return on wealth increases through higher leverage, α (upper-right panel), coupled with higher term premium, loan growth increases in the near horizon after the term premium shock. Tobin's Q, ψ (middle-left panel), also increases following the term premium shock, which means banks value an extra unit of wealth relatively more as the expected return on maturity transformation increases.

Importantly, as shown by the red-dotted lines, the model predicts that banks with a lower ρ (i.e., banks that have higher leverage, are less well capitalized, and thus value a marginal unit of wealth more) display a relatively stronger reaction to term premium shocks than in the baseline calibration.

[12] Figure B-1 in the appendix shows how leverage and Tobin's Q change for different ρ. Intuitively, in the context of the moral hazard problem presented in GK15, banks with a higher ρ can obtain a relatively larger benefit of diverting assets from the bank. As a result, the cost (per unit of wealth) of diverting, ψ, increases when ρ is higher because the incentive constraint is always binding. Also, as banks with higher a ρ must fund their asset holdings with a relatively larger fraction of their own equity, those banks display a lower leverage.

The main force driving this result is that low-ρ banks display higher leverage in equilibrium and, therefore, the increase in term premium has a stronger effect over their return on wealth, as shown in (11). The stronger increase in the return on wealth translates into stronger lending growth, as shown in (13).

The model delivers the following testable implications:

Testable implication 1 *Banks respond to higher expected excess returns on maturity transformation by increasing loan supply.*

Testable implication 2 *More leveraged banks increase loan supply relatively more because they experience a stronger increase in expected profitability following a rise in expected excess returns on maturity transformation than other banks.*

4 Empirical Strategy

To test the main implications of the model, we need to isolate the effects of changes in term premiums on bank lending and profitability. Our analysis faces the econometric challenge that variables that are difficult to observe and measure, such as expectations about the economic outlook or uncertainty, might simultaneously affect term premiums and bank behaviors. Such variables could cause an a omitted variable bias and lead to spurious results. We take two concrete steps to mitigate this concern: First, we develop an instrumental variable (IV) approach that isolates variations in term premiums that are due to factors arguably unrelated to the outlook of the domestic economy. Second, we exploit plausibly exogenous variation in term premiums borrowing from the literature on high-frequency event study identification of monetary policy shocks. Next we describe the two approaches in detail.

4.1 Instrumental variable

To identify the effect of changes in term premiums on bank outcomes, we need an instrument that affects term premiums for reasons unrelated to the future economic outlook. The instrumental variable we focus on is the foreign official (i.e., central banks and foreign exchange reserve managers) holdings of Treasury securities, normalized by U.S. 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 and Rebucci (2022)). 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.[13] 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 "shocks" to the demand for U.S. Treasuries that would affect Treasury yields and term premiums.[14]

Figure 3 shows that our instrument is negatively correlated with the term premium over the sample period between 1994 and 2019. This negative correlation is especially notable during 2004–2006 when long-term rates hardly moved despite rising short rates, which former Federal Reserve Chairs Alan Greenspan famously called a conundrum (Greenspan, 2005) and Ben Bernanke attributed to the global savings glut (Bernanke, 2005). More formally, we show that the instrument is a strong predictor of term premiums in Table OA-1, where we regress 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 in columns 1–2 indicate that higher demand by foreign official investors for Treasury securities is associated with statistically significant lower term premiums, after controlling for current macro conditions. As seen in columns 3–6, the same pattern holds if we replace the Kim-Wright term premium (our baseline measure) with term premium series from alternative term structure models of Adrian et al. (2013) and Kim and Priebsch (2020), which we describe in more detail below.

4.2 Term premium shocks

A second method we use to isolate plausibly exogenous variations in term premiums is based on high-frequency interest rate changes around important monetary policy events. Changes over narrow windows around such events can be thought of as reflecting predominantly surprises associated

[13] 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).

[14] 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.

with the monetary policy announcements, rather than other macroeconomic news. The event study approach for the identification of monetary policy shocks was pioneered by Kuttner (2001) and has become the standard approach in empirical monetary policy studies.

We proceed in three steps. First, we calculate one-day changes in the 3-month Tbill yield and in the expectations and term premiums components (based on the Kim-Wright model) of the 3-month/5-year term spread on days when FOMC statements and minutes are released. Second, we follow Miranda-Agrippino and Ricco (2021) in regressing those event-day changes on past Greenbook/Tealbook forecasts and keeping the residuals as a measure of "true shocks" that are free from potential Fed information effect (that is, they do not reflect revisions in investor beliefs about the state of the economy, see, e.g., Romer and Romer (2000) and Nakamura and Steinsson (2018)). Finally, we convert the cleaned event-day shocks into quarterly series following the procedure in Gertler and Karadi (2015), by accumulating event-day changes over time and calculating the quarterly averages. This procedure gives more weight to events that occur early in the quarter and allows events that occur later in the quarter to affect the shocks series in the current and the following quarter. The quarterly term premium shocks thus calculated are shown in Figure 4, together with the Kim-Wright term premium estimates.

5 Data

U.S. Call Report data. For the bank-level analysis, we use quarterly balance sheet data from the U.S. Call Reports that reflect banks' domestic operations. The bank-level panel starts in 1994Q1 and ends in 2019Q4. The baseline sample includes about 11,500 commercial banks with headquarters in 409 MSAs, with the number of banks declining between the start and the end of the sample from about 8,700 banks to some 4,350 banks. Our main regression variables are total bank loan growth (including and excluding off-balance sheet credit lines) and bank profitability metrics (NIMs and ROE) as dependent variables and bank size, capital ratio, the share of core deposits in total liabilities, the share of securities in total assets, and the share of reserves in total assets as controls. In additional tests, we use a measure of the degree to which banks are engaged in maturity transformation, namely the maturity gap from English et al. (2018).

Y-14Q Loan-level data. 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. These banks have at least $50 billion in total assets during the period of analysis and together account for three-quarters of total U.S. C&I loans (Crosignani et al., 2023; Favara et al., 2021). The data represent individual C&I loan exposures (of at least $1 million) between each reporting bank and individual borrowers. We limit the sample to loans to nonfinancial U.S.-domiciled firms and to 15 reporting banks for which we also have information on GDP growth forecasts from the Blue Chip Economic and Financial Indicators, a crucial control variable. Caglio et al. (2021) combine the Y-14Q data with the U.S. Flow of Funds and show that the Y-14Q borrowers make up 60% of nonfinancial business debt liabilities. For each BHC's main commercial bank we have balance sheet data from the Call Report.

The Y-14Q data contain detailed information about each loan contract, including the amount (in US$), loan type (credit lines, term loans), interest rate, and maturity. A unique feature of the data is that it includes borrower-level industry, location, and financial information as reported by the lenders (mostly on a yearly basis). For each firm we observe balance sheet variables such as total assets, fixed assets, debt, cash holdings, tangibility, interest coverage ratios, sales growth, and select income statement items such as capital expenditure. Our extensive margin regression sample for the period 2013Q1–2019Q4 contains loans extended to more than 25,000 nonfinancial firms. We use the Y-14Q data in two ways: First, in the loan-level dataset we examine banks' lending decisions in response to changes in the term premium. Second, we extract the firm-level balance sheet information and set it up as a firm-year panel to examine the effects of changes in the term premium on firms' investment decisions.[15]

Macroeconomic data. We use a collection of macroeconomic variables in both time-series and bank-level regressions. For the term spread, we use the Fama 3-month yield and Fama-Bliss 5-year zero coupon Treasury yields from Center for Research in Security Prices (CRSP). Term premium estimates are downloaded from the website of the Federal Reserve Board for Kim and Wright (2005), from the website of the FRB New York for Adrian et al. (2013), and were provided by the authors for Kim and Priebsch (2020). Real GDP growth and GDP deflator inflation come from the Federal Reserve Economic Data (FRED) at the FRB St. Louis. The excess bond premium (Gilchrist and Zakrajšek, 2012) is sourced from the Federal Reserve Board (see website). We obtain the one-year ahead real GDP forecast and GDP deflator inflation from the SPF at the FRB Philadelphia (see website). We download total foreign official holdings, as well as Chinese holdings, of Treasury coupon securities constructed by Bertaut and Judson (2022) using data from

[15] Reporting forms and data dictionaries are available on the Federal Reserve website.

the Treasury International Capital (TIC) reporting system (see website).[16] We do not have data on Chinese *official* holdings. However, as noted in Department of the Treasury, Federal Reserve Bank of New York, and Board of Governors of the Federal Reserve System (2023), emerging country holdings are heavily concentrated in the official sector.

Summary statistics. Appendix Table C-1 reports summary statistics for data used in bank-, loan- and firm-level analyses. In the bank-level panel, average loan growth during 1994Q1-2019Q4 is 3.8%, average NIMs are 1% and average ROE is 2.3%. In the time series, the Kim-Wright term premium series has an average value of 0.3% and a standard deviation of 0.44% (in the bank-level regression sample, these values are 0.1% and 0.5%, respectively). The Kim-Wright term premium shock series is centered on zero and has a standard deviation of 0.005%. For calculations of economic magnitudes, we use changes in one standard deviation of the term premium series and shock representing 50 bps and 5 bps, respectively.

6 Results

6.1 Bank-level analysis over 1994–2019

The goal is to test the model's implications relating bank lending outcomes to changes in the term premium. For testable implication 1, we use the following specification estimated in bank-quarter panel data:

$$Loan\ growth^i_{t,t+4} = \alpha_i + \beta_1\,\Delta y^1_t + \beta_2\left(y^{20,eh}_t - y^1_t\right) + \beta_3\,y^{20,tp}_t + \tau\mathbf{X}_t + \gamma\mathbf{Z}_{it} + \varepsilon^i_{t,t+4} \quad (15)$$

where the dependent variable $Loan\ growth^i_{t,t+4}$ is the four-quarter ahead loan growth at bank i (excluding and including off-balance sheet credit lines). For the term premium, we employ three estimation strategies: OLS with the Kim-Wright term premium estimates, the IV strategy outlined in Section 4.1, and OLS with the Kim-Wright term premium shocks described in Section 4.2. The vector of macro controls $\mathbf{X}_t$ 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. We include bank fixed effects (α_i) and bank MSA fixed effects (where the MSA refers to the bank's headquarters location) to control for unobserved local shocks to all banks. Furthermore, we include a vector of standard bank-level determinants of lending $\mathbf{Z}_{it}$ comprising

[16] Also see Bertaut and Judson (2014) and Bertaut and Tryon (2007).

bank size (log share of the bank's assets in total banking sector assets), capital ratio (ratio of equity to total assets), core deposits as a share of total liabilities, and securities-to-asset ratio.[17] 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 and lending capacity. Testable implication 1 indicates that the coefficient of interest β_3 should be positive.

Bank lending. In Table 3 we report our main results based on the longest time periods afforded by the data availability. Across specifications, the estimation results indicate that a higher term premium is positively associated with subsequent loan growth. OLS estimates for the simple term premium series are reported for reference in columns 1 and 3 and have positive signs. Focusing on well identified effects, the IV estimates in columns 2 and 5 suggest that a rise in the term premium induced by lower foreign official demand for Treasury securities is followed by significantly higher loan growth over the following four quarters. Furthermore, the first-stage F-test for instrument relevance is above 100, suggesting a strong instrument (Lee et al., 2022). The OLS estimates in columns 3 and 6 similarly suggest that a positive term premium shock is associated with higher loan growth, consistent with model prediction 1.

Across specifications, the coefficient estimates are statistically significant at conventional levels and deliver similar economic magnitudes. The estimates in columns 2 and 3 indicate that a one standard deviation increase in the term premium (of 50 and 5 bps, respectively) is associated with an increase in loan growth by 1.1–1.2 ppts, which is an economically sizable effect given that average loan growth over the sample period is 3.8% and its standard deviation is 1.5%. By contrast, the expectations component is less important in predicting bank loan growth, but indicates that expectations of higher short rates are generally associated with lower bank lending. The fact that the term premium and expectations components of the term spread have opposite effects on bank loan growth highlights the importance of this decomposition for understanding the channels through which banks react to changes in long term rates.

Role of bank leverage. We now examine the model prediction 2 that the response of bank lending to a term premium shock is more pronounced for more leveraged banks, as they value an extra unit of wealth and thus react to an increase in expected returns from maturity transformation

[17] In the baseline analysis the capital ratio is given by the share of equity of total assets but the results are invariant to using the regulatory Tier 1 ratio (Tier 1 capital divided by risk-weighted assets).

relatively more. We measure bank leverage with the share of equity capital in total assets and estimate the baseline specifications with an interaction of the term premium with the capital ratio. Given that we focus on estimating differential effects in bank responses to fluctuations in the term premium, we are able to include quarterly fixed effects and hence absorb the level effects of macro shocks on bank behaviors (including that of the term premium itself). In addition, to make sure that the interaction term of the capital ratio with the term premium is not confounded by other bank-specific or macroeconomic factors, we saturate the specification with interaction terms between all bank characteristics and the term premium, expectations, and short-rate changes.

The estimates are reported in Table 4 and consistently show that an increase in identified term premium (either induced by higher foreign official demand for Treasuries or high-frequency event study-based monetary policy shocks) is associated with greater loan growth at banks with lower capital. All estimates on the interaction of the capital ratio and the term premium are statistically significant. In terms of economic magnitude, estimates in columns 2 and 3 indicate that a bank at the 25th percentile of the capital ratio distribution (8%) exhibits loan growth higher by 0.9–1.3 ppts (IV) or 0.6–0.8 ppts higher (term premium shock) than a bank at the 75th percentile of the capital distribution (12%), implying a differential effect of 0.3–0.4 ppts depending on the estimate. (Once again, this economic effect is sizable given that the average and standard deviation of loan growth over the sample period are 3.8% and 1.5%.)

Robustness. We subject the baseline results to three robustness tests. First, we examine the stability of coefficients to a longer time period and to slight changes in the set of bank controls. Specifically, we replace the share of core deposits with that of total deposits in liabilities and we remove the share of securities as a control variable (these changes are demanded by the lengthening of the sample period). The results are shown in Table OA-2 and reveal that the level effects of the term premium on bank loan growth (with or without off balance sheet credit lines) are robust to these changes, and that the first stage F-statistics in IV estimations remain above 100.

In a second test, we focus on the instrumental variable and remove China's holdings of U.S. Treasuries from the construction of the total foreign official holdings of U.S. Treasuries. This change is motivated by the potential concern that Chinese official demand for Treasuries may be correlated with the U.S. economic outlook given the strong economic linkages between the two economies. In Table OA-3 we report the results and notice that the new definition of the IV leaves our conclusions unchanged: across specifications, a higher term premium due to lower demand from foreign official investors for Treasury securities (excluding China) significantly boosts growth in banks' total loan books.[18]

Third, we verify that the main results are not driven by the choice of term structure model. The motivation for this exercise is that term premium estimates are subject to some degree of uncertainty regarding the underlying econometric model and its parameters. We focus on two alternative term premium estimates from Adrian et al. (2013) (ACM) and Kim and Priebsch (2020), respectively. The ACM differs from the Kim-Wright model in that it does not incorporate survey measures of short rate expectations in the data set used to estimate the model (for a comparison of the two models, see Li et al. (2017)). The Kim-Priebsch model has the advantage of formally taking into account the "effective lower bound" period from 2008 to 2015 which overlaps with our sample period. We repeat the analysis using these alternative term premium series and find, first, that our instrumental variable, foreign official Treasury security holdings, has strong explanatory power for the alternative term premium estimates above and beyond the short rate and other macroeconomic factors (Table OA-1, columns 3-6). Second, the estimates for our baseline specifications, as shown in Table OA-4, reveal our conclusions are robust to using the ACM and Kim-Priebsch term premium estimates.

6.2 Loan-level analysis around the Taper Tantrum

In this section, we test the model's prediction 2 regarding heterogeneous responses of bank lending to term premiums depending on ex-ante bank leverage using granular data on bank-firm lending relationships from the Y-14Q dataset. A key advantage of the loan-level data is that it allows us to examine bank lending decisions following a change in the term premium while holding borrower-level loan demand constant each quarter. From the Y-14Q data we extract information on outstanding loans and on new loan originations to nonfinancial domestic firms in a symmetric window of up to five quarters around 2013Q2, when the taper tantrum started.

For identification, we exploit the unexpected nature of the "taper tantrum" that followed the May 22, 2013 remarks by Chair Ben Bernanke in the Q&A session after his semiannual congressional testimony, indicating that the Federal Reserve might "step down" the pace of its quantitative easing program "in the next few meetings."[19] Following the speech, Treasury bond yields and term premiums surged unexpectedly (Chari et al., 2021), as depicted in Figure 5, inducing a large monetary policy shock (Bernanke, 2015). We take advantage of this unique episode to

[18] Market commentaries suggested that China likely held a significant amount of U.S. Treasuries offshore in Belgium around 2013–2015. Our results are invariant to removing holdings by Belgium from the instrumental variable.

[19] Minutes of the FOMC's April 30-May 1 meeting were released later that day.

analyze bank lending behaviors following an unexpected and dramatic rise in the term premium. Identification of the term premium's effect on bank lending requires that the tapering announcement was not driven by expectations about the future state of the economy, in particular, by an improving economic outlook. To mitigate this possibility, we limit the sample to the banks that participate in the Blue Chip Survey and control for their quarterly one-year ahead GDP growth forecasts before and after the taper tantrum. It is also noteworthy that market commentators were skeptical about the economic outlook around that time and believed that, if anything, the Fed's reaction function was less accommodative than expected.[20]

We specify the following regression model in a difference-in-difference framework:

$$Loan\ outcome_{bj,t+k} = \beta_1 Capital\ ratio_{b,2012} \times Post_t + \gamma_1' \mathbf{X}_{bt} + \gamma_2' \mathbf{X}_{bt} \times Post_t + \\ + \gamma_3' \mathbf{Z}_{bj} + \delta_{jt} + \varepsilon_{bjt} \tag{16}$$

where $Loan\ outcome_{bj,t+k}$ refers to an indicator for newly originated loans in the stock of outstanding loans from bank b to firm j at $t+k$ during a period of $k = 3, 4, 5$ quarters before and after 2013Q2. We also consider lending outcomes for newly originated loans, where $Loan\ outcome_{bj,t+k}$ is the loan amount (log) or the loan spread. $Post_{t+k}$ is a dummy variable that takes value one starting in 2013Q3 for up to $k = 5$ quarters subsequently (and zero in a symmetric period before 2013Q2). We drop the loans reported in 2013Q2 to clearly separate the periods before and after the May 2013 event. As in the bank-level regressions, we control for standard determinants of bank lending (in vector $\mathbf{X}_{bt}$) such as bank size (log-assets), the share of core deposits in total liabilities, and securities-to-asset ratio, both in levels and in interactions with the $Post_t$ dummy. The capital ratio is measured at end-2012 so it is predetermined with respect to the rise in the term premium.

Critically, these specifications include the bank-level one-year ahead GDP growth forecasts from the Blue Chip surveys, in levels and interactions with $Post_t$. These forecasts account for the baseline level of banks' expectations of the economic outlook, an important driver of lending decisions, as well as any revision to those expectations following the tapering announcement. We add a pair-level variable representing the duration of the banking relationship as of end-2012 ($\mathbf{Z}_{bj}$) to capture the effect of relationship lending on loan outcomes and to mitigate potential concerns of assortative matching between bank and firms.[21] The specification also adds interacted borrower$\times$quarter fixed effects (δ_{jt}) to control for loan demand changes and other unobserved

[20] See Sinha and Smolyansky (2022) for a detailed discussion of market and policymakers' narratives around the taper tantrum.

[21] Ideally, we would prefer to include bank$\times$firm fixed effects but our sample periods of several quarters around the taper tantrum are too short to observe multiple new originations from a given bank to a given borrower.

factors 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. Model prediction 2 indicates that the coefficient of interest β_1 should be negative to reflect that more leveraged (lower capital) banks respond to an increase in the risk premium by increasing loan supply relatively more.

Bank lending. The regression estimates are reported in Table 5. Across dependent variables (panels A-C) and time periods between three and five quarters around 2013Q2 (columns 1-3), the estimated coefficients on $Capital\ ratio_b \times Post_t$ are statistically significant at conventional levels and indicate a robust relation between bank leverage and the supply of bank loans after the start of the taper tantrum. In panels A-B, the estimates suggest that, in the period after the May 2013 event, more leveraged banks have a higher likelihood of granting new loans and, conditional on approved loans, they grant larger loans than other banks. The results in panel C strengthen the interpretation of these estimates as supply-side effects as they show that more leveraged banks are equally more likely to reduce loan spreads on new loans than other banks.

The estimated relationship between bank leverage and loan supply during the $Post_t$ period is economically sizable. Comparing banks with capital ratios at the 25th and 75th percentiles of the distribution (10% vs. 14%), the estimates in column 2 of panels B-C corresponding to lending outcomes in a period of four quarters before and after 2013Q2 indicate that lower capital banks granted new loans that were larger by 11% and less expensive by 7 bps. Consistent with our bank-level evidence from Table 4, these findings support the model's implication 2 that term premiums have heterogeneous effects on bank lending depending on bank leverage.

Robustness. We check the robustness of our results in two ways: (a) a placebo test and (b) a specification that accounts for banks' large reserve accumulation before the the taper tantrum. First, we check the validity of the identifying assumption of "parallel trends" in lending by banks with different levels of leverage. For this purpose, we identify a period when the term premium was very stable and examine changes in banks' lending decisions before and after a cutoff point during this period. Given that the Y-14Q data start in 2012Q1, we settle on the period between 2012Q2 and 2013Q1 (see Figure OA-1). We run regressions in two sample periods: 2012Q4 vs 2013Q1 and 2012Q2-2013Q3 vs 2012Q4-2013Q1. The specifications are similar to those in Table 5 but the capital ratio is measured in 2012Q1 so it is predetermined relative to lending outcomes in the two placebo periods. The regression estimates are reported in Table OA-5 and show no evidence of pre-existing trends across specifications, as ex-ante bank leverage has statistically insignificant effect on the extensive and intensive margins of lending.

Second, we address the concern that our results may pick up lending effects of bank reserves (deposits at the Federal Reserve) accumulated during the Fed's quantitative easing programs before and during the taper tantrum. QE programs were implemented starting in November 2008, August 2010, and September 2012, and resulted in an unprecedented injection of reserves into the banking system. Omitting reserves from the specifications may induce a bias on the estimated coefficient on $Capital\ ratio_b \times Post_t$ whose sign depends on the true effect of reserves on lending and its correlation with bank leverage.[22] In Table OA-6 we estimate the main specifications in Table 5 where we add the share of reserves in total assets in level and interacted with $Post_t$. The results show that our main estimates are robust to the inclusion of this additional variable.

Real effects. Next, we examine if the relative lending boost at lower capital banks during the taper tantrum translates into better firm-level outcomes. The credit effects that we documented above would affect firm performance if bank-dependent firms found it costly to switch across lenders as some lenders contract loan supply relative to others. To examine the effects of the term premium on firm investment, we turn to the firm-year dataset extracted from the Y-14Q data. Specifically, we examine the investment rate of firms that were ex-ante differentially exposed to the taper tantrum through their lenders' leverage. We use the following specification that relates the investment rate after the start of the taper tantrum to the firms' ex-ante exposure to high-capital banks in a firm-year panel:

$$\begin{aligned} Investment\ Rate_{jt} = \beta_1 Post_t \times Exposure\ to\ Bank\ Capital_j + \\ + \gamma_1' \mathbf{Z}_{jt} + \gamma_2' \mathbf{Z}_{jt} \times Post_t + \delta_{\tilde{j}t} + \varepsilon_{jt} \end{aligned} \tag{17}$$

where the dependent variable is the investment rate, computed as the capital expenditure of firm j in year t divided by capital stock (fixed assets) at $t-1$ and $Post_t$ is a dummy variable taking value one in 2014 or 2014-2015 (and zero in 2013). The key variable "Exposure to bank capital$_j$" is the firms' exposure to the rise in term premiums after the start of the taper tantrum through their relationships with lenders differing in degree of leverage. This exposure is computed as the average capital ratio of a firm's lenders weighted by the share of borrowing from each of those lenders at end-2013. The vector of firm controls $\mathbf{Z}_{jt}$ includes firm size (log-assets), firm

[22] Reserves may influence bank lending through different channels, for instance, by affecting relative asset prices and inducing portfolio reallocations, through balance sheet costs, or by influencing aggregate demand. Empirically, Kandrac and Schlusche (2021) document a positive effect of bank-level reserve accumulation on lending and risk-taking, while Diamond et al. (2020) document a crowding-out effect.

leverage (total debt/assets), cash holdings (% assets), tangible assets (% assets), interest coverage ratio (EBITDA/interest expense), sales growth (a proxy for future growth opportunities and hence loan demand), and a dummy variable taking value one for listed firms. Firm controls enter the specifications in levels and interacted with $Post_t$. We include year, state, and industry fixed effects, or interacted state×industry×year fixed effects ($\delta_{\tilde{j}t}$) to control for time-varying geographic and sectoral shocks affecting firms in a given location and industry.

The coefficient of interest is β_1 which we expect to be negative, supporting the prediction that follows from model's implication 2, that firms borrowing from lower capital banks exhibit higher investment rates than other firms as the term premium rises and they receive more credit from those banks. The results, reported in Table 6, provide support for this prediction. The coefficient estimates on the interaction of $Post_t$ with "Firm exposure to bank capital" are negative and statistically significant across the time horizons examined, suggesting that firms borrowing from more leveraged banks before the taper tantrum had relatively higher investment rates in later years. These estimates are also economically significant. Looking at the coefficients in columns 2 and 4 and comparing a firm with more leveraged lenders (at the 25th percentile of the capital ratio distribution) with a firm with less leveraged lenders (at the 75th percentile of the distribution), the former firm had an investment ratio that was higher by between 1.7 and 2.1 ppts (relative to the mean investment rate of 24%) compared to the latter firm.

6.3 Loan-level analysis over 2013–2019

In the previous section we showed that the steep and sustained rise in the term premium after the start of the taper tantrum induces a boost in bank lending on the extensive and intensive margins. Next we investigate if the taper tantrum results generalize to the full time period over which we have loan-level data (2013Q1-2019Q4).[23] To this end, we specify the following lending regression in data on outstanding loans at the bank-firm loan-level:

$$\begin{aligned} Loan\ outcome_{bj,t+1} &= \beta_1 Capital\ ratio_{bt} \times Term\ premium\ shock_t + \\ &+ \gamma_1' \mathbf{X}_{bt} + \gamma_2' \mathbf{X}_{bt} \times Term\ premium\ shock_t + \gamma_3' \mathbf{Z}_{bjt} + \delta_{j\text{-}t} + \varepsilon_{bjt} \end{aligned} \quad (18)$$

[23] The first reporting quarter in the Y-14Q is 2012Q1. However, consistency of data submissions from reporting banks stabilizes within a few quarters, therefore we start the regression sample in 2013Q1. The results are fully robust to including data from 2012Q1–2012Q4 in the sample.

where $Loan\ outcome_{bj,t+1}$ refers to an indicator for newly originated loans from bank b to firm j in quarter $t+1$, the loan amount (log), and spread.[24] Similar to previous regressions, we control for the standard bank characteristics (size, core deposits, securities) and for bank-level GDP growth forecasts in level and interactions with the term premium shock, expectations, and the short rate ($\mathbf{X}_{bt}$). We also include a quarterly pair-level relationship duration variable ($\mathbf{Z}_{bjt}$) and interacted borrower×quarter fixed effects (δ_{jt}). The estimates are obtained using OLS with standard errors clustered at the bank-firm level. According to testable implication 2, the coefficient estimate on β_1 should be negative to reflect that more leveraged banks increase loan supply more than less leveraged banks following a rise in the risk premium.

Bank lending. The results are reported in Table 7. Across specifications, the estimated coefficient on $Capital\ ratio_b \times Term\ premium\ shock_t$ are statistically significant and indicate a positive link between bank leverage and the supply of bank loans during 2013Q1-2019Q4. The estimates suggest that, following a positive term premium shock, lower capital banks are more likely to grant new loans; in addition, they grant larger and cheaper loans than other banks. In terms of economic interpretation, the coefficient estimates in columns 1, 3, and 5 of Table 7 indicate that, if we compare the lending behavior of banks with capital ratios at the 25th and 75th percentiles of the distribution (11% vs. 14%) following a positive term premium shock of 5 bps (approximately 1.5x standard deviations during 2013–2019), then lower capital banks increase loan supply more than other banks in the following quarter—they are more likely to grant new loans by 4.1% (the share of new loans is 11%), to grant loans that are larger by 3% and loans that are less expensive by 2 bps. Overall, these results are consistent with our bank- and loan-level evidence and establish more general patterns in the microdata beyond the taper tantrum analysis.

Loan maturities. To strengthen our evidence that more leveraged banks increase exposure to maturity transformation in response to changes in the term premium more than other banks, we also examine several loan maturity outcomes. An increase in loan supply, as predicted by model implication 2, would suggest that banks take more maturity risk by lengthening loan maturities when the term premium rises. To test this idea, we aggregate the loan-level data to the bank-firm-quarter level and estimate the previous specification with the following outcome variables: the share of loans with maturity greater than 3 or 5 years and the average volume-weighted maturity of

[24] A key difference between this and the taper-tantrum specification is that banks' capital ratio here is lagged one quarter, while in the taper tantrum analysis it was fixed at end-2012 (before the event).

the bank's loan book. The results based on the full Y-14Q sample are reported in Table 8. Across specifications, the estimates are statistically significant and suggest that more leveraged banks are more likely to lend longer term than other banks following a positive term premium shock.[25]

7 Mechanism: Bank profitability

Our evidence so far shows that a steeper yield curve associated with a higher term premiums affects banks' lending decisions. The underlying mechanism is one of *expected bank profitability*: a higher term premium represents higher expected profits on maturity transformation. In response to an increase in the term premium, banks take more duration risk, in particular by lending more or by lending longer term. In this section we provide direct evidence for this mechanism. For this purpose, we return to the baseline model estimated in bank-level data (over 1994Q1-2019Q4) and estimate it with dependent variables representing two bank profitability metrics: NIMs and ROE (over a four-quarter horizon). For term premiums we use the Kim-Wright term premium series and the two identification strategies based on IV and term premium shocks described in Section 4.

The results are reported in Table 9 and reveal a positive and statistically significant relation between term premiums and future bank profitability that holds across estimation strategies. In terms of economic magnitudes, the estimates in columns 3-4 and 5-6 of Table 9 indicate that a one standard deviation increase in the term premium or term premium shock (representing 50 or 5 bps) is associated with an increase in bank NIMs and ROE by 1-4 bps and 6-32 bps over the following four quarters, respectively. These effects are economically sizable given that over the sample period the average NIMs and ROE were 1% and 2.3%. Furthermore, in Table 10 we replicate the bank profitability analysis in the context of the taper tantrum and find that banks with lower capital had higher profitability as the term premium sharply increased after the start of the taper tantrum, with estimated coefficients becoming statistically significant in the later quarters.

[25] The model predicts that banks with lower leverage would increase their leverage relative more after a positive term premium shock. This is shown in Figure 2, upper-right panel. Table OA-7 provides supporting evidence. We limit the sample to several quarters before/after the taper tantrum and relate the capital ratio to a bank's ex-ante level of capital (measured at end-2012 and interacted with the "Post" dummy taking value one after the start of the taper tantrum and zero before it). The level effect of initial capital ratio is not estimated due to the inclusion of bank fixed effects. Across specifications, the negative coefficient estimates on the difference-in-differences term suggest that banks with initial higher capital (lower leverage) are relatively more likely to increase their leverage after a rise in the term premium.

8 Conclusion

This paper documents an increase in bank lending and profitability following an unexpected rise in the term premium, especially for more leveraged banks. We call this mechanism the *expected bank profitability channel*. Our findings are consistent with predictions 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 premiums (rather than higher expected short rates), banks increase their exposure to maturity transformation and 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 interesting questions to future research.

References

Acharya, V. V., Eisert, T., Eufinger, C., and Hirsch, C. (2019). Whatever it takes: The real effects of unconventional monetary policy. *The Review of Financial Studies*, 32(9):3366–3411.

Adrian, T., Crump, R. K., and Moench, E. (2013). Pricing the term structure with linear regressions. *Journal of Financial Economics*, 110(1):110–138.

Adrian, T., Estrella, A., and Shin, H. S. (2019). Risk-taking channel of monetary policy. *Financial Management*, 48(3):725–738.

Ahmed, R. and Rebucci, A. (2022). Dollar Reserves and U.S. Yields: Identifying the Price Impact of Official Flows. NBER Working Paper No. 30476.

Alessandri, P. and Nelson, B. D. (2015). Simple banking: Profitability and the yield curve. *Journal of Money, Credit and Banking*, 47(1):143–175.

Ang, A., Piazzesi, M., and Wei, M. (2006). What does the yield curve tell us about GDP growth? *Journal of Econometrics*, 131(1-2):359–403.

Bansal, R. and Yaron, A. (2004). Risks for the long run: A potential resolution of asset pricing puzzles. *The Journal of Finance*, 59(4):1481–1509.

Begenau, J., Piazzesi, M., and Schneider, M. (2015). Banks' risk exposures. *NBER Working Paper No. 21334*.

Beltran, D. O., Kretchmer, M., Marquez, J., and Thomas, C. P. (2013). Foreign Holdings of U.S. Treasuries and U.S. Treasury Yields. *Journal of International Money and Finance*, 32(1):1120–1143.

Bernanke, B. (2005). The Global Saving Glut and the U.S. Current Account Deficit. *Sandridge Lecture, Virginia Association of Economics (Richmond, VA)*.

Bernanke, B. S. (2015). The courage to act: A memoir of a crisis and its aftermath.

Bernanke, B. S. and Gertler, M. (1995). Inside the black box: The credit channel of monetary policy transmission. *Journal of Economic Perspectives*, 9(4):27–48.

Bernanke, B. S., Reinhart, V. R., and Sack, B. P. (2004). Monetary policy alternatives at the zero bound: An empirical assessment. *Brookings Papers on Economic Activity*, 35(2):1–100.

Bertaut, C. and Judson, R. (2014). Estimating U.S. Cross-Border Securities Positions: New Data and New Methods. Federal Reserve Board International Finance Discussion Papers No. 2014-1113.

Bertaut, C. and Judson, R. (2022). Estimating U.S. Cross-Border Securities Flows: Ten Years of the TIC SLT. *FEDS Notes*.

Bertaut, C. C. and Tryon, R. W. (2007). Monthly estimates of u.s. cross-border securities positions. Federal Reserve Board International Finance Discussion Papers No. 2007-910.

Bottero, M., Minoiu, C., Peydró, J.-L., Polo, A., Presbitero, A. F., and Sette, E. (2022). Expansionary yet different: Credit supply and real effects of negative interest rate policy. *Journal of Financial Economics*, 146(2):754–778.

Brunnermeier, M. K. and Sannikov, Y. (2014). A macroeconomic model with a financial sector. *American Economic Review*, 104(2):379–421.

Caballero, R. J., Farhi, E., and Gourinchas, P.-O. (2008). An equilibrium model of "global imbalances" and low interest rates. *American Economic Review*, 98(1):358–93.

Caballero, R. J. and Krishnamurthy, A. (2009). Global imbalances and financial fragility. *American Economic Review*, 99(2):584–88.

Caglio, C. R., Darst, R. M., and Kalemli-Ozcan, S. (2021). Risk-taking and monetary policy transmission: Evidence from loans to SMEs and large firms. NBER Working Paper No. 28685.

Campbell, J. Y., Chan, Y. L., and Viceira, L. M. (2003). A multivariate model of strategic asset allocation. *Journal of Financial Economics*, 67(1):41–80.

Chakraborty, I., Goldstein, I., and MacKinlay, A. (2020). Monetary stimulus and bank lending. *Journal of Financial Economics*, 136(1):189–218.

Chari, A., Dilts Stedman, K., and Lundblad, C. (2021). Taper Tantrums: Quantitative easing, Its aftermath, and emerging market capital flows. *The Review of Financial Studies*, 34(3):1445–1508.

Chodorow-Reich, G. (2014). The employment effects of credit market disruptions: Firm-level evidence from the 2008–9 financial crisis. *The Quarterly Journal of Economics*, 129(1):1–59.

Cox, J. C., Ingersoll, J. E., and Ross, S. A. (1985). A theory of the term structure of interest rates. *Econometrica*, 53(2):385–407.

Crosignani, M., Macchiavelli, M., and Silva, A. F. (2023). Pirates without borders: The propagation of cyberattacks through firms' supply chains. *Journal of Financial Economics*, 147(2):432–448.

Department of the Treasury, Federal Reserve Bank of New York, and Board of Governors of the Federal Reserve System (2023). Foreign portfolio holdings of U.S. securities, as of June 30, 2022.

Di Tella, S. (2020). Risk premia and the real effects of money. *American Economic Review*, 110(7):1995–2040.

Diamond, W., Jiang, Z., and Ma, Y. (2020). The reserve supply channel of unconventional monetary policy. Jacobs Levy Equity Management Center for Quantitative Financial Research Paper.

Drechsler, I., Savov, A., and Schnabl, P. (2017). The deposits channel of monetary policy*. *The Quarterly Journal of Economics*, 132(4):1819–1876.

Drechsler, I., Savov, A., and Schnabl, P. (2021). Banking on deposits: Maturity transformation without interest rate risk. *The Journal of Finance*, 76(3):1091–1143.

Duffie, D. and Epstein, L. G. (1992a). Asset pricing with stochastic differential utility. *The Review of Financial Studies*, 5(3):411–436.

Duffie, D. and Epstein, L. G. (1992b). Stochastic differential utility. *Econometrica: Journal of the Econometric Society*, pages 353–394.

Duffie, D. and Lions, P.-L. (1992). PDE solutions of stochastic differential utility. *Journal of Mathematical Economics*, 21(6):577–606.

English, W. B., den Heuvel, S. J. V., and Zakrajšek, E. (2018). Interest rate risk and bank equity valuations. *Journal of Monetary Economics*, 98:80 – 97.

Estrella, A. and Hardouvelis, G. A. (1991). The term structure as a predictor of real economic activity. *Journal of Finance*, 46(2):555–576.

Favara, G., Ivanov, I., and Rezende, M. (2021). GSIB surcharges and bank lending: Evidence from U.S. corporate loan data. *Journal of Financial Economics*, 142(3):1426–1443.

Favero, C. A., Kaminska, I., and Söderström, U. (2005). The predictive power of the yield spread: Further evidence and a structural interpretation. Available at SSRN 743104.

Gertler, M. and Karadi, P. (2015). Monetary policy surprises, credit costs, and economic activity. *American Economic Journal: Macroeconomics*, 7(1):44–76.

Gertler, M. and Kiyotaki, N. (2015). Banking, liquidity, and bank runs in an infinite horizon economy. *American Economic Review*, 105(7):2011–43.

Gilchrist, S. and Zakrajšek, E. (2012). Credit spreads and business cycle fluctuations. *American Economic Review*, 102(4):1692–1720.

Gomez, M., Landier, A., Sraer, D., and Thesmar, D. (2021). Banks' exposure to interest rate risk and the transmission of monetary policy. *Journal of Monetary Economics*, 117:543–570.

Greenspan, A. (2005). Testimony of Alan Greenspan before the Senate Committee on Banking, Housing, and Urban Affairs on Monetary Presenting the Federal Reserve's Monetary Policy Report to Congress. Federal Reserve System: Board of Governors.

Haddad, V. and Sraer, D. (2020). The banking view of bond risk premia. *The Journal of Finance*, 75(5):2465–2502.

Hamilton, J. D. and Kim, D. H. (2002a). A re-examination of the predictability of economic activity using the yield spread. *Journal of Money, Credit and Banking*, 34(2):340–360.

Hamilton, J. D. and Kim, D. H. (2002b). A re-examination of the predictability of the yield spread for real economic activity. *Journal of Money, Credit, and Banking*, 34(2):340–360.

Harvey, C. R. (1988). The real term structure and consumption growth. *Journal of Financial Economics*, 22(2):305–333.

Harvey, C. R. (1989). Forecasts of economic growth from the bond and stock markets. *Financial Analysts Journal*, 45(5):38–45.

Harvey, C. R. (1993). The term structure forecasts economic growth. *Financial Analysts Journal*, 49(May/June):6–8.

Jardet, C., Monfort, A., and Pegoraro, F. (2013). No-arbitrage Near-Cointegrated VAR(p) term structure models, term premia and GDP growth. *Journal of Banking & Finance*, 37(2):389 – 402.

Jiménez, G., Mian, A., Peydró, J.-L., and Saurina, J. (2020). The real effects of the bank lending channel. *Journal of Monetary Economics*, 115:162–179.

Kaminska, I. and Zinna, G. (2020). Official demand for u.s. debt: Implications for u.s. real interest rates. *Journal of Money, Credit and Banking*, 52(2-3):323–364.

Kandrac, J. and Schlusche, B. (2021). Quantitative easing and bank risk-taking: Evidence from lending. *Journal of Money, Credit and Banking*, 53(4):635–676.

Khwaja, A. I. and Mian, A. (2008). Tracing the impact of bank liquidity shocks: Evidence from an emerging market. *American Economic Review*, 98(4):1413–1442.

Kim, D. H. and Priebsch, M. (2020). Are Shadow Rate Models of the Treasury Yield Curve Structurally Stable? *Journal of Financial and Quantitative Analysis (forthcoming)*.

Kim, D. H. and Wright, J. H. (2005). An arbitrage-free three-factor term structure model and the recent behavior of long-term yields and distant-horizon forward rates. Federal Reserve Board FEDS Working Paper 2005-33.

Krishnamurthy, A. and Vissing-Jorgensen, A. (2011). The effects of quantitative easing on interest rates: Channels and implications for policy. *Brookings Papers on Economic Activity (Fall 2011)*.

Krishnamurthy, A. and Vissing-Jorgensen, A. (2015). The impact of Treasury supply on financial sector lending and stability. *Journal of Financial Economics*, 118(3):571–600.

Kuttner, K. N. (2001). Monetary policy surprises and interest rates: Evidence from the fed funds futures market. *Journal of Monetary Economics*, 47(3):523–544.

Lee, D. S., McCrary, J., Moreira, M. J., and Porter, J. (2022). Valid t-ratio Inference for IV. *American Economic Review*, 112(10):3260–90.

Li, C., Meldrum, A., and Rodriguez, M. (2017). Robustness of long-maturity term premium estimates. *FEDS Note*.

Miranda-Agrippino, S. and Ricco, G. (2021). The transmission of monetary policy shock. *American Economics Journal: Macroeconomics*, 13(3):74–107.

Nakamura, E. and Steinsson, J. (2018). High-frequency identification of monetary non-neutrality: The information effect. *The Quarterly Journal of Economics*, 133(3):1283–1330.

Paul, P. (2023). Banks, maturity transformation, and monetary policy. *Journal of Finanial Intermediation*, 53:101011.

Rodnyansky, A. and Darmouni, O. M. (2017). The effects of quantitative easing on bank lending behavior. *The Review of Financial Studies*, 30(11):3858–3887.

Romer, C. D. and Romer, D. H. (2000). Federal reserve information and the behavior of interest rates. *American Economic Review*, 90(3):429–457.

Rudebusch, G. D., Sack, B. P., and Swanson, E. T. (2006). Macroeconomic implications of changes in the term premium. FRB of San Francisco Working Paper 2006-46.

Rudebusch, G. D. and Williams, J. C. (2009). Forecasting recessions: The puzzle of the enduring power of the yield curve. *Journal of Business and Economic Statistics*, 27(4):492–503.

Schwert, M. (2018). Bank capital and lending relationships. *The Journal of Finance*, 73(2):787–830.

Sinha, N. R. and Smolyansky, M. (2022). How sensitive is the economy to large interest rate increases? Evidence from the Taper Tantrum. FEDS Working Paper 2022–085.

Stock, J. H. and Watson, M. W. (1989). New indexes of coincident and leading indicators. In Blanchard, O. and Fischer, S., editors, *NBER Macroeconomics Annual 1989*. MIT Press, Cambridge, MA.

Tabova, A. M. and Warnock, F. E. (2021). Foreign Investors and U.S. Treasuries. NBER Working Paper No. 29313.

Warnock, F. E. and Warnock, V. C. (2009). International capital flows and U.S. interest rates. *Journal of International Money and Finance*, 28(6):903 – 919.

Wright, J. H. (2006). The yield curve and predicting recessions. FEDS Working Paper 2006–07.

Figures and Tables

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.

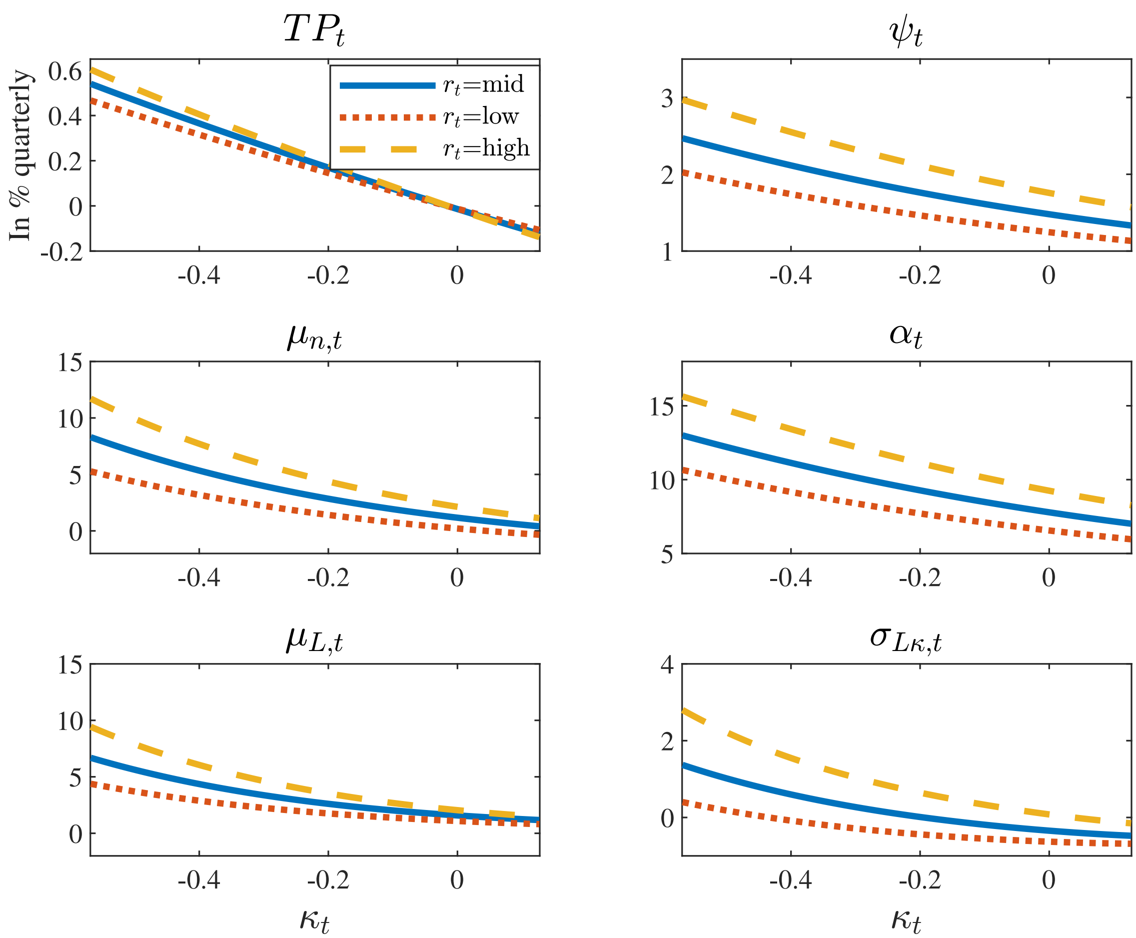


Figure 2: Impulse responses to a κ shock in the model

This figure shows the model's impulse-responses to a κ_t shock that causes approximately a 100bps increase in term premium. The red-dotted and yellow-dashed line lines are the responses of the model for different parameter in the incentive constraint (ρ).

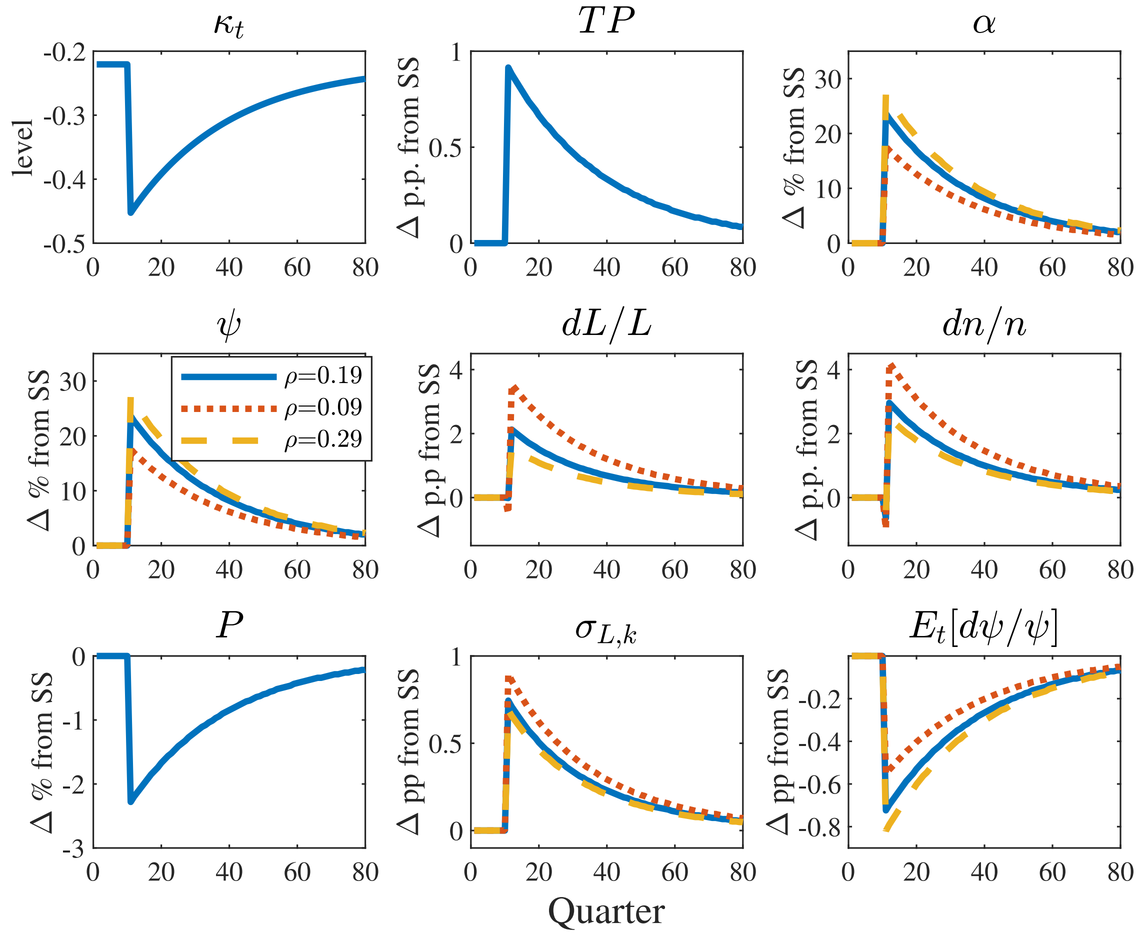


Figure 3: Instrumental variable vs. Term premium (Kim-Wright)

This figure shows (a) the 5-year term premium series from the term structure model of Kim and Wright (2005) and (b) the instrumental variables representing the foreign official holdings of U.S. Treasuries normalized by U.S. GDP.

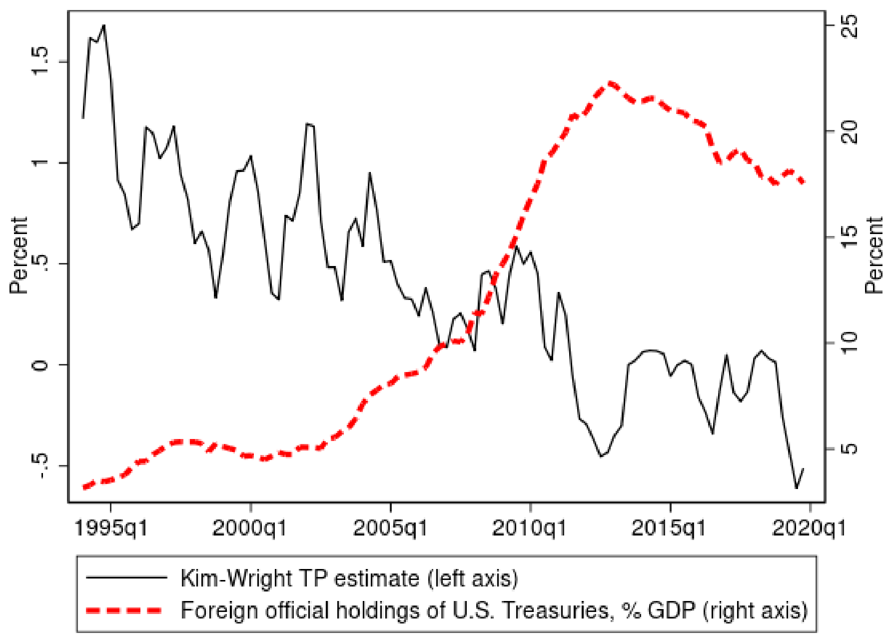


Figure 4: Term premium vs. Term premium shocks (Kim-Wright)

This figure shows (a) the 5-year term premium series from the term structure model of Kim and Wright (2005) and (b) high-frequency term premium shocks estimated as changes in the Kim-Wright term premium on FOMC event days.

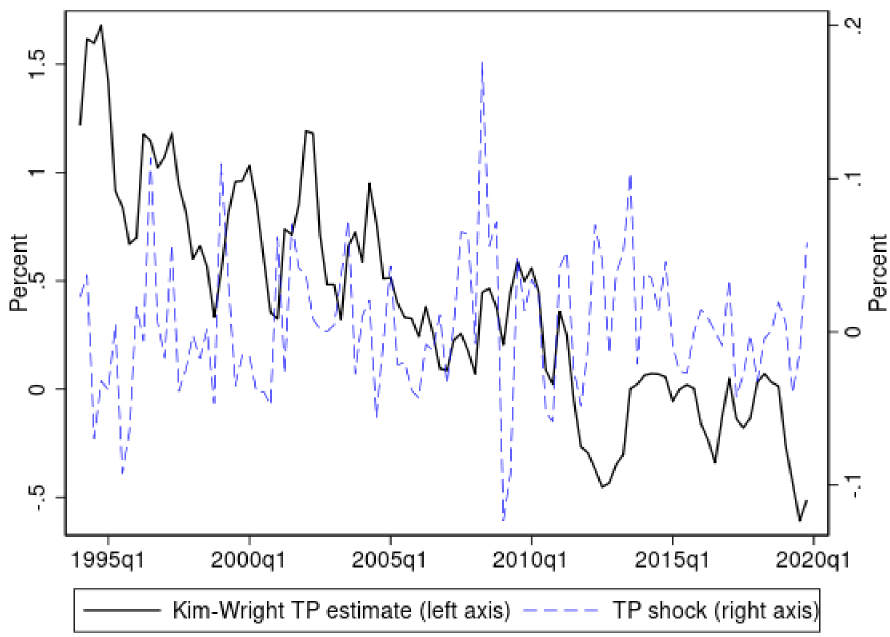


Figure 5: Treasury yields and the term premium during Taper Tantrum

This figure depicts the sharp and sustained rise in market yields on 5-year Treasury securities and in the 5-year term premium during the Taper Tantrum episode following former Chair Ben Bernanke speech on May 22 2013 regarding the Federal Reserve's intention to start tapering asset purchases under its quantitative easing program (the date of the speech is indicated by the dashed vertical line). Treasury yields series is the Market Yield on U.S. Treasury Securities at 5-Year Constant Maturity, Quoted on an Investment Basis [series code DGS5], retrieved from FRED, Federal Reserve Bank of St. Louis (link). The term premium series is the Term Premium on a 5 Year Zero Coupon Bond [series code THREEFYTP5], retrieved from FRED, Federal Reserve Bank of St. Louis (link). Source: Board of Governors of the Federal Reserve System (US).

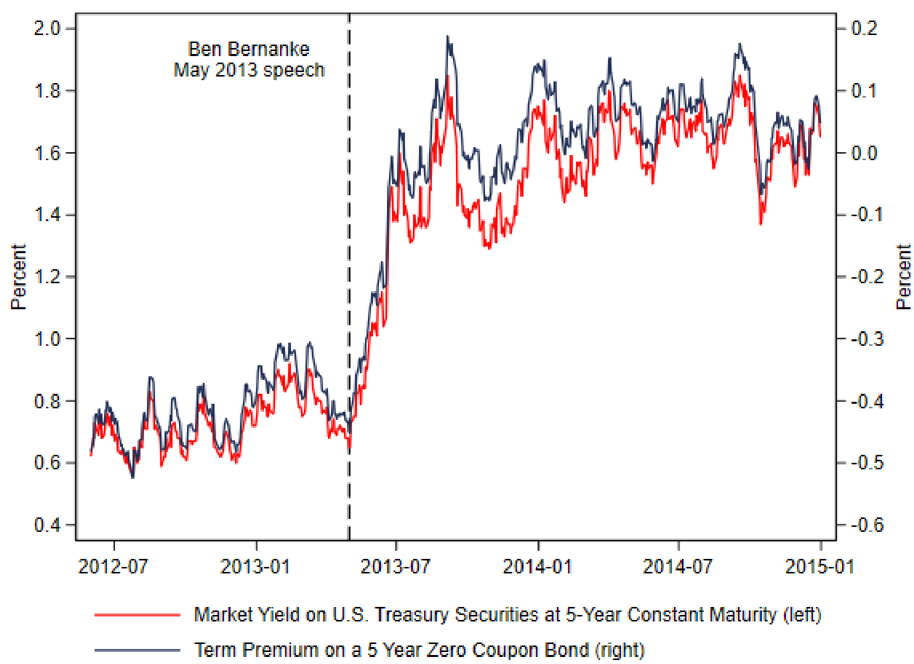


Table 1: Model Calibration

		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. (2021)
	c	0.02	Fixed cost	Avg. Tobin's Q in GK15
	δ	2.85	Deposit constraint	Match Y-9C

The model calibration is described in the text.

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

This table reports OLS regressions in monthly time series. The dependent variables are real GDP growth, banking system loan growth, NIMs, and ROE. The sample period is 1973Q1–2019Q4 in columns 1-4 and 1984Q4-2019Q4 in columns 5-8. Specifications include one-month lagged macro controls (change in the short rate given by the 3-month Tbill yield), one-year ahead real GDP forecasts, and excess bond premium) and lagged dependent variables. Time series on Kim and Wright (2005) term premium estimates, real GDP grwoth, and aggregate banking sector variables (total loans, NIM, and ROE) come from Federal Reserve Economic Data (FRED). Sources for other variables are discussed in Section 5. Robust and autocorrelation-consistent standard errors in parentheses. Significance: *p<.1; **p<.05; ***p<.01.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variables	**Real GDP growth**$_{t,t+4}$		**Bank loan growth**$_{t,t+4}$		**NIM**$_{t,t+4}$		**ROE**$_{t,t+4}$	
3m5y term spread$_t$	0.64**		0.87**		0.05**		1.33**	
	(0.26)		(0.36)		(0.03)		(0.53)	
Term premium$_t$		1.03***		0.89**		0.13**		1.53**
		(0.23)		(0.27)		(0.02)		(0.60)
Expectations$_t$		0.58**		0.87**		0.02		1.09*
		(0.26)		(0.39)		(0.03)		(0.59)
Δ Short rate$_t$	-0.15	-0.13	0.06	0.06	-0.03	-0.03	0.50	0.49
	(0.23)	(0.23)	(0.18)	(0.18)	(0.02)	(0.02)	(0.36)	(0.36)
Observations	183	183	183	183	137	137	137	137
R^2	0.34	0.37	0.60	0.60	0.91	0.92	0.64	0.64
Macro controls	Y	Y	Y	Y	Y	Y	Y	Y

Table 3: Term premium and bank lending: Bank-level evidence

This table reports OLS and IV estimates from a regression of bank loan growth (excluding and including credit lines) on the Kim-Wright term premium. In columns 1 and 4 we use the term premium level series, in columns 2 and 5 we instrument for it with foreign official holdings of U.S. Treasuries (normalized by U.S. GDP) and in columns 3 and 6 we use the term Kim-Wright term premium shocks. The sample is 1994Q1-2019Q4. Specifications include the following lagged controls: short-rate changes, expectations (3-month/5-year spread minus the term premium), four-quarter real GDP growth, four-quarter GDP deflator inflation, one-year ahead real GDP growth and GDP deflator inflation forecasts from SPF, excess bond premium, and lagged dependent variables. Bank controls include bank size (log share of bank assets in total banking system assets), capital ratio, the share of core deposits in total liabilities and the share of securities in total assets. Bank MSA fixed effects are for the MSA of the bank's headquarters location. Standard errors double-clustered by bank and quarter in parentheses. Significance: *p<.1; **p<.05; ***p<.01.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	**Loan growth**$_{t,t+4}$			**Loan growth (including credit lines)**$_{t,t+4}$		
	OLS	**IV**	**OLS TP shock**	**OLS**	**IV**	**OLS TP shock**
Term premium$_t$	1.34***	2.17***	24.42**	0.73**	1.46***	22.04**
	(0.35)	(0.45)	(10.64)	(0.31)	(0.43)	(10.06)
Expectations$_t$	-1.27***	-1.34***	-10.29	-1.14***	-1.20***	-6.80
	(0.20)	(0.21)	(6.89)	(0.18)	(0.18)	(6.57)
Δ Short rate$_t$	-1.27***	-1.23***	-11.27**	-1.48***	-1.44***	-8.95*
	(0.15)	(0.17)	(5.24)	(0.12)	(0.14)	(4.86)
Observations	630,401	630,401	634,153	627,712	627,712	631,463
R^2	0.39	0.23	0.22	0.38	0.23	0.22
Macro controls	Y	Y	Y	Y	Y	Y
Bank controls	Y	Y	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y	Y	Y
Bank MSA FE	Y	Y	Y	Y	Y	Y
First-stage F test		284.8			284.7	

Table 4: Term premium and bank lending: Differential effects by bank leverage

This table reports OLS and IV estimates from a regression of bank loan growth (excluding and including credit lines) on the Kim-Wright term premium in interaction with bank capital. In columns 1 and 4 we use the term premium level series, in columns 2 and 5 we instrument for it with foreign official holdings of U.S. Treasuries (normalized by U.S. GDP) and in columns 3 and 6 we use the term Kim-Wright term premium shocks. The sample is 1994Q1-2019Q4. Bank controls include bank size (log share of bank assets in total banking system assets), the share of core deposits in total liabilities and the share of securities in total assets. Macro controls (from Table 3) are spanned by quarter fixed effects. Bank MSA fixed effects are for the MSA of the bank's headquarters location. Standard errors double-clustered by bank and quarter in parentheses. Significance: *p<.1; **p<.05; ***p<.01.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variables	**Loan growth**$_{t,t+4}$			**Loan growth (including credit lines)**$_{t,t+4}$		
	OLS	**IV**	**OLS TP shock**	**OLS**	**IV**	**OLS TP shock**
Capital ratio$_t$ × Term premium$_t$	-15.31***	-22.39***	-149.17*	-16.07***	-22.74***	-142.79*
	(3.61)	(4.89)	(86.18)	(3.63)	(4.91)	(85.86)
Observations	629,234	629,234	629,234	626,530	626,530	626,530
R^2	0.45	0.15	0.45	0.44	0.14	0.44
Bank controls	Y	Y	Y	Y	Y	Y
Bank controls × Term premium	Y	Y	Y	Y	Y	Y
Bank controls × Expectations	Y	Y	Y	Y	Y	Y
Bank controls × Short rate	Y	Y	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y	Y	Y
Quarter FE	Y	Y	Y	Y	Y	Y
Bank MSA FE	Y	Y	Y	Y	Y	Y
First-stage F test		55.84			55.33	

Table 5: Term premium and bank lending: Loan-level evidence from Taper Tantrum

This table reports OLS estimates from a regression of bank lending outcomes on the interaction of bank capital and a "Post" dummy that takes value one after 2013Q2, and zero otherwise. The data are at the bank-firm loan level and cover a period of between three and five quarters before and after 2013Q2. The dependent variables are a dummy variable that takes value one for new loans and zero otherwise in data on outstanding loans (panel A), and log-volume and spreads in data on new loan originations (panels B and C). Specifications control for bank-level one-year ahead real GDP growth expectations from the Blue Chip survey in levels and interacted with Post. Relationship duration is the # of quarters since the first loan is observed in a given bank-firm pair (log). Specifications include the following lagged bank controls: size (log-assets), capital ratio (as of end-2012), and securities-to-asset ratio, in levels and interacted with the Post dummy. Standard errors clustered by bank-firm in parentheses. Significance: *p<.1; **p<.05; ***p<.01.

	(1)	(2)	(3)
# of quarters before and after taper tantrum	**3Q**	**4Q**	**5Q**
		A. New loan$_{t+1}$	
Capital ratio$_t$ × Post$_t$	-0.015***	-0.013***	-0.013***
	(0.002)	(0.002)	(0.002)
Observations	133,262	174,659	293,348
R^2	0.651	0.656	0.620
		B. Loan volume (log)$_{t+1}$	
Capital ratio$_t$ × Post$_t$	-0.025***	-0.027***	-0.030***
	(0.002)	(0.006)	(0.008)
Observations	8,506	11,312	17,489
R^2	0.773	0.772	0.882
		C. Loan spread$_{t+1}$	
Capital ratio$_t$ × Post$_t$	2.789***	1.646*	1.559**
	(0.455)	(0.775)	(0.639)
Observations	2,254	2,915	4,151
R^2	0.863	0.851	0.862
Relationship duration	Y	Y	Y
Firm × quarter FE	Y	Y	Y
Bank controls	Y	Y	Y
Bank controls × Post	Y	Y	Y
Growth expectations	Y	Y	Y
Growth expectations × Post	Y	Y	Y

Table 6: Real effects of term premium: Firm-level evidence from the Taper Tantrum

This table reports OLS estimates from a firm-level regression of the investment rate on the average capitalization of a firm's lenders and a "Post" dummy that takes value one in 2014 (columns 1–2) or 2014–2015 (columns 3–4) and zero in 2013. The data are at the firm-year level. The investment rate is computed as capital expenditure divided by lagged capital stock (fixed assets). "Firm exposure to bank capital" is defined at the firm level as the average capital ratio of a firm's banks weighted by the share of total borrowing from each of those banks at end-2013. Specifications include the following firm controls: size (log-assets), leverage (total debt/assets), cash holdings (% assets), tangibility (tangible assets in % of total assets), interest coverage ratio (EBITDA/interest expense), firm sales growth, and a dummy variable that takes value one for listed firms, in levels and interacted with Post. Industry is given by two-digit NAICS classification. Standard errors double-clustered by firm and year in parentheses. Significance: *p<.1; **p<.05; ***p<.01.

	(1)	(2)	(3)	(4)
	Investment rate			
	2013 vs 2014		**2013 vs 2014-2015**	
Firm exposure to bank capital × Post	-0.122**	-0.259**	-0.095**	-0.215**
	(0.005)	(0.006)	(0.018)	(0.026)
Observations	54,181	44,331	80,567	65,800
R^2	0.071	0.249	0.065	0.250
Firm controls	Y	Y	Y	Y
Firm controls × Post	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
State FE	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
State × Industry × Year FE		Y		Y

Table 7: Term premium and bank lending: Loan-level evidence over 2013–2019

This table reports OLS estimates from a regression of bank lending terms on bank capital interacted with the term premium shock during 2013Q1-2019Q4. The dependent variables are a dummy variable for new loan originations, loan volume (log), and loan spread, respectively. The data are at the bank-firm loan level and refer to outstanding loans to nonfinancial firms reported on a quarterly frequency during 2013Q1-2019Q4. The term premium shock is computed from changes in the Kim-Wright term premium on FOMC event days (see Section 4 for details); expectations are bank-specific one-year ahead GDP growth forecasts from the Blue Chip survey. Bank controls include size (log-assets), capital ratio, core deposits (% liabilities) and securities (% assets) in levels and interacted with the term premium shock, expectations, and the short rate. Relationship duration is defined as the number of quarters since the first loan is observed for a given bank-firm pair (log). Standard errors clustered by bank-firm in parentheses. Significance: *p<.1; **p<.05; ***p<.01.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	**New loan**$_{t+1}$		**Loan amount (log)**$_{t+1}$		**Loan spread**$_{t+1}$	
Capital ratio$_t$ × Term premium shock$_t$	-0.466***	-0.366***	-0.277***	-0.316***	0.215**	0.215**
	(0.021)	(0.021)	(0.064)	(0.066)	(0.091)	(0.089)
Observations	616,493	616,493	632,980	632,980	270,422	270,422
R^2	0.638	0.639	0.663	0.663	0.822	0.822
Relationship duration	Y	Y	Y	Y	Y	Y
Firm × Quarter FE	Y	Y	Y	Y	Y	Y
Bank controls	Y	Y	Y	Y	Y	Y
Bank controls × Term premium shock	Y	Y	Y	Y	Y	Y
Bank controls × Expectations		Y		Y		Y
Bank controls × Short-rate		Y		Y		Y

Table 8: Term premium and loan maturities: Loan-level evidence over 2013–2019

This table reports OLS estimates from a regression of bank lending terms on bank capital interacted with the term premium shock during 2013Q1-2019Q4. The dependent variables are the share of loan-maturity loans (>3 years or >5 years) and the loan volume-weighted average maturity in data that is aggregated to the bank-firm-quarter level. The data refer to outstanding loans to nonfinancial firms reported on a quarterly frequency during 2013Q1-2019Q4. The term premium shock is computed from changes in the Kim-Wright term premium on FOMC event days (see Section 4 for details); expectations are bank-specific one-year ahead GDP growth forecasts from the Blue Chip survey. Bank controls include size (log-assets), capital ratio, core deposits (% liabilities) and securities (% assets) in levels and interacted with the term premium shock, expectations, and the short rate. Relationship duration is defined as the number of quarters since the first loan is observed for a given bank-firm pair (log). Standard errors clustered by bank-firm in parentheses. Significance: *p<.1; **p<.05; ***p<.01.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	**Share long-maturity loans (> 3 years)** $_{t+1}$		**Share long-maturity loans (> 5 years)** $_{t+1}$		**Average maturity (volume-weighted)** $_{t+1}$	
Capital ratio$_t$ × Term premium shock$_t$	-0.267***	-0.242***	-0.734***	-0.712***	-2.045***	-2.203***
	(0.018)	(0.020)	(0.028)	(0.029)	(0.179)	(0.180)
Observations	175,333	175,333	175,333	175,333	175,333	175,333
R^2	0.576	0.577	0.617	0.621	0.542	0.549
Relationship duration	Y	Y	Y	Y	Y	Y
Firm × Quarter FE	Y	Y	Y	Y	Y	Y
Bank controls	Y	Y	Y	Y	Y	Y
Bank controls × Term premium shock	Y	Y	Y	Y	Y	Y
Bank controls × Growth expectations		Y		Y		Y
Bank controls × Short-rate		Y		Y		Y

Table 9: Mechanism: Term premium and bank profitability: Bank-level evidence

This table reports OLS and IV (second stage) estimates from a regression of bank profitability (NIMs and ROE) on term premium estimates. In columns 1 and 4 we use the Kim-Wright estimate of the term premium. In columns 2 and 5 we use a term premium shock computed from changes in the Kim-Wright term premium on FOMC event days (see Section 4 for details). In columns 3 and 6 the instrumental variable for the Kim-Wright term premium is the foreign official holdings of U.S. Treasuries (normalized by U.S. GDP). The sample is 1994Q1-2019Q4. Specifications include the following lagged controls: short-rate changes, expectations (3-month/5-year spread minus the term premium), four-quarter real GDP growth, four-quarter GDP deflator inflation, one-year ahead real GDP growth and GDP deflator inflation forecasts from SPF, excess bond premium, and lagged dependent variables. Bank controls include bank size (log share of bank assets in total banking system assets), capital ratio, the share of core deposits in total liabilities, the share of securities in total assets, and the share of trading assets in total assets. Bank MSA fixed effects are for the MSA of the bank's headquarters location. Standard errors clustered by bank in parentheses. Significance: *p<.1; **p<.05; ***p<.01.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable		**NIMs**$_{t,t+4}$			**ROE**$_{t,t+4}$	
	OLS	**IV**	**OLS TP shock**	**OLS**	**IV**	**OLS TP shock**
Term premium$_t$	0.055***	0.087***	0.193***	0.403***	0.630***	1.198***
	(0.001)	(0.001)	(0.008)	(0.015)	(0.020)	(0.154)
Expectations$_t$	-0.008***	-0.011***	-0.159***	-0.180***	-0.198***	-1.843***
	(0.001)	(0.001)	(0.005)	(0.009)	(0.009)	(0.103)
Δ Short rate$_t$	-0.002***	-0.001**	-0.086***	0.029***	0.041***	-0.545***
	(0.000)	(0.000)	(0.004)	(0.005)	(0.005)	(0.086)
Observations	640,385	640,385	650240	640,384	640,384	650239
R^2	0.754	0.427	0.394	0.399	0.160	0.163
Macro controls	Y	Y	Y	Y	Y	Y
Bank controls	Y	Y	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y	Y	Y
Bank MSA FE	Y	Y	Y	Y	Y	Y
First-stage F test		974511			1.529e+06	

Table 10: Mechanism: Term premium and bank profitability around the Taper Tantrum

This table reports OLS estimates from a regression of bank profitability (NIMs in panel A and ROE in panel B) on the interaction of bank capital and a "Post" dummy that takes value one after 2013Q2, and zero otherwise. The data are at the bank-quarter level and cover a period of between three and five quarters before and after 2013Q2. Specifications include the following lagged bank controls: size (log-assets), capital ratio, and securities-to-asset ratio, in levels and interacted with the Post dummy. Standard errors clustered by bank in parentheses. Significance: *p<.1; **p<.05; ***p<.01.

	(1)	(2)	(3)
# of quarters before and after taper tantrum	**3Q**	**4Q**	**5Q**
		A. NIMs$_{t+1}$	
Capital ratio$_t$ × Post$_t$	-0.057	-0.095*	-0.118**
	(0.034)	(0.040)	(0.040)
Observations	22,281	33,469	44,755
R^2	0.963	0.951	0.942
		B. ROE$_{t+1}$	
Capital ratio$_t$ × Post	-2.177	-3.146*	-4.210**
	(1.151)	(1.441)	(1.529)
Observations	22,281	33,469	44,755
R^2	0.840	0.800	0.776
Bank controls	Y	Y	Y
Bank controls × Post	Y	Y	Y
Bank FE	Y	Y	Y
Quarter FE	Y	Y	Y

Appendix

A Stochastic Discount Factor

We present a simple representative agent consumption-based model to illustrate the type of preferences and endowment process that would deliver a similar stochastic discount factor (SDF) than the one presented in the main text. In brief, the setup is Bansal and Yaron (2004), model 2, but for simplicity we assume there are no shocks to expected consumption growth.[26] The setup consists of a representative agent with recursive preferences, following Duffie and Epstein (1992b),

$$U_t = E_t \int_t^\infty f(c_s, U_s)\, \mathrm{d}s, \tag{A-1}$$

$$f(c,U) = \frac{1}{1-\frac{1}{\psi}} \left\{ \rho c^{1-\frac{1}{\psi}} \left[(1-\gamma) U\right]^{\frac{\frac{1}{\psi}-\gamma}{1-\gamma}} - \rho (1-\gamma) U \right\},$$

were γ is the risk aversion parameter, ψ is the elasticity of intertemporal substitution, c is agent's consumption, and U is the utility level. As shown in Duffie and Epstein (1992a), the SDF, m_t, is

$$\frac{\mathrm{d}m_t}{m_t} = \frac{\mathrm{d}f_c}{f_c} + f_U \mathrm{d}t,$$

where f_c and f_U is partial derivative of $f(c,U)$ with respect to c and U, respectively. The consumption process is

$$\begin{aligned} \frac{\mathrm{d}c_t}{c_t} &= \mu \mathrm{d}t + \sqrt{\exp(v_t)}\, \mathrm{d}W_{1,t}, \\ \mathrm{d}v_t &= \lambda_v (v - v_t)\, \mathrm{d}t + \kappa \mathrm{d}W_{2,t}, \end{aligned}$$

where v_t is the log of variance. It can be shown that the value function depends on two state variables, consumption level and volatility level (Duffie and Epstein, 1992b; Campbell et al., 2003):

$$U = \frac{(\xi(v)\, c)^{1-\gamma}}{1-\gamma},$$

[26] The analysis would be the same if we assume shocks to expected consumption growth are perfectly correlated with consumption growth (or level) shocks.

where $\xi(v)$ is a unknown function that has to be solved using the integral (A-1). Then, the partial derivatives can be written as

$$\begin{aligned} f_c &= \rho c^{-\gamma} \xi^{\frac{1}{\psi}-\gamma}, \\ f_U &= \left(\frac{\frac{1}{\psi}-\gamma}{1-\frac{1}{\psi}}\right) \rho \left\{\xi^{\frac{1}{\psi}-1}-1\right\}. \end{aligned}$$

Using Ito's lemma,

$$\begin{aligned} \frac{\mathrm{d}f_c}{f_c} &= -\gamma \frac{\mathrm{d}c}{c} + \frac{1}{2}\gamma(\gamma+1)\left(\frac{\mathrm{d}c}{c}\right)^2 \\ &\quad + \left(\frac{1}{\psi}-\gamma\right)\frac{\mathrm{d}\xi}{\xi} + \frac{1}{2}\left(\frac{1}{\psi}-\gamma\right)\left(\frac{1}{\psi}-\gamma-1\right)\left(\frac{\mathrm{d}\xi}{\xi}\right)^2 \\ &\quad -\gamma\left(\frac{1}{\psi}-\gamma\right)\frac{\mathrm{d}c}{c}\frac{\mathrm{d}\xi}{\xi} \end{aligned}$$

Then, the SDF is

$$\frac{dm_t}{m_t} = -r_t \mathrm{d}t - \gamma\sqrt{\exp(v_t)}\mathrm{d}W_{1,t} - \left(\frac{1}{\psi}-\gamma\right)\frac{\xi_v}{\xi}\kappa \mathrm{d}W_{2,t}, \tag{A-2}$$

with

$$\begin{aligned} r_t &= \left(\frac{\gamma-\frac{1}{\psi}}{1-\frac{1}{\psi}}\right)\rho\left\{\xi^{\frac{1}{\psi}-1}-1\right\} + \gamma\mu - \gamma(\gamma+1)v_t \\ &\quad + \left(\frac{1}{\psi}-\gamma\right)\left[\frac{\xi_v}{\xi}\lambda_v(v-v_t) + \frac{1}{2}\frac{\xi_{vv}}{\xi}\kappa^2\right] + \frac{1}{2}\left(\frac{1}{\psi}-\gamma\right)\left(\frac{1}{\psi}-\gamma-1\right)\left(\frac{\xi_v}{\xi}\kappa\right)^2 \end{aligned}$$

where ξ_v is the partial derivative of ξ with respect to v. Notice the SDF (A-2) is similar to the one proposed in the Model section,

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

Finally, ξ solves the following ordinary differential equation

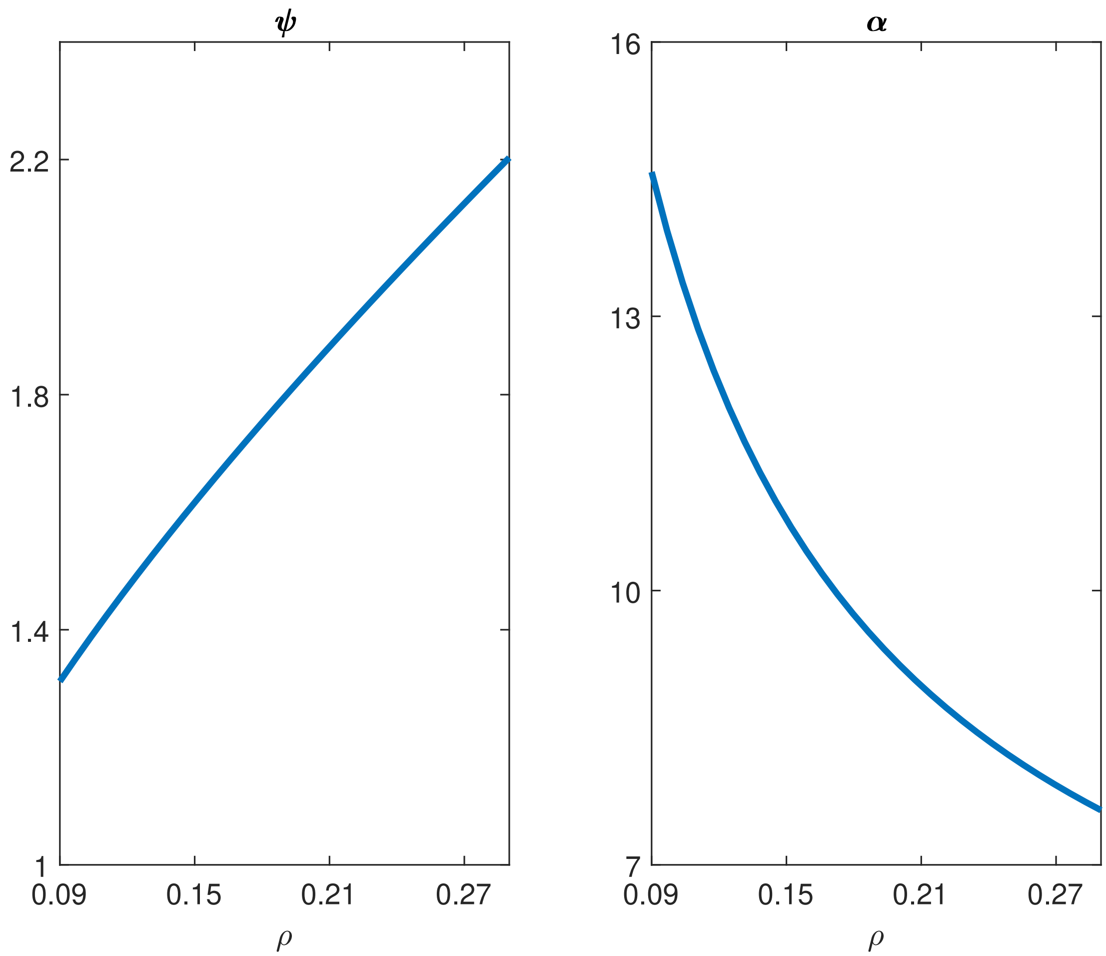
$$0 = \frac{\rho}{1-\frac{1}{\psi}}\left\{\xi^{\frac{1}{\psi}-1}-1\right\} + \mu - \frac{\gamma}{2}\exp(v) + \frac{\xi_v}{\xi}\lambda_v(v-v_t) + \frac{1}{2}\frac{\xi_{vv}}{\xi}\kappa^2 - \frac{\gamma}{2}\left(\frac{\xi_v}{\xi}\kappa\right)^2,$$

which can be solved numerically and has a unique solution provided the state variable is strong Markov (Duffie and Lions, 1992).

B Model solution: Tobin's Q and leverage for different ρ

Figure B-1: Relationship between ρ, $\psi(r, \kappa)$, and α

This figure shows the solution for $\psi(\bar{r}, \bar{\kappa})$ and $\alpha_t = x_t^{(\tau)} P_t^{(\tau)} / n_t$ for different levels of ρ.



C Data

Table C-1: Descriptive statistics

This table reports summary statistics for selected regression variables in the bank-level analysis (Tables 3-4, 9) (panel A) and the taper tantrum loan-level analysis (baseline Tables 5, 10) (panel B). Term premium level series and shocks are based on term structure models from Kim and Wright (2005) (baseline), Adrian et al. (2013) and Kim and Priebsch (2020) (robustness). In panel B, one-year ahead real GDP growth is at the bank-level and comes from the Blue Chip Economic and Financial Indicators.

	N	SD	Mean	P25	P50	P75
A. Variables in bank-level regressions						
Loan growth	634153	0.14	0.05	-0.02	0.04	0.11
Loan growth (including credit lines)	631463	0.14	0.05	-0.02	0.04	0.11
Net interest margins	629324	0.00	0.01	0.01	0.01	0.01
Return on equity	629323	0.03	0.02	0.02	0.03	0.04
Term premium (Kim-Wright) x 100	634153	0.49	0.50	0.09	0.48	0.84
Term premium shock (Kim-Wright) x 100	634153	0.05	0.00	-0.03	0.00	0.04
Term premium (Adrian-Crump-Moench) x 100	634153	0.58	0.84	0.34	0.89	1.32
Term premium (Kim-Priebsch) x 100	634153	0.60	0.41	0.05	0.45	0.84
Term premium shock (Adrian-Crump-Moench) x 100	634153	0.07	0.01	-0.04	0.01	0.04
IV (Foreign official holdings of UST/U.S. GDP)	634153	0.07	0.10	0.05	0.08	0.18
Expectations (Kim-Wright) x 100	634153	0.78	0.64	-0.12	0.81	1.38
Δ Short rate x 100	634153	1.30	-0.04	-0.56	-0.01	0.83
Short rate (shock) x 100	634153	0.12	-0.01	-0.03	0.00	0.04
SPF: one-year ahead real GDP growth	634153	0.01	0.03	0.02	0.03	0.03
SPF: one-year ahead GDP deflator inflation	634153	0.00	0.02	0.02	0.02	0.02
Real GDP growth	634153	0.02	0.03	0.02	0.03	0.04
GDP deflator inflation	634153	0.01	0.02	0.02	0.02	0.02
Excess bond premium	634153	0.65	0.01	-0.36	-0.22	0.13
Bank size (log-share of bank assets)	634153	1.11	-10.55	-11.30	-10.62	-9.90
Capital ratio	634153	0.04	0.11	0.08	0.10	0.12
Core deposits-to-liabilities	634153	0.13	0.80	0.74	0.82	0.88
Securities-to-assets	634153	0.15	0.25	0.14	0.23	0.34
Maturity gap	56453	0.58	0.27	0.38	0.54	0.74
B. Variables in Taper Tantrum loan-level analysis						
Loan amount (US$ million)	17489	87.22	29.55	1.55	7.50	26.80
Log(amount)	17489	2.33	15.48	14.25	15.83	17.10
Loan spread x 100 (ppts)	4151	1.22	2.35	1.50	2.19	3.00

Table C-1: Descriptive statistics (continued)

This table reports summary statistics for selected regression variables in the firm-level real effects analysis around the taper tantrum (Table 6) (panel C) and the full Y-14Q sample (Tables 7-8) (panel D). In Panel D, the data structure is bank-firm loan-level for all variables except share of long-maturity loans and (volume-weighted) average maturity which are reported in the aggregated bank-firm quarter panel.

	N	SD	Mean	P25	P50	P75
B. Variables in Taper Tantrum loan-level analysis (continued)						
New loan	293348	0.27	0.08	0.00	0.00	0.00
Net interest margins x 100	33469	0.19	0.86	0.74	0.84	0.95
Return on equity x 100	33469	2.79	1.70	1.08	1.92	2.88
Maturity gap / 100	33912	0.27	0.58	0.38	0.55	0.75
Capital ratio (x 100)	17489	2.65	12.96	10.74	12.17	14.72
Bank size (log-assets)	17489	1.13	6.55	5.68	7.17	7.28
Securities-to-assets	17489	0.07	0.19	0.16	0.18	0.20
Core deposits-to-liabilities	17489	0.10	0.57	0.49	0.55	0.63
Reserves-to-assets	17489	0.09	0.07	0.02	0.05	0.08
Blue Chip: one-year ahead real GDP growth	17489	0.44	2.34	2.08	2.36	2.60
C. Variables in Taper Tantrum firm-level analysis						
Investment rate (Capex/L.Capital stock)	80567	0.33	0.24	0.00	0.11	0.32
Firm exposure to bank capital	80567	0.03	0.11	0.11	0.12	0.13
Firm size (log-assets)	80567	2.51	17.50	16.04	17.16	18.84
Firm leverage (debt/assets)	80567	0.28	0.35	0.14	0.31	0.51
Cash ratio (cash/assets)	80567	13.75	10.17	1.16	4.90	13.70
Tangibility (% assets)	80567	19.41	89.30	88.56	99.39	100.00
Interest Coverage Ratio	80567	0.86	0.44	0.04	0.11	0.33
Real sales growth	80567	40.65	13.87	-0.26	6.70	17.07
1: Listed firm	80567	0.23	0.06	0.00	0.00	0.00
D. Variables in full-sample loan-level analysis						
Loan amount (US$ million)	632980	64.34	27.27	2.50	8.50	30.00
Loan amount (log)	632980	1.48	16.04	14.73	15.96	17.22
Loan spread (ppts)	318846	1.06	2.12	1.50	1.95	2.50
New loan	616493	0.32	0.11	0.00	0.00	0.00
Share long-maturity loans (>3 years)	175333	0.24	0.93	1.00	1.00	1.00
Share long-maturity loans (>5 years)	175333	0.39	0.77	0.71	1.00	1.00
Average maturity (volume-weighted)	175333	2.66	5.80	4.96	5.00	6.44
Capital ratio	632980	1.41	12.79	11.89	12.57	13.67
Bank size (log-assets)	632980	1.22	20.41	19.52	21.16	21.38
Securities-to-assets	632980	0.01	0.03	0.02	0.02	0.03
Core deposits-to-liabilities	632980	13.99	63.15	55.78	67.65	69.83
Relationship duration (log)	632980	1.05	0.38	0.00	0.00	0.00
Term premium shock (Kim-Wright) x 100	632980	0.03	0.00	-0.02	0.00	0.03
Blue Chip: one-year ahead real GDP growth	632980	0.34	2.42	2.18	2.40	2.65
Short-rate x 100	632980	2.75	0.78	-1.59	1.37	2.49

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

Figure OA-1: Term premium during Taper Tantrum placebo tests

This figure depicts the 5-year term premium during the period over which we conduct placebo tests for the Taper Tantrum analysis between 2012Q2 and 2013Q1. The term premium series is the Term Premium on a 5 Year Zero Coupon Bond [series code THREEFYTP5], retrieved from FRED, Federal Reserve Bank of St. Louis (link). Source: Board of Governors of the Federal Reserve System (US).

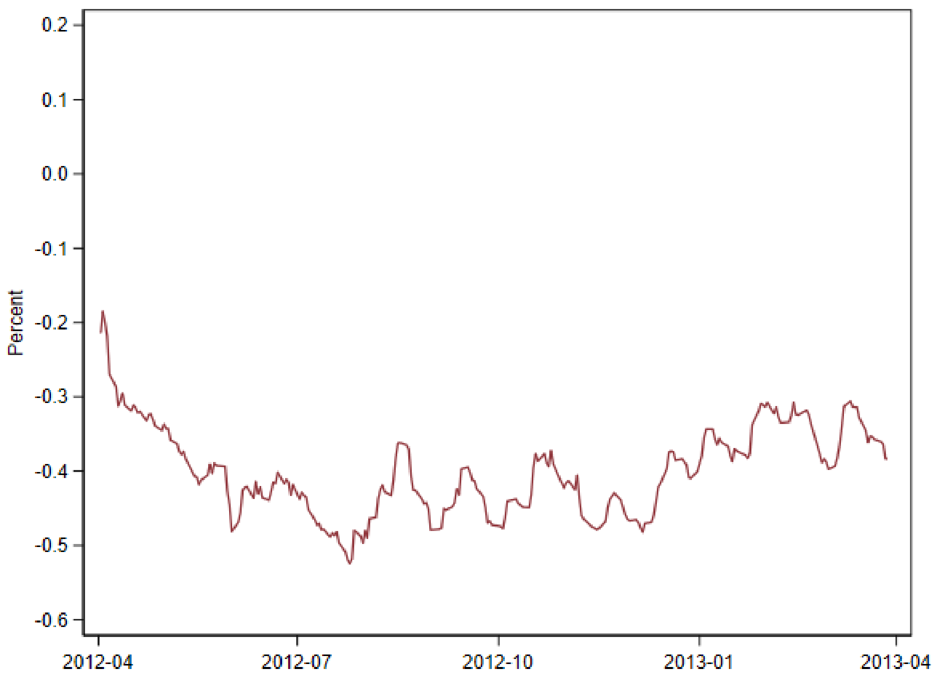


Table OA-1: First stage—Instrument relevance

This table reports OLS estimates of contemporaneous time series regressions of the 5-year term premium estimated using the Kim and Wright (2005), Adrian et al. (2013) and Kim and Priebsch (2020) models, respectively, on the instrumental variable (Foreign official holdings of Treasury securities, normalized by GDP) and the short rate (3-month T-bill yield). Regressions in columns 2, 4, and 6 add macro controls including real GDP growth, GDP deflator inflation, one-year ahead real GDP growth and GDP deflator inflation forecasts from SPF, and the excess bond premium. The sample period is 1961Q3-2019Q4 in columns 1, 3 and 5; and 1973Q1-2019Q4 in columns 2, 4, and 6 (due to the availability of the excess bond premium time series). Robust and kernel-based autocorrelation-consistent standard errors in parentheses. Significance: *p<.1; **p<.05; ***p<.01.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	**Kim-Wright term premium$_t$**		**Adrian-Crump-Moench term premium$_t$**		**Kim-Priebsch term premium$_t$**	
Foreign official holdings of U.S. Treasuries$_t$	-0.03***	-0.07***	-0.04***	-0.05***	-0.05***	-0.07***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Short-rate$_t$	0.07***	-0.02	0.12***	0.08***	0.12***	0.09***
	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.02)
Observations	234	187	234	187	232	185
R^2	0.19	0.62	0.60	0.82	0.67	0.85
Macro controls		Y		Y		Y

Table OA-2: Robustness of bank-level evidence to longer sample period

This table reports OLS and IV estimates from a regression of bank loan growth (excluding and including credit lines) on the Kim-Wright term premium. In columns 1 and 4 we use the term premium level series, in columns 2 and 5 we instrument for it with foreign official holdings of U.S. Treasuries (normalized by U.S. GDP) and in columns 3 and 6 we use the term Kim-Wright term premium shocks. The sample is 1973Q4-2019Q4 in columns 1-2, 1994Q1-2019Q4 in columns 3 and 6, and 1991Q1-2019Q4 in columns 4-5. Specifications include the following lagged controls: short-rate changes, expectations (3-month/5-year spread minus the term premium), four-quarter real GDP growth, four-quarter GDP deflator inflation, one-year ahead real GDP growth and GDP deflator inflation forecasts from SPF, excess bond premium, and lagged dependent variables. Bank controls include bank size (log share of bank assets in total banking system assets), capital ratio, and the share of deposits in total liabilities. Bank MSA fixed effects are for the MSA of the bank's headquarters location. Standard errors double-clustered by bank and quarter in parentheses. Significance: *p<.1; **p<.05; ***p<.01.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable		**Loan growth**			**Loan growth**$_{t,t+4}$ **(including credit lines)**$_{t,t+4}$	
	OLS	**IV**	**OLS MP shock**	**OLS**	**IV**	**OLS MP shock**
Term premium$_t$	0.13	2.83***	0.28**	0.83**	3.40***	0.25**
	(0.40)	(0.70)	(0.12)	(0.40)	(0.73)	(0.11)
Expectations$_t$	-0.28	0.14	-0.13*	-1.23***	-1.39***	-0.09
	(0.32)	(0.38)	(0.08)	(0.26)	(0.29)	(0.07)
Δ Short rate$_t$	-0.39**	0.03	-0.12**	-0.79***	-0.59***	-0.10*
	(0.17)	(0.21)	(0.06)	(0.17)	(0.22)	(0.05)
Observations	1,603,535	1,603,535	638,962	748,003	748,003	631,463
R^2	0.27	0.16	0.19	0.34	0.18	0.20
Macro controls	Y	Y	Y	Y	Y	Y
Bank controls	Y	Y	Y	Y	Y	Y
Bank MSA FE	Y	Y	Y	Y	Y	Y
First-stage F test		110.1			193.4	

Table OA-3: Robustness of IV estimates to dropping China's official U.S. Treasury holdings

This table reports IV (second stage) estimates from a regression of bank loan growth (excluding and including credit lines) and bank profitability (NIMs and ROE) on term premium estimates. Compared to baseline Table 3, the instrumental variable is constructed by excluding Chinese holdings of U.S. Treasuries. The sample period is 1994Q1-2019Q4. Specification details are as in baseline Table 3. Standard errors are double-clustered by bank and quarter. Significance: *p<.1; **p<.05; ***p<.01.

Dependent variable	(1) **Loan growth**$_{t,t+4}$	(2) **Loan growth (incl. credit lines)**$_{t,t+4}$	(3) **NIM**$_{t,t+4}$	(4) **ROE**$_{t,t+4}$
	IV	**IV**	**IV**	**IV**
Term premium$_t$	1.77***	1.19***	0.08***	0.53***
	(0.41)	(0.40)	(0.01)	(0.12)
Expectations$_t$	-1.31***	-1.19***	-0.01	-0.19***
	(0.20)	(0.18)	(0.01)	(0.07)
Δ Short rate$_t$	-1.24***	-1.44***	-0.00	0.04
	(0.15)	(0.13)	(0.00)	(0.06)
Observations	634,153	631,463	640,385	640,384
R^2	0.23	0.23	0.43	0.16
Macro controls	Y	Y	Y	Y
Bank controls	Y	Y	Y	Y
Bank MSA FE	Y	Y	Y	Y
First-stage F test	357.1	357.2	343.4	363.0

Table OA-4: Robustness of bank-level estimates to alternative term premium estimates

This table reports OLS estimates from a regression of bank loan growth (excluding and including credit lines) on term premium estimates from the term structure model in Adrian et al. (2013) (columns 1-4) and Kim and Priebsch (2020) (columns 5-8). The sample period is 1994Q1-2019Q4. Specification details are as in baseline Table 3. TP shock estimates based on the Kim-Priebsch model are not reported as their term premium series is monthly and precludes a high-frequency event study. Standard errors are double-clustered by bank and quarter. Significance: *p<.1; **p<.05; ***p<.01.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	**Loan growth**$_{t,t+4}$		**Loan growth (including credit lines)**$_t$		**Loan growth**$_{t,t+4}$		**Loan growth (including credit lines)**$_t$	
	Adrian et al. (2013)				Kim and Priebsch (2020)			
	IV	**OLS TP shock**	**IV**	**OLS TP shock**	**OLS**	**IV**	**OLS**	**IV**
Term premium$_t$	2.70***	3.76	1.75***	5.48**	0.99***	1.49***	0.45	0.99***
	(0.73)	(2.99)	(0.60)	(2.72)	(0.29)	(0.35)	(0.27)	(0.35)
Expectations$_t$	-1.80***	3.64	-1.68***	4.41**	-1.10***	-1.06***	-1.01***	-0.97***
	(0.38)	(2.20)	(0.31)	(2.00)	(0.19)	(0.19)	(0.17)	(0.17)
Δ Short rate$_t$	-0.88***	-1.13	-1.19***	-0.70	-1.18***	-1.13***	-1.41***	-1.35***
	(0.19)	(2.50)	(0.16)	(2.40)	(0.14)	(0.15)	(0.11)	(0.12)
Observations	634,153	634,153	631,463	631,463	634,153	634,153	631,463	631,463
R^2	0.22	0.22	0.23	0.22	0.39	0.23	0.38	0.23
Macro controls	Y	Y	Y	Y	Y	Y	Y	Y
Bank controls	Y	Y	Y	Y	Y	Y	Y	Y
Bank MSA FE	Y	Y	Y	Y	Y	Y	Y	Y
First-stage F test	51.83		53.25			463.2		462.8

Table OA-5: Placebo test for Taper Tantrum analysis

This table reports OLS estimates from a regression of bank lending outcomes on the interaction of bank capital and a "Post" dummy. The data are at the bank-firm loan level and cover two distinct periods: 2012Q4 vs 2013Q1 (labelled 1Q in columns 1 and 3), and 2012Q2-2013Q3 vs 2012Q4-2013Q1 (columns 2, 4, and 5). In columns 1 and 3, the "Post" dummy takes value one in 2013Q1 (zero in 2012Q4). In columns 2, 4, and 5 it takes value one in 2012Q4-2013Q1 (and zero in 2012Q2-2013Q3). The number of loans spread observations is insufficient to estimate the regression for the 2012Q4 vs 2013Q1 period. Specification details are as in Table 5. Standard errors clustered by bank-firm in parentheses. Significance: *p<.1; **p<.05; ***p<.01.

	(1)	(2)	(3)	(4)	(5)
Placebo period	**1Q**	**2Q**	**1Q**	**2Q**	**2Q**
	A. New loan$_{t+1}$		**B. Loan volume (log)**$_{t+1}$		**C. Loan spread**$_{t+1}$
Capital ratio$_t$ × Post$_t$	0.005	-0.003	0.034	-0.002	-0.011
	(0.006)	(0.004)	(0.010)	(0.017)	(0.040)
Observations	40,009	80,067	2,262	5,200	1,660
R^2	0.635	0.656	0.761	0.761	0.800
Relationship duration	Y	Y	Y	Y	Y
Firm × quarter FE	Y	Y	Y	Y	Y
Bank controls	Y	Y	Y	Y	Y
Bank controls × Post	Y	Y	Y	Y	Y
Growth expectations	Y	Y	Y	Y	Y
Growth expectations × Post	Y	Y	Y	Y	Y

Table OA-6: Robustness of Taper Tantrum analysis to controlling for bank reserves

This table reports OLS estimates from a regression of bank lending outcomes on the interaction of bank capital and a "Post" dummy that takes value one after 2013Q2, and zero otherwise, where we additionally control for bank reserves. The data are at the bank-firm loan level and cover a period of between three and five quarters before and after 2013Q2. Specification details are as in Table 5 except we also include the bank-level share of reserves in total assets (measured at the end of 2012Q1) in levels and interacted with the Post dummy (coefficients not shown). Standard errors clustered by bank-firm in parentheses. Significance: *p<.1; **p<.05; ***p<.01.

	(1)	(2)	(3)
# of quarters before and after taper tantrum	**3Q**	**4Q**	**5Q**
		A. New loan$_{t+1}$	
Capital ratio$_t$ × Post$_t$	-0.013***	-0.010***	-0.010***
	(0.003)	(0.002)	(0.002)
Observations	133,262	174,659	293,348
R^2	0.651	0.656	0.620
		B. Loan volume (log)$_{t+1}$	
Capital ratio$_t$ × Post$_t$	-0.044***	-0.059***	-0.055***
	(0.009)	(0.013)	(0.012)
Observations	8,506	11,312	17,489
R^2	0.774	0.774	0.883
		C. Loan spread$_{t+1}$	
Capital ratio$_t$ × Post$_t$	3.011***	1.957**	2.097*
	(0.551)	(0.709)	(0.934)
Observations	2,254	2,915	4,151
R^2	0.830	0.825	0.837
Relationship duration	Y	Y	Y
Firm × quarter FE	Y	Y	Y
Bank controls	Y	Y	Y
Bank controls × Post	Y	Y	Y
Growth expectations	Y	Y	Y
Growth expectations × Post	Y	Y	Y

Table OA-7: Term premium and bank leverage after the Taper Tantrum

This table reports OLS estimates from a regression of banks' capital ratio on the interaction of initial bank capital and a "Post" dummy that takes value one after 2013Q2, and zero otherwise. The data are at the bank-quarter level and cover a period of between three and five quarters before and after 2013Q2. Specifications include the following bank controls: size (log-assets), capital ratio (measured at end-2012), core deposits (% liabilities), securities (% assets), and maturity gap, in levels and interacted with the Post dummy. Standard errors double-clustered by bank and quarter in parentheses. Significance: *p<.1; **p<.05; ***p<.01.

	(1)	(2)	(3)
# of quarters before and after taper tantrum	**3Q**	**4Q**	**5Q**
Dependent variable		**Capital ratio$_t$**	
Capital ratio$_{2012}$ $\times$ Post$_t$	-0.050**	-0.059***	-0.058***
	(0.012)	(0.014)	(0.014)
Observations	22,057	33,095	43,939
R^2	0.959	0.950	0.940
Bank controls	Y	Y	Y
Bank controls x Post	Y	Y	Y
Bank FE	Y	Y	Y
Quarter FE	Y	Y	Y