Maturity mismatches and the transmission of term premium shocks through bank lending

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Abstract

This paper shows that the transmission of term premium shocks to the real economy operates more strongly through banks whose owners have high maturity mismatches. Using bank-level call report data, it finds that the subsidiaries of bank holding companies that engage in a greater degree of maturity transformation lend more in response to an unanticipated rise in the term premium. This inference is obtained by applying a unique methodology that suppresses the demand side effects of term premium shocks when measuring their independent effects on the supply side of the loanable funds market. Without the methodology the inferences are reversed.

Keywords: Maturity mismatches, term premium, real economy, call report data.

JEL Classification: E44; G11; G12; G21.

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1 Introduction

How are unanticipated changes in the term premium, the additional compensation that lenders demand to hold long-term assets instead of holding and reinvesting in short-term assets, related to lending and economy activity? Theoretical explorations of this relationship have been inconclusive and have revealed conflicting mechanisms. One important source of the conflict is related to the different effects that term premium shocks have on the demand and supply sides of the loanable funds market. On the supply side, a positive term premium shock for example, can prompt banks to lend more given the higher profitability of maturity transformation. Conversely, the higher term premium, signalling higher future uncertainty, can curb the demand for loans. Regardless of their position on these demand and supply side effects, most researchers agree that the changes in the term premium are highly impactful for lending, economic fluctuations, policy transmission and the general stability of the banking industry. Identifying and measuring the independent channels through which term premiums shock are transmitted to the real economy are, therefore, important.

In this paper, I use a unique methodology and bank level data to suppress the demand side and measure the supply side effects of term premium shocks. There are two key components of the methodology. First, I use the mismatches between the maturity structure of banks' assets and liabilities to identify the different impact that term premium shocks may have on banks' lending. While banks naturally profit from maturity transformation, I reasonably assume that the effects of term premium shocks could be more acute for banks with greater degrees of mismatches. Second, I link the term premium sensitivity of a bank's loans to the maturity mismatches of not the bank itself but its owner. I then compare the lending growth of banks that are located in the same state but are owned by different bank holding companies to determine how the owners' maturity mismatches impact the transmission of term premium shocks to bank lending. Doing so allows me to suppress any demand side effects of term premium shocks as banks that lend in the same state would be facing similar local conditions. The key restriction that I impose here is that banks are not too large so that there is a closer association with the local economy. This methodology is also consistent with the long-standing literature on internal capital markets (e.g., Campello, 2002; Cetorelli and Goldberg, 2012; De Haas and Lelyveldb, 2010; Houston et al., 1997) revealing that bank holding companies (BHCs) can effectively shift funds to their subsidiaries through internal capital markets and that the lending decisions of these subsidiaries are more closely related to the balance sheet of their owners.

Using dynamic panel estimations I infer that the transmission of term premium shocks to the real economy is stronger through banks with higher degrees of maturity mismatches. Specifically, I find that bank lending growth is positively related to maturity mismatches and that positive term premium shocks have a greater positive impact on the loan growth rate of banks that have a relatively greater share of long-term assets and short-term liabilities on their balance sheets. I take several steps to reach this inference. It turns out that the steps I take for suppressing the demand side is critical as without this methodology the inferences are reversed.

I construct the data set by using call report data that spans the period 2011:Q1-2023:Q2. The baseline panel data set is large mostly due to its large cross section dimension, including 5,536 banks and 567 BHCs. To obtain the results, I use estimators that are specifically designed to accommodate panels with this disparity between the time and cross dimensions. I begin the analysis by determining the relationship between banks' maturity mismatches and the term premium sensitivity of bank lending. To do so, I first adopt empirical specifications from earlier studies on maturity mismatches, term premium and monetary transmission. The formulation that links a macroeconomic variable, the term premium, to banks' maturity mismatches and lending, for example, is similar to the specification of Gomez et al. (2021) that explores the link between monetary transmission and maturity mismatches. The main difference in my model is that I use the term premium shock instead of the federal funds rate as the macroeconomic variable. For the former I use the term premium shock series of Kim and Wright (2005) that is obtained from a three factor model and that reflects the unanticipated changes in the spread between 10-year and 2-year US Treasury bond yields. I extend this model to allow for a more a suitable investigation of the link between term premium and bank lending by including the level and expected slope shifts of the yield curve as in Paul (2023) that explores the link between banks' interest risk and monetary policy.

Initial findings indicate that while the lending growth rate of banks with greater maturity mismatches is relatively higher compared to other banks, it is less so when there is a positive term premium shock. These findings, robust to different definitions of the term premium and economically important, imply that the term premium sensitivity of lending is lower for banks with higher maturity mismatches. While it is plausible that these banks are also the ones that engage in a greater degree of financial hedging and are more flexible in repricing loans, our findings are generally counterintuitive as they suggest that banks exhibiting a greater degree of maturity transformation, lend less when this activity receives greater compensation.

I proceed by applying the methodology to account for the demand side effects of term premium shocks. Restricting the panel to banks with owners and those that are not too large, and comparing their lending growth rates, I draw inferences that are opposite of those from the initial analysis. Specifically, I find that amongst banks in a given state, banks whose owner BHC has a relatively higher (lower) degree of maturity mismatches lends more in response to a positive (negative) term premium shock. These results, too, are robust to different definitions of the term premium and maturity mismatches, and they are economically large.

It is reasonable to postulate that the disparity between the two sets of results is due to the greater capability of BHCs, that have subsidiaries in multiple states and some overseas, to diversify demand side risks. Consistent with this postulation, I find that neither maturity mismatches nor the interaction of these mismatches with the term premium are significantly related to lending when I restrict the sample to smaller banks with owners. The negative effects of the term premium on bank lending through maturity mismatches in my estimations that include banks with and without owners then implies that small banks (without a owner BHC) have a lower capacity to diversify demand side effects and are negatively affected by positive term premium shocks. Conversely, an unexpected increase in the term premium prompts higher lending for subsidiaries of BHCs that reap the benefits of their owners' risk diversification capabilities.

One natural question to ask is if the results are driven by other bank or BHC specific characteristics that are related to maturity mismatches. As in Kashyap and Stein (1995), for example, banks' profitability, closely related to maturity mismatches and the term premium, could be the main determinant of lending. In this paper, I follow several exercises to account for other characteristics. I first consider a broader model that includes measures of profitability, asset quality and capital adequacy for banks and BHCs. I find that while some of the bank-specific measures are significantly related to lending, maturity mismatches of BHCs are the primary determinants of their subsidiaries' lending. As a second exercise, I use a propensity score matching methodology that first measures the sensitivity of banks to term premium shocks and then separately uses various bank and BHC characteristics to infer treatment effects. These exercises similarly point to BHC maturity mismatches as the key determinant of the term premium sensitivity. Specifically, the lending growth rate amongst banks that have similar financial ratios and have owners with similar financial ratios, those with higher maturity mismatches is more positively (negatively) impacted by positive (negative) term premium shocks. Further tests reveal that the same conclusion cannot be drawn for the other bank and BHC specific characteristics. Finally, I split the sample period into two even subperiods and identify banks whose owners' have substantially higher maturity mismatches but have relatively stable characteristics otherwise in the latter period. Restricting the sample to these banks, I find that the lending sensitivity to term premium is significantly and economically higher in the latter period.

My findings are critically linked to policy transmission to the extent that policy shocks are related to the term premium. Using several vector autoregressive and local projection specifications, I observe that positive monetary and fiscal shocks (a monetary tightening and a fiscal expansion) generate negative and positive term premium responses, respectively. In light of the earlier findings, these relationships imply that policy transmission could be amplified through BHC maturity mismatches. The fall in the term premium due to a monetary tightening, for example, could have a greater negative impact on the loan growth for the subsidiaries of BHCs with higher maturity mismatches. A similar amplification mechanism could be associated with fiscal expansions financed by long-term debt issuance. The higher term premium due to large long-term bond supply could prompt higher lending for BHCs with higher maturity mismatches. I find support for these amplification mechanisms by incorporating several fiscal and monetary shocks series into the panel model. While policy shocks can be strongly related to business cycles, the key insight in my paper is not exclusive to these shocks. Any shock that generates an unanticipated change in the term premium is reinforced by the maturity mismatches of BHCs as they are transmitted to the real economy. Consistent with this inference, I demonstrate that the bank lending growth forecasts of a random forest supervised learning algorithm are more accurate for banks' whose owners have high maturity mismatches.

A majority of the research on the relationship between the term premium and the real economy has been in the monetary transmission literature. Studies such as Brunnermeier and Sannikov (2014), Bundick et al. (2021), Gertler and Kiyotaki, (2010), He and Krishnamurthy (2013), Paul (2023) uncover or suggest a significant monetary transmission to the real economy through the term premium. A common mechanism in these studies is that monetary policy affects the term premium and economic activity to the extent that it can change the perception of long-term risks. Unanticipated contractionary policy shocks that reduce inflation and inflation volatility risks, for example, can reduce term premia. Studies on the effects of fiscal policy on term premia, though smaller in number, also reveals a significant relationship. Under imperfect substitutability of long-term and short-term assets, long-term debt financed fiscal spending, for example, can increase the term premium as in Andres et al. (2004), Aysun et al. (2024), Hau and Rey (2004), Horvath et al. (2022) and Vayanos and Vila (2009). I find evidence that is consistent with these effects of monetary and fiscal policy shocks on the term premium and economic activity. Unlike these studies, however, my analysis puts the emphasis on term premium shocks instead of policy shocks and it demonstrates that the transmission of term premium shocks to the real economy is strengthened by maturity mismatches. In other words, an unanticipated increase in the term premium, regardless of whether its due to a monetary easing, fiscal expansion or risk perception, prompts a higher degree of lending by banks whose owners have a higher degree of maturity mismatches on their balance sheets.

My analysis is more closely related to empirical studies on banks' maturity mismatches or interest rate risk. The baseline model that I adopt for example is similar to Gomez et al. (2021) that investigate the interaction of monetary policy transmission and banks' maturity mismatches. Unlike this study, I instead focus on term premium shock transmission. As in the bank-level analysis of Paul (2023), I distinguish between term premium shocks and the expected path of term premia, when measuring the effects of term premium shocks. Unlike Paul (2023) that measures the impact of term premium shocks on banks' stock returns, the focus in my paper is on banks' lending. The more important distinguishing feature of this paper, compared to the two studies mentioned above, is the unique approach that accounts for the demand side effects of term premium shocks when measuring their impact on the real economy through the supply side of the loanable funds market.

Identifying the independent effects of term premium shocks on loan demand and loan supply is important as findings indicate that loan demand and loan supply are significantly - yet differently - related to the term premium. On the demand side, there is a long-standing literature demonstrating the negative effects of term premium shocks on the demand for loans by firms (Adrian et al. 2013; Campbell and Shiller, 1991; Mishkin, 1996) and households (Bernanke and Gertler, 1995; Dynan and Kohn, 2007; Gertler and Gilchrist, 1994). There is an equally well-established literature on the supply side that associates higher risk-taking and lending by banks with higher term premiums (Adrian et al., 2010; Borio and Zhu, 2012; Dell'Ariccia et al., 2017; Hanson and Stein, 2015). My work contributes to this literature by identifying the unique effects of term premium shocks on loan supply and by uncovering a positive relationship between these effects and BHCs' maturity mismatches.

2 Data and estimation methodology

In this section, I describe the bank-level data that I collect to investigate the link between maturity mismatches, the term premium and bank lending. I also describe the set of restrictions on the data set that allow for an adequate identification of the supply side effects of term premium shocks.

The bank-level data are obtained from the Uniform Bank Performance Reports (UBPR) of the Federal Financial Institutions Examination Council (FFIEC). The data are quarterly and span the period 2011:Q1-2023:Q2. The reason I choose this period is two folds. First, the linear models that we draw inferences from are unable to capture the nonlinear dynamics governing bank balance sheets during the 2008-09 financial crisis and in its immediate aftermath.[1] Second, the estimation methodologies that I use, while equipped with components to minimize reverse-casuality risks, are designed for panels with a relatively smaller time dimension. My sample includes 5,536 unique banks and 567 unique BHCs and 50 time periods. As explained above a key step in my methodology will be to compare the lending behavior of banks with different owners that are at the same time not too large. Restricting the sample to these banks shrinks

[1] Banks remained relatively stable and avoided large losses during and after the COVID-19 pandemic.

the size of the sample as displayed in Table 1. Specifically, the average number of banks and BHCs per quarter under this restriction are considerably less than those in the full sample. My initial analysis will nevertheless consider the full sample. It should also be pointed out that banks without owners are much smaller in size compared to banks with owners on average; the average assets of the banks with owners are roughly 20 times that of stand-alone banks.

Besides focusing on only banks with owners, I impose several other restrictions to refine the data set. First, I drop observations for banks that do not have an identification number and those that do not report a headquarter state. Second, I only keep insured commercial banks as they account for a majority of the lending activity in the US and since the lending behavior of other types of banks such as Edge banks, US branches of foreign banks may not be as strongly related to US term premium and policies. Finally, I exclude banks that are in the top 5% of the size distribution in a given quarter. With this restriction, there is a size disparity between owners and their subsidiaries, with owners assets equalling approximately 30 folds the assets of their subsidiaries (as displayed in Table 1). This disparity is important since a key component of my methodology, described below, is that the lending behavior of banks do not have a large impact on the balance sheets of their owners. The restriction thus allows me to severe the link between bank and owner balance sheets. I do, however, estimate my model with the full sample that includes these large banks to initially gauge the connection between maturity mismatches, the term premium and lending.

A second crucial element of my analysis is the comparison of the lending behavior of banks that have different owners but are operate in the same state. While the average number of subsidiaries per owner is not too high (2.7) as indicated in Table1, there is a sufficient number of banks with different owners per state to conduct this analysis.

The term premium data are from the Federal Reserve Bank of St. Louis, FRED database. Besides the term spread between the yields on 10 year and 2 year treasury securities, I use several other measures of the term premium series in Kim and Wright (2005). These measures, listed in Table 1 and described in Appendix A, are obtained from a three factor model and represent an unanticipated change in the premium for holding long-term debt instruments over short-term debt instruments. As reported in Table 1, all measures of the term premium were negative on average during the sample period. More critically, these measures all have a coefficient of variation exceeding 1, thus providing me with substantial variation to explore how the relationship between banks' maturity mismatches and their lending in periods with high and low term premia. Same observation can be made for the lending growth rate that is positive on average but highly volatile across banks and time.

My baseline measure of maturity mismatches is the difference between banks' assets and liabilities that have a maturity greater than 1 year as a fraction of their total assets. This measure, as well as its alternative with maturity of 3 years, is positive implying that banks' long-term assets are greater than their long-term liabilities on average, consistent with the common maturity transformation behavior of banks. In addition to these two measures, I use the ratio of banks' short-term assets to their deposits as a proxy for the current ratio.[2] Similar to the inference mentioned above, this measure is less than 1 on average suggesting that banks' short-term liabilities are greater than their short-term assets. Besides maturity mismatches, I use other structural and performance ratios to identify the unique contribution of maturity mismatches to the term premium sensitivity of bank lending. In particular, I control for profitability (net interest income divided by assets), asset quality (loan charge-off minus recoveries divided by assets) and capital adequacy (tier 1 capital divided by assets) in my estimations.

Throughout the bank-level analyses, I use the system generalized method of moments (GMM) dynamic panel estimator of Arellano and Bover (1995) to draw inferences from the models. There are two main reasons why I choose this estimator. First, the estimator is better suited for panels with large cross-section and small time dimensions and thus is a good fit for our panel that has 5,536 banks and 50 quarters. Second, my model specification, adhering to standard practice, includes lagged dependent variables on the right-hand-side to capture persistence of lending growth. Dynamic panel estimators are designed for such specifications. Alternative estimators such as a fixed effects estimators are subject to a Nickell bias that is generated by the correlation between the lagged dependent variables and bank-specific effects. The GMM system estimator that I use also accounts for fixed and random effects, and the potential heteroskedasticity and

[2] UBPR only include long-term assets and do not include short-term liabilities. I measure short-term assets as the difference between banks' total and long-term assets and I use deposits to capture short-term liabilities when computing the current ratio.

autocorrelation in the error term, and it does not require a strict exogeneity of the right-hand-side variables. In my estimations, I use the lags of all right-hand-side variables as instruments and apply Windmeijer's finite-sample correction since the two-step estimation produces downward biased standard errors. It should be noted that throughout all estimations, tests of over-identifying restrictions indicate that instruments as a group are valid and exogenous and that there is no evidence for second-order serial correlation in the error term.

3 Initial inferences

I begin my analysis by configuring a model that is a combination of components featured in earlier specifications that measure the bank-level impact of macroeconomic policies and shocks. Consistent with Gomez et al. (2021), I first relate banks' lending growth to their maturity mismatches and the interaction of these mismatches with an observed macroeconomic variable as follows:

$$l^g_{i,t} = \sum_{k=1}^{8}\alpha_k l^g_{i,t-k} + \sum_{k=1}^{8}\beta_k \Delta tsv_{t-k} + \sum_{k=1}^{8}\gamma_k mm_{i,t-k} + \sum_{k=1}^{8}\lambda_k mm_{i,t-k} * \Delta tsv_{t-k} + \varepsilon_{i,t} \quad (1)$$

where $l^g_{i,t}$ represents the quarterly growth rate (log-difference) of bank i's net loans and leases in period t. $mm_{i,t}$ is the measure of bank i's maturity mismatches defined in the previous section and Δtsv_t is the quarterly change (in percentage points) in the systematic term structure variable. The maturity mismatch variable that I use is similar to the income gap variable of Gomez et al. (2021) and it is a straightforward way of capturing the unhedged interest rate exposure of banks. The right hand side variables and the number of lags is also similar. Unlike Gomez et al. (2021) who use the federal funds rate as the macroeconomic variable and incorporates only the first lag of the maturity mismatch variable, I use a term structure variable and I consider banks' maturity mismatches and their corresponding interaction with the term structure variable in the past 8 quarters. The reason for the latter disparity is that some loan contracts could have been formulated more than a quarter in the past when banks where under a different maturity structure and that a longer lag structure could provides a greater scope to incorporate loan repricing. It should also be noted that I follow standard practice in the monetary transmission literature and include 8 lags of the right hand side variables.

To estimate the model above, I first use term spreads (measured as the difference between the yields of 10 year and 2 year, constant maturity U.S. Treasury Securities). The results reported in the first column of Table 2 indicate a faster pace of lending growth for an economy with a steeper yield curve and for banks with a greater amount of long-term assets relative to long-term liabilities. The latter result reasonably suggests that banks that engage in a higher degree of maturity transformation do so by extending loans. The positive link between the term spread and bank lending is consistent with the predictive power of term spreads over future economic activity and implies that banks lend more rapidly as they expect higher economic growth with a steeper yield curve.

The results more critically indicate that lending growth of banks with higher maturity mismatches is less sensitive to the term spread. There are two potential explanations. First, it is possible that banks with higher maturity mismatches also engage in a greater degree of financial hedging. Second, banks with a greater share of loans on their balance sheets are also the ones that are more flexible in repricing their loans in response to higher long-term interest rates.

While both explanations above could be valid, the more critical question that I pose is how do banks, and those with higher maturity mismatches, react to the changes in the markets' perception of risk associated with holding long-term assets. To search for answers, I replace the term spread variable above with the term premium measure of Kim and Wright (2005). The term premium measure, as explained above, is obtained from a three-factor term structure model and it represents the shocks to the slope of the yield curve. This shock variable can be represented as

$$\Delta tp_t = \Delta i_t^l - \Delta E\left(i_t^l\right) \tag{2}$$

where Δi_t^l is the yield change of a long-term government bond (with a maturity of 10 years in my baseline estimations) and $\Delta E\left(i_t^l\right)$ is the change in the average expected future short term rates (3 month T-bill rates) over the maturity horizon of the long-term bond. In restructuring my model, I follow a formulation similar to that in Paul (2023), and include variables that capture the level and expected slope shifts of the yield curve in addition to the Kim and Wright (2005) term premium shock. The transformed model that I estimate is given by,

$$l^g_{i,t} = \textstyle\sum_{k=1}^{8}\alpha_k l^g_{i,t-k} + \sum_{k=1}^{8}\beta_k \Delta tp_{t-k} + \sum_{k=1}^{8}\gamma_k mm_{i,t-k} + \sum_{k=1}^{8}\lambda_k mm_{i,t-k} * \Delta tp_{t-k} \\ + \sum_{k=1}^{8}\psi_k \Delta i^s_{t-k} + \sum_{k=1}^{8}\chi_k \left[\Delta E\left(i^l_{t-k}\right) - \Delta i^s_{t-k}\right] + \varepsilon_{i,t} \tag{3}$$

where the last two terms on the right hand side represent the level and the expected slope shifts of the yield curve, respectively, and short-term rates are captured by the 3 month T-bill rate.

The distinction between the three components of long-term yields, the short-term rate, the average expected short-term rates and the term premium shock is important for my analysis as it allows me to more accurately define and capture the impact of unanticipated changes in long-term yields on bank lending. The results reported in the second column of Table 2 suggest that while bank lending responds negatively to both the slope and level increases in expected future short-term interest rates, it responds positively to an increase in the term premium. The latter result reasonably implies that an unanticipated increase in the compensation for holding long-term assets increases the degree of maturity transformation that banks' engage in according to their standard business model. The significant response of lending to the changes in short-term rates and their expected future path, however, indicates more generally that banks are not immune to interest rate risk. Notwithstanding loan repricing and relatively inelastic deposit rates, the negative relationship could be explained by the decrease in the value of non-performing loans and the higher degree of riskiness of banks' outstanding loans (relative to new loans) generated by current and future expected short-term interest rates.

A more central finding for my analysis is that the loan growth of banks with greater maturity mismatches are less sensitive to term premium shocks and that this decline in sensitivity is economically important. The estimated value of 0.7186 in the second column implies that bank lending grows roughly 0.7 percent faster in a given quarter if there is a 1 percentage point increase in the term premium in the previous 8 quarters. The interactive variable coefficient value of -0.0416 then implies that the positive response of loan growth is roughly 0.04 percentage point lower if the maturity mismatch ratio is 1 percentage point higher. More meaningfully, the findings imply that loan growth's response to a one standard deviation term premium shock (in the past 8 quarters) is 0.12 percentage points lower for a bank with a maturity mismatch ratio one standard deviation higher than the mean value. This is an economically important result given that the average lending growth rate is approximately 1.5 percent in my sample. As reported in Table 2, both the direction and the magnitudes of the relationships are similar to those in the baseline findings when I use different maturities for the long-term government bonds, the shadow rate for the short-term interest rate and the instantaneous forward values of the long-term rates to measure the term premium.

The most striking aspect of the interactive variable coefficients is not their size but their sign. Specifically, the negative coefficient of the variables suggest that banks who find maturity transformation more profitable, benefit less when this activity receives a greater compensation in the market. There are several critical missing components that prevent me from terminating the analysis and concluding that this a counterintuitive result at this point. First, long-run interest rate risk affects both sides of the financial market. So far, I have not accounted for any effects that changes in the term premium may have on the demand for loans. If, for example, there is a sharp contraction in the demand for bank loans following an increase in the term premium, banks that primarily profit from converting short-term funding to long-term loans could be more adversely affected. Second, there is a well-established literature on internal capital markets in banking that commonly favors centralized over decentralized decision making. Therefore, a potential shortcoming of my analysis so far is that I have not considered the maturity mismatches of the banks' owners. These mismatches could be more important for the relationship between interest rate risk and lending. Third, while it is plausible that lending does not have a meaningful impact on the systematic term premium variable for a majority of the banks in the sample, this cannot be said for some large banks. It is, thus, important to refine the analysis to minimize these reverse-casuality risks. Finally, the significant interactive variable coefficients do not necessarily imply that term premium shocks impact lending through maturity mismatches only. The impact could rather depend on other characteristics such as profitability, loan quality and capital adequacy, that could be related to maturity mismatches. Below, we account for these issues to obtain more precise inferences related to the interaction of maturity mismatches, interest rate risk and the supply of loanable funds.

4 Suppressing loan demand

In this section, I identify and measure the effects of term premium shocks on bank lending that operates through the supply side of the loanable funds market, I measure and compare the interaction of the term premium with different bank and owner financial characteristics and I investigate policy transmission through maturity mismatches.

4.1 Baseline methodology and findings

Bank lending is determined by both demand and supply side factors. Simply put, a bank that is lending more is doing so either because its clients have a higher demand for loans or because it has sound fundamentals or access to cheaper funding. Our aim is to focus on the supply side and determine how mismatches in banks' balance sheets interact with the term premium to alter the level of lending. This is not a straightforward task however given the simultaneity of demand and supply side effects. In this section, I shut-down demand side effects by comparing the lending growth rate of banks that do business in the same state. A crucial step in this methodology is to focus on only small banks so that there is a closer tie between small bank lending and local activity. Doing so, however, can also severe the link between banks' balance sheets and their lending. Specifically, the well-documented literature on internal capital markets suggests that bank holding companies often provide funding to their subsidiaries through internal channels and that these channels are highly effective. The lending behavior of small banks therefore could be more closely associated with the strength of their parent bank holding companies' balance sheets than that of their own. This is especially important for my analysis as banks that are affiliates of bank holding companies account for most of the lending in my data set.

I incorporate internal capital markets into my analysis by comparing the lending growth rate of banks, that are headquartered in the same state, but are owned by different bank holding companies. This relative lending growth rate, $\widetilde{l}^g_{i,t}$, is given by,

$$\widetilde{l}^g_{i,t} = l^g_{i,t} - \overline{l}^g_t \tag{4}$$

where i indexes the bank, $l^g_{i,t}$ is the quarterly growth rate of bank i's loans and $\overline{l}^g_t$ is the average growth rate of bank lending in the same state that bank i is headquartered in. The computation of this average includes all banks, with and without owners. It is important to notice here that by comparing the lending growth rate of a bank with other banks in the same state, I am shutting-down any systematic effects that changes in the term premium have on the local demand for loans.

I follow a similar approach when incorporating maturity mismatches into the analysis. This time, however, I compare the maturity mismatches of bank holding companies that are the owners of the small banks in a given state to investigate the effects that these mismatches have on bank lending. The relative measure of maturity mismatches for bank i, $\widetilde{mm}_{i,t-k}$, is expressed as follows:

$$\widetilde{mm}_{i,t} = mm_{i,t} - \overline{mm}_t \tag{5}$$

where $mm_{i,t}$ is our measure of the mismatch between the maturity of assets and liabilities on the balance sheet of bank i's owner, and $\overline{mm}_t$ is the average maturity mismatch of all bank holding companies, excluding bank i's owner, that have subsidiaries in the same state as bank i.

To determine the relationship between these two variables and their interaction with the term premium, I estimate the following dynamic panel model:

$$\begin{aligned} \tilde{l}^g_{i,t} = {} & \textstyle\sum_{k=1}^{8}\alpha^a_k \tilde{l}^g_{i,t-k} + \sum_{k=1}^{8}\beta^a_k tp_{t-k} + \sum_{k=1}^{8}\gamma^a_k \widetilde{mm}_{i,t-k} + \sum_{k=1}^{8}\lambda^a_k \widetilde{mm}_{i,t-k} * tp_{t-k} \\ & + \textstyle\sum_{k=1}^{8}\psi^a_k \Delta i^s_{t-k} + \sum_{k=1}^{8}\chi^a_k \left[\Delta E\left(i^l_{t-k}\right) - \Delta i^s_{t-k}\right] + \varepsilon_{i,t} \end{aligned} \tag{6}$$

where tp_t is the measure of the term premium in my baseline estimation (estimated term premium on a 10 year long-term government bond over a 3 month T-bill).

The focus in the model above is similarly on the interactive term. The goal, therefore, is to determine how changes in the term premium impact bank lending through the maturity mismatches on bank holding company balance sheets. A positive (negative) relationship between the interaction term and the dependent variable implies that banks with owners that have relatively higher maturity mismatches lend more (less) when the term premium increases.

The main difference between the results reported in Table 3 and the earlier results is that the interactive variable coefficients are now significantly positive suggesting that affiliates of bank holding companies with a greater degree of maturity mismatches lend more in a given state compared to other banks in that state. The magnitudes of the interactive variables' coefficients are also much larger compared to those from my earlier estimations. The interactive variable coefficient value in the first column implies that the positive response of a banks' loan growth is roughly 0.52 percentage point higher than other banks in a given state if the maturity mismatch ratio of its owner is 1 percentage point higher than the average ratio computed across the other owners of banks in that state.

I obtain similar inferences when I use two alternative measures of maturity mismatches. The first measure captures maturity mismatches as the difference between banks' assets and liabilities, with a maturity greater than 3 years, as a fraction of total assets. The second ratio, banks' short-term assets divided by their deposits, approximates a current ratio by using deposits as banks' short-term liabilities. I transform this variable prior to estimation so that an increase in the ratio implies an increase in maturity mismatches. The inferences are also similar when I include measures of owners' profitability, loan quality and capital adequacy. While the coefficients of the maturity mismatch and the interactive variables are similarly positive and significant, none of the bank-holding-company-specific variables are significantly related to banks' relative lending growth. The inferences are also similar when I use different maturities for the yield and the forward rate of the long-term bond. As displayed in Table 4, both the signs and the magnitudes of the interactive variable coefficients are similar and the owner-specific variable coefficients are significant.

4.2 Banks versus owners and other owner-specific variables

So far, the results indicate that banks' lending sensitivity to term premium shocks is significantly related to the maturity mismatches of their owners. I proceed by comparing this impact of owners' maturity mismatches to that of banks' own maturity mismatches. To do so, I restrict the sample as described above and estimate equation (6) by also including other bank-specific control variables. In this equation, the maturity mismatch variable now measures the deviation of a bank's maturity mismatch ratio from the average ratio across all the banks (including banks with the same owner) in a given state.

The results displayed in Table 5 are strikingly different from the baseline results reproduced in column 1. First, lending is not related to banks' maturity mismatches, the term premium and their interaction. In light of the earlier inferences, this result implies that term premium shocks are transmitted to banks' lending through the maturity mismatches of their owners and not their own. Second, I find that unlike owner-specific control variables, bank-specific ratios are significantly related to lending. In particular, I find that banks that are more profitable, that have less loan charge-offs, and are less capitalized lend more. These results are robust to using different measures of maturity mismatches and definitions of the term premium as illustrated in Table 5.

In the broader definition of the baseline model I did not account for the interaction of the term premium with other owner specific characteristics. This could be a potential shortcoming. While I find that the ratios capturing these characteristics are insignificant, this does not preclude a significant interaction between these characteristics and the term premium. To check for this possibility, I conduct 3 estimations that separately incorporate the interaction of the term premium with the ratios that indicate owners' profitability, loan quality and capital adequacy. These estimations, as displayed in Table 6, do not provide any evidence for a significant interaction of the term premium with the three other owner characteristics. While the data seem to favor maturity mismatches over any other characteristic, I conduct two other experiments below to further ascertain this inference.

Overall, I can note that no matter how I define maturity mismatches and the term premium, the maturity mismatches of banks' owners is the only channel through which term premium shocks impact bank lending when I suppress the demand side of the loanable funds market.

4.3 Maturity mismatches and policy transmission

My primary goal is to measure how the changes in term premium affect the lending behavior of banks with different maturity structures. My analysis, however, can also have bearings on macroeconomic policies to the extent that these policies impact the term premium in the economy. In this section, I document the relationship between monetary and fiscal policies and the term premium by using several time series models and indicators of policy stance. In so doing, I use monthly data that spans the sample period that I used in the panel estimations above (January, 2011 to June, 2023) and mostly a two variable VAR model. The ordering of the two variables in the model imply that the term premium is not contemporaneously related to policy variables.

Plots displayed on the left-hand-side and right-hand-side of Figure 1 show the responses of the term premium to the changes in the stance of monetary and fiscal policy, respectively. The baseline measure for the term premium here is the Kim and Wright (2005) term premia on 10-year US Treasury bond yields over 3-month US Treasury bills. For a majority of the estimations, a monetary tightening is captured by an increase in the Wu-Xia shadow rate (Wu and Xia, 2016). Since the federal funds rate is at or near its zero lower bound for a significant portion of our sample period. The responses (orthogonalized impulse responses) generally demonstrate a negative link between the term premium and a monetary tightening. This is consistent with historical evidence that monetary tightening episodes have had a greater positive impact on short-term rates than on long-term rates. The maximum amplitude of the response in the top left plot implies that a 100 basis point increase in the shadow rate generates roughly a 20 basis points decrease in the term premium.[3] A similar relationship, albeit smaller in magnitude, is observed between the shadow rate and a term premium measured as the spread between a 5-year and a 2-year US Treasury bond.

I proceed by investigating how the issuance of US Treasury securities with different term structures affect the term premium. To do so, I obtain the total value of the outstanding marketable bills and bonds issued by the US Treasury for the monthly sample period mentioned above. I then construct a measure for the relative supply of long term securities by subtracting the growth rate of bills from the growth rate of bonds. The maturity terms of US Treasury bills and US Treasury bonds range from 4 to 52 weeks and 20 to 30 years, respectively. Measuring and incorporating the relative growth rate of US Treasury bonds, therefore, allow us to determine how US Treasury transactions that alter the maturity structure in the bond market are related to the term premium. The two plots on the top right corner of Figure 1, corresponding to the baseline and the alternative measure of the term premium mentioned above, demonstrate a positive relationship

[3] The orthogonalized impulse response function (OIRF) in STATA represents the percent change in the response variable to a one standard deviation innovation to the shock variable. I converted these OIRFs so that they represent the percent changes in the term premium in reponse to a percent change in the shadow rate. I did so by dividing the OIRF of the term premium by the OIRF of the shadow rate.

between the relative growth of long-term bonds and the term premium. The maximum amplitude of the response in the first plot implies that if the growth rate of US Treasury bonds outpace the growth of US Treasury bills by 1 percent, the term premium increases by approximately 1.3 percentage points. The magnitude of this relationship is 1.07 percentage points when the term premium is measured as the spread between a 5-year and a 2-year US Treasury bond.

4.3.1 Other considerations

So far I assumed that the term premium, through its lagged values, can have an impact on policy variables. I rule out this relationship by first using a VAR-X model that incorporates policy measures as exogenous variables. The inferences drawn from the corresponding plots in Figure 1 are similar. Second, I use 3 shock variables, 1 for monetary policy and 2 for fiscal policy in the VAR-X model as exogenous variables to determine the effects on the term premium. The U.S. monetary policy shock is the Bu, Rogers and Wu (2021) series that is derived from the common component of the changes in interest rates, for every maturity, following a FOMC announcement. The reason I choose this shock series is that it does a better job of capturing policy shocks under the unconventional regime after 2009. For the first fiscal shock, I use the bond supply shock series from Phillot (2025) that is derived from high-frequency bond auctions data that track the relative supply of long-term US Treasury securities. For the second fiscal shock, I use the Ramey (2011) fiscal shock series that is derived from a narrative approach and that captures the stance of discretionary U.S. fiscal spending. These shocks also generate similar responses, albeit less significant, of the term premium.

As a final test, I use the local projection method of Jorda (2005) to obtain the responses of the term premium to changes in the baseline fiscal and monetary policy measures. These responses, too, demonstrate a negative link between the shadow rate and the term premium and a positive link between the relative growth of long-term bond supply and the term premium as illustrated by the plots at the bottom of Figure 1.

4.3.2 Policy transmission in the panel model

Given the findings so far and the strong impact of monetary and fiscal policy shocks on the term premium illustrated in Section 2, one can postulate that the maturity mismatches of banks' owners are important for policy transmission. A natural way to proceed therefore is to test the validity of this postulation. I conduct this test by replacing the term premium shock in my dynamic panel model with monetary and fiscal policy shocks to measure the impact of these shocks and their interaction with maturity mismatches on bank lending. The modified equation is given by,

$$\tilde{l}^{g}_{i,t} = \sum_{k=1}^{8} \alpha^{p}_{k} \tilde{l}^{g}_{i,t-k} + \sum_{k=1}^{8} \beta^{p}_{k} psv_{t-k} + \sum_{k=1}^{8} \gamma^{p}_{k} \widetilde{mm}_{i,t-k} + \sum_{k=1}^{8} \lambda^{p}_{k} \widetilde{mm}_{i,t-k} * psv_{t-k} + \varepsilon^{p}_{i,t} \quad (7)$$

where psv is the policy shock variable. For the baseline estimations, I use the Bu, Rogers and Wu (2021) and Phillot (2025) measures to capture monetary and fiscal policy shocks, respectively. To estimate this model I similarly apply my methodology of suppressing the demand side of the loanable funds market so that the lending growth and maturity mismatch variables are measured in deviation form.

The results displayed in Table 7 are generally consistent with the earlier inferences and postulations. The negative and positive coefficients of the interactive terms with monetary and fiscal policy measures, respectively, suggest that policy transmission operates more strongly through the maturity mismatches of banks' owners. Specifically, the negative and positive lending responses to a monetary tightening and an increase in Treasury bond supply are amplified through bank owners' maturity mismatches. Considering the positive link between maturity mismatches and the responsiveness of the term premium in the panel estimations, these results imply that policy shocks, through their impact on the term premium, are more strongly transmitted through bank owners with a greater degree of maturity mismatches.

The results in Table 7 indicate that a similar observation can be made if the federal funds rate and the Ramey news shock series are used as alternative measures of monetary and fiscal shocks, and if maturity mismatches are measured at the 3 year maturity. Also similar to the results in Table 2, I obtain opposite signs for the interactive variable coefficients when I do not suppress demand side effects and use banks' maturity mismatches instead of their owners.

5 Further Analysis

In this section, I conduct two tests to more clearly identify the unique contribution of maturity mismatches to the term premium sensitivity of bank lending and I use a supervised machine learning algorithm to obtain forecasts of lending growth for banks whose owners have high and low maturity mismatches.

5.1 A propensity score matching exercise

The results so far indicated that it's owners' maturity mismatches, and not banks' maturity mismatches, that is related to the term premium sensitivity of lending. This inference was drawn from estimations that controlled for other owner and bank characteristics. These estimations also revealed that owners' maturity mismatches were the only significant determinant of the said sensitivity amongst the set of all owner-specific financial ratios. To further ascertain that it is owners' maturity mismatches, and not any other characteristic such as profitability, capital adequacy or loan quality, that is the principal channel through which term premium shocks are transmitted to bank lending, I conduct a propensity score matching analysis. To do so, I first estimate the following equation to obtain banks' lending sensitivity to the term premium shock.

$$l^g_{i,t} = \textstyle\sum_{k=1}^{8} \beta^m_{i,k} tp_{t-k} + \varepsilon^m_{i,t} \tag{8}$$

where $l^g_{i,t}$ represents the quarterly lending growth rate of bank i, and tp_t is the baseline measure of the term premium shock described above.

After estimating $\beta^m_{i,k}$ for each bank, I approximate the overall lending sensitivity of bank i to the term premium as the sum of the coefficients $tps_i = \sum_{k=1}^{8} \hat{\beta}^m_{i,k}$. If the coefficients are jointly insignificant for a given bank, I initially set the overall term premium sensitivity of this bank's lending to zero. I also follow an alternative strategy in the second stage of the analysis.

Next, I use tps_i as the outcome variable in a logistic treatment propensity score matching model. In this model, the treatment variable is constructed by using bank owners' average maturity mismatches (the difference between banks' assets and liabilities with a maturity greater than 1 year divided by total assets) in the sample period. The treatment variable is assigned a value of one if a bank's maturity mismatch ratio is above the sample average and zero otherwise. In the model, the average profitability, asset quality and capital adequacy of bank i's owner are incorporated as the variables that predict the treatment assignment. Simply put, I measure the impact of maturity mismatches on the term premium sensitivity of banks' lending across banks whose owners are similar in terms of profitability, asset quality and capital adequacy.

The average treatment effects that I obtain are displayed in Table 8. The coefficient value of 0.0213 in the first row can be interpreted as follows: In response to a 1 percentage point increase in the term premium in the previous 8 quarters, the lending growth rate of banks with high maturity mismatches, the treatment group, is roughly 2 percent more than the lending growth rate of banks with low maturity mismatches. This is a substantial disparity between the two groups as the average sensitivity to the term premium is 0.4 percent across banks exhibiting a significant degree of sensitivity.

In the baseline estimation, I assigned a value of zero to tps if bank loans were not significantly related to the term premium. Alternatively, I omit these observations in the second stage of the methodology that measures average treatment effects. Doing so, as reported in the second row of Table 8, reveals a larger disparity between the term premium sensitivity of high and low maturity mismatch banks. I similarly find larger treatment effects when I use tighter thresholds to distinguish between owners with high and low maturity mismatches. Specifically, allocating owners whose maturity mismatches are in the top and bottom 40 and 33.3 percent in the two groups, respectively, yields higher average treatment effects. The results, however, are not driven by outliers as I obtain similar results by omitting observations for tps_i that are more than 3 standard deviations away from the mean.[4]

In line with earlier inferences, further tests show that it is the owners' maturity mismatches and not those of banks that significantly impact the term premium sensitivity of lending, and that maturity mismatches is the only owner-specific characteristic that is significantly related to the said sensitivity. These results are displayed in the last 4 rows of the table. To obtain the latter set of results, I use profitability, asset quality and capital adequacy ratios to classify banks whose owners are in the high and low ratio groups. In so doing and when using bank-specific maturity

[4] I tried various other cutoffs and I omitted outliers in terms of maturity mismatches and obtained quantitatively and qualitatively similar results.

mismatches, I populate the treatment group with ratios above the sample average.

5.2 Term premium sensitivity after an increase in maturity mismatches

While the propensity score matching exercise effectively identifies the unique effects of maturity mismatches, it uses average levels of maturity mismatches across the whole sample in doing so. By design, this methodology does not allow one to capture the evolution of the lending sensitivity as banks transition from a low maturity mismatch state to a high maturity mismatch state. In this section, I conduct an alternative test that captures this transition.

To conduct the analysis, I first split the sample period into two equal time periods, 2011:Q1-2017:Q1 and 2017:Q2-2023:Q2. I then measure owners' average maturity mismatches in the two subsamples. Next, I identify owners that have higher mismatches in the latter period and estimate the following equation by restricting the sample to the subsidiaries of these owners:

$$\begin{aligned}\tilde{l}^{g}_{i,t} &= \textstyle\sum_{k=1}^{8}\alpha^{f}_{k}\tilde{l}^{g}_{i,t-k} + \sum_{k=1}^{8}\beta^{f}_{k}tp_{t-k} + \sum_{k=1}^{8}\gamma^{f}_{k}\widetilde{mm}_{i,t-k} + \sum_{k=1}^{8}\lambda^{f}_{k}\widetilde{mm}_{i,t-k} * tp_{t-k} \\ &+ \textstyle\sum_{k=1}^{8}\mu^{f}_{k}D^{p}\widetilde{mm}_{i,t-k} * tp_{t-k} + \sum_{k=1}^{8}\psi^{f}_{k}\Delta i^{s}_{t-k} + \sum_{k=1}^{8}\chi^{f}_{k}\left[\Delta E\left(i^{l}_{t-k}\right) - \Delta i^{s}_{t-k}\right] + \varepsilon_{i,t}\end{aligned} \tag{9}$$

where D^{p} is a period dummy is set equal to one for the 2017:Q2-2023:Q2 period. It should be noted here that when measuring the variables in deviation form, I use the whole sample not just owners that have reported higher maturity mismatches in 2017:Q2-2023:Q2.

The coefficients μ^{f}_{k} in the model determine whether the interaction between maturity mismatches in the second half of the sample period is weaker or stronger. The results reported in Table 9 provide evidence for the latter effect. While the coefficients of the interactive variable is positive and significant for the whole sample period as reported in the first two columns, the results in the last two columns indicate that this interaction is more strongly related to lending in general, increasing more than twofold, in the second half of the sample during which banks' owners have higher maturity mismatches. In other words, the impact of an owner's maturity mismatches on the term premium sensitivity of its subsidiaries' lending grows with the degree of the owners' maturity mismatches. This result is mostly robust as I find a similar amplification mechanism when I use alternative definitions of the term premium and maturity mismatches as listed in the table.

I also find a similar result, reported in the last of the table, when I account for other owner characteristics. To conduct this exercise, I measure the average maturity mismatches, profitability, asset quality and capital adequacy ratios in the two sample periods. I then keep the observations for owners that have a maturity mismatch ratio one standard deviation higher than the sample average in the second half of the sample period but also have profitability, asset quality, and capital adequacy ratios within one standard deviation band of the corresponding sample averages in both subperiods. Simply put, I identify owners that are characterized by higher maturity mismatches but relatively stable profitability, asset quality and capital adequacy in the second half of the sample, and detect a higher lending sensitivity to term premium in the second half of the sample for the subsidiaries of these owners.

5.3 Forecasting bank lending

Panel estimations reveal a stronger relationship between bank lending and term premium and policy shocks for the subsidiaries of BHCs with greater maturity mismatches. Can this stronger relationship be leveraged to improve the accuracy of bank lending forecasts? In this section, I search for the answer to this question by using a random forest machine learning algorithm to separately predict the lending growth rates of subsidiaries of BHCs with high and low maturity mismatches. The main reason I choose a random forest algorithm is that it does a better job of handling unbalanced panels with missing data. It's also a preferred method for forecasting in the literature due to the relatively stable forecasts that it produces and since it reduced overfitting.

To conduct this analysis, I use the first half of the sample period as the training period and banks' lending growth as the dependent variable. For the baseline analysis, I use the Bu, Rogers and Wu (2021) and Phillot (2025) monetary and fiscal shock series, the term premium shock, the short-term rate and the expected term premium, shadow rate, and owners' and banks' profitability, asset quality and capital adequacy ratios as the independent variables. To determine the significance of owners' maturity mismatches for forecasting accuracy, I first classify banks into high and low maturity mismatch categories in each quarter if their owner is in the top and bottom 50th percentile of the maturity mismatch distribution in that quarter. Here, I similarly use the difference between owners' assets and liabilities with a maturity greater than 1 year divided by total assets to capture maturity mismatches. I then apply the random forest algorithm separately to these two groups of banks to obtain lending growth forecasts for the second half of the sample period.[5] Finally, I summarize and compare the accuracy of forecasts by computing following root mean squared error statistic:

$$rmse = \left[\sum_{t=1}^{T}\sum_{i=1}^{N}\left(l_{i,t} - l_{i,t}^{f}\right)\right]^{1/2} \tag{10}$$

where $l_{i,t}$ and $l_{i,t}^{f}$ represent bank i's lending growth in quarter t and its forecasted value, respectively.

The results, reported in Table 10, indicate a higher forecasting accuracy for the lending growth rate of banks whose owners have higher maturity mismatches. This inference, robust to different measures of maturity mismatches and the term premium and also to using an alternative specification that excludes monetary and fiscal shocks from the set of independent variables, is consistent with my earlier findings. Specifically, given that economic shocks are more important drivers of lending for banks whose owners have high maturity mismatches, supervised machine learning algorithms that include these shocks do a better job of forecasting lending growth for these banks.

6 Concluding remarks

My results demonstrated that the transmission of term premium shocks to the real economy are strengthened by the degree of maturity mismatches on bank holding company balance sheets. Using a large number of bank-level observations and linking banks to their owners, I find that banks' whose owners have greater shares of long-term assets and short-term liabilities exhibit a relatively faster (slower) lending growth in response to a positive (negative) shock to the term premium. By contrast, the maturity mismatches of banks are not significantly related the term premium sensitivity of their lending growth. These inferences for the term premium sensitivity of

[5] Following common practice, I set the number of trees to 100, the number of independent variables at each split to the square root of the number of independent variables, the depth to 0 and the minimum number of observations at each leaf node to 1.

lending supply are drawn by applying a unique methodology that accounts for and suppresses the simultaneous demand side effects of term premium shocks. Without this methodology, I find that the inferences are reversed and that banks with higher maturity mismatches are less sensitive to term premium shocks. The disparity in the results highlights the importance of separating the supply and demand side effects of term premium shocks and it is consistent with the greater capability of bank holding companies to diversify the demand side effects of term premium shocks. Using further analysis, I demonstrate that it is bank holding companies' maturity mismatches and not any other bank holding company or bank specific characteristic that is significantly related to the transmission of term premium shocks.

Exploring the policy implications of the results, I find evidence that the channels of transmission identified in my analysis could strengthen the impact of monetary and fiscal shocks on the real economy. I first use several VAR and local projections models to illustrate that term premiums decrease and increase in response to a monetary tightening and a long-term bond financed fiscal expansion, respectively. I then incorporate monetary and fiscal shocks into my panel model and find that the effects of these shocks on bank lending are amplified through the maturity mismatches of BHCs. Consistent with these and earlier results, a random forest supervised learning algorithm produced more accurate lending growth forecasts for banks' whose owners have high maturity mismatches.

The findings in this paper have critical implications for the stability of financial markets as any systematic shock, including but not limited to policy shocks, that impacts long-term economic risk manifests itself through the term premium. The strong link that I identify between term premium sensitivity of bank lending and the maturity mismatches of BHCs (and not those of their subsidiaries) then warrants a closer monitoring of these mismatches at the BHC level for ensuring financial and economic stability.

There are several natural directions that can be taken by future research. Some of the bank holding companies in my sample are considerably larger then the rest and are classified as globally active. It would be informative to measure the responsiveness of these banks (their subsidiaries in particular) to changes in US term premium shocks and compare this responsiveness with more locally active BHCs. In so doing, measuring and comparing the effects of the term premia on other international assets could have implications for the international transmission of shocks and financial integration. In my paper the focus is on the real economy. Alternatively, one could use bank stock returns instead of bank lending to determine whether the relationship that we identify between maturity mismatches and term premium shocks have any implications for asset pricing and portfolio management. It would also be interesting to incorporate BHC maturity mismatches into structural models of monetary transmission to determine the contribution of these mismatches to the macroeconomic effects of monetary policy shocks. Specifically, dynamic stochastic general equilibrium models with and without maturity mismatches and portfolio balancing effects (allowing for term premia) can be estimated to infer the share of monetary policy shocks' contribution to output volatility that can be attributed to the endogenous amplification through maturity mismatches. Finally, it is necessary to complete the picture by also identifying and quantifying the transmission of term premium shocks through the demand side of the loanable funds market. The methodology in this paper provides a useful setup for future research along this path. Specifically, one can reverse the methodology and compare the lending behavior of BHCs' subsidiaries operating in different states to determine how term premium shocks impact bank lending through their effects on borrowers' financial strength.

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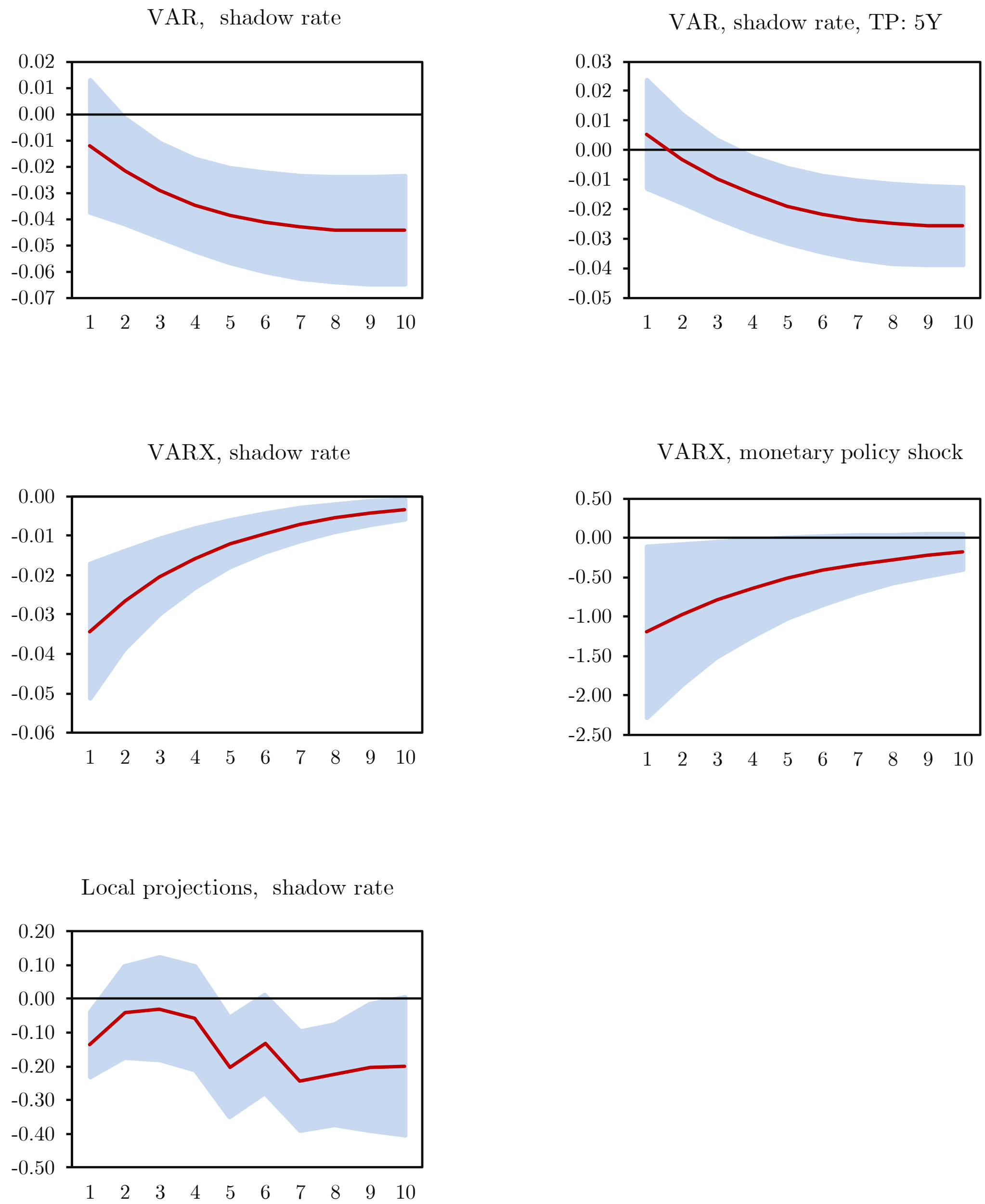
Appendix A. Data

Table A.1. Data descriptions

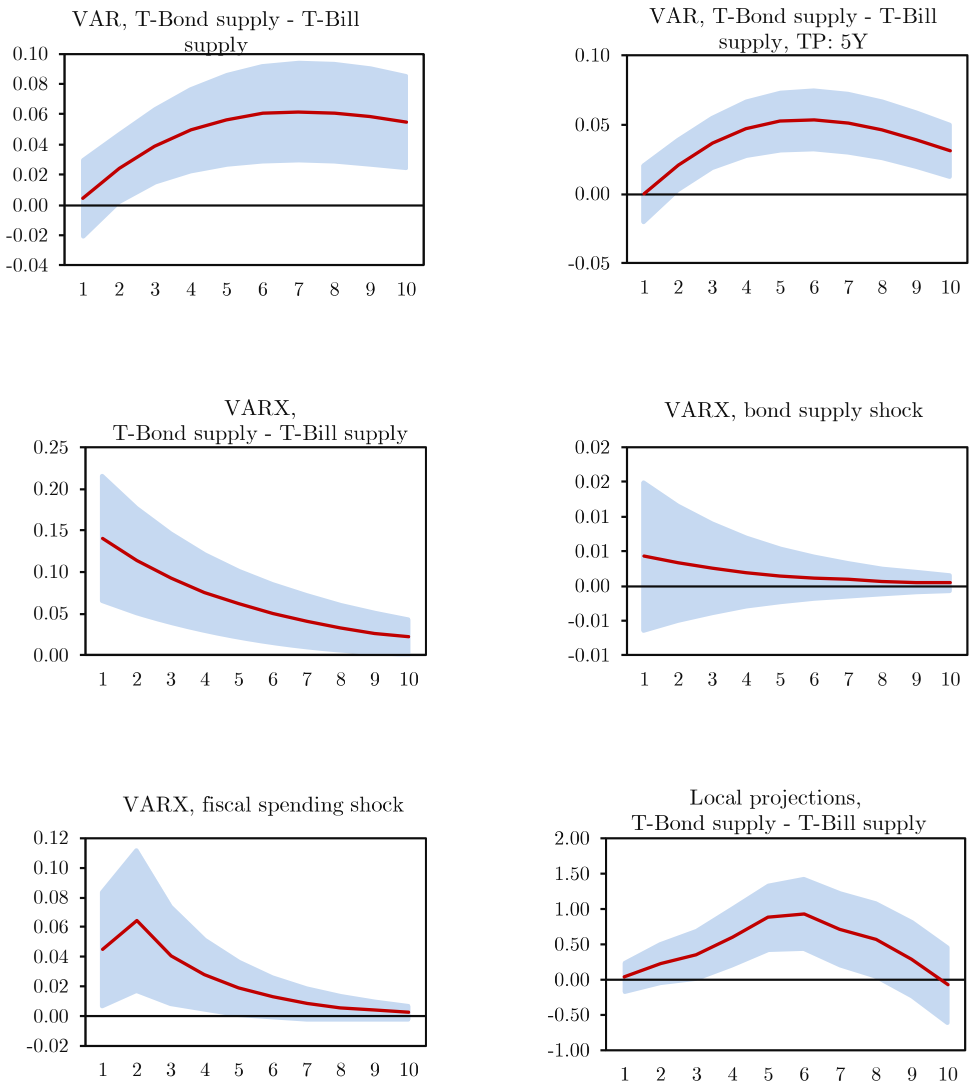
	Variable	Acronym	Description
Bank level data			
	Bank ID	RSSD9001	The primary identifier of a bank.
	Date	RSSD9999	The quarter for which the report was filed.
	Bank type	RSSD9331	A two-digit code indicating the type of entity. This is used to identify commercial banks.
	Primary Insurer	RSSD9424	A code indicating the highest level of deposit-related insurance of the head office of a U.S. depository institution or U.S. branch of a foreign bank. This is used to determine whether a bank is insured or not.
	BHC Affiliation	RSSD9348	The five-digit code assigned to the principle holding company or the highest holding company in a tiered organization.
	State	RSSD9210	A two-digit code assigned to a state of the United States or a U. S. territory in which the entity is physically located or its mailing address.
	Loans	UBPRE024	Loans and lease-financing receivables net of unearned income and the allowance for possible loan and lease financing receivable losses divided by total assets. I multiply this ratio with total assets to obtain our measure of loans.
	Total assets	UBPRD659	A year-to-date average of the average assets reported in the Call Report Schedule RC-K. We obtain a quarterly measure of total assets from this measure as follows: First quarter's average assets is the same as total assets. For quarter 2, we multiply the reported average assets for this quarter by 2 and subtract total assets in quarter 1. I similarly multiply average assets in quarter 3 by 3 and subtract the sum of total assets in quarter 1 and quarter 2 to obtain total assets in quarter 3. I follow a similar methodology to obtain total assets in quarter 4.
	Net interest income to assets ratio	(UBPRE003* UBPRD569) / Total assets	Total interest income, plus the tax benefit on tax-exempt income, less total interest expense, divided by total assets. UBPRE003 is net interest income divided by average assets. I multiply this ratio by average assets and then divide by our measure of total assets.
	Loan charge-offs to assets ratio	(UBPRE019*Average loans) / Total assets	Gross loan and lease charge-off, less gross recoveries (includes allocated transfer risk reserve charge-off and recoveries), divided by average total assets. UBPRE019 is net loan charge-offs divided by average loans. I multiply this ratio by average loans and then divide by our measure of total assets.
	Maturity mismathes, 1 year	UBPRE575	Loans/Securities over one year less liabilities over one year divided by assets.
	Maturity mismathes, 3 years	UBPRE572	Loans/Securities over three years less liabilities over three years divided by assets.
	Current ratio	Deposits / Short-term assets	I divide loans by UBPRE600 (loans as a percent of total deposits) to obtain deposits. Short-term assets are measured as the difference between total assets and long-term assets. The latter is computed as UBPRE576 (demand deposits to total assets ratio) divided by UBPRE577 (demand deposits to long-term assets ratio) and multiplied by total assets.
Macroeconomic data			
	Term premium shock		Kim and Wright (2005) term premium shock obtained from a three-factor term structure model, representing shock to the slope of the yield curve (spread between the yield of a 10-year US Treasury bond and a 3-month US Treasury bill in our baseline estimations).
	Expected term premium		Average expected future T-bill rates over the maturity horizon of the long-term Treasury bond minus the current T-bill rate.
	Short-term rates		T-bill rates in our baseline estimations.
	Shadow rate		Wu and Xia (2016) shadow rate capturing the monetary policy stance at the zero lower bound.
	Fiscal spending shock		Ramey (2011) news shock series.
	Bond supply shock		Phillot (2025) US Treasury bond supply shock series.
	Monetary policy shock		Bu, Rogers and Wu (2021) FOMC announcement shock series.

Figure 1. Term premium response to monetary impulses



Notes: Impulse responses displayed in the first four graphs are obtained from a VAR model with the term premium and the monetary policy measure. The Kim and Wright (2005) measure of the term premium between 10-year and 2-year Treasury bond yields is the baseline measure of the term premium. In the VAR-X model the monetary policy shock variable is treated as an exogenous variable. The shadow rate is the monetary policy measure of Wu and Xia (2016). The impulse responses in the last graph are obtained by using the local projections method of Jorda (2005).

Figure 2. Term premium response to fiscal impulses



Notes: Notes: Impulse responses displayed in the first five graphs are obtained from a VAR model that includes the term premium and the relative supply of long-term bond supply. The latter is measured as the difference between the growth rates of Treasury bonds and Treasury bills. The Kim and Wright (2005) measure of the term premium between 10-year and 2-year Treasury bond yields is the baseline measure of the term premium. In the VAR-X models the relative supply of long-term Treasury securities and the Phillot (2025) bond supply shock series are treated as exogenous variables. Fiscal spending shocks are represented by the Ramey (2011) news shock series. The impulse responses in the last graph are obtained by using the local projections method of Jorda (2005).

Table 1. Descriptive statistics

Variables used in the estimation	Mean	Std. deviation
Term premium		
10-Year Minus 2-Year Treasury (Constant Maturity)	-0.069	0.384
Term Premium on a 5 Year Zero Coupon Bond	-0.180	0.272
Term Premium on a 3 Year Zero Coupon Bond	-0.132	0.219
Instantaneous Forward Term Premium 5 Years Hence	-0.213	0.438
Instantaneous Forward Term Premium 3 Years Hence	-0.259	0.331
Lending growth rate	0.015	0.103
Maturity mismatches		
Loans/Securities $>$ 1 year minus liabilities $>$ 1 year	0.498	0.140
Loans/Securities $>$ 3 years minus liabilities $>$ 3 years	0.387	0.143
Current ratio	0.701	0.181
Profitability	0.034	0.007
Asset quality	0.229	2.336
Capital adequacy	0.031	0.042
Other descriptive statistics		
Number of unique banks	5,536	
Number of unique owners	567.0	
Average # of banks per quarter	579.1	
Average # of BHCs per quarter	232.8	
Average # of banks per state, per quarter	14.9	
With different owners	7.6	
Average # of subsidiaries	2.7	
Average ratio of assets (banks/owners)	0.031	
Average ratio of assets (banks without owners / banks with owners)	0.053	

Notes: Term premium and forward term premium series are from Kim and Wright (2005). The current ratio is measured as the short-term assets to deposits ratio. Profitability, asset quality, and capital adequacy are represented by the net interest income to assets, gross-loan-and-lease-charge-offs (less gross recoveries) to assets, and tier 1 capital to assets ratios. Number of unique banks and owners are obtained by considering the whole sample period.

Table 2. Maturity mismatches, term premium and bank lending: Common methodologies

				Different maturities - long term bonds			Shadow rates	
	Term spread	Term premium	Forward rates	5-year	7-year	9-year	Term spread	Term premium
Maturity mismatch	0.2249	0.2140	0.2116	0.2138	0.2124	0.2118	0.2001	0.1984
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
TSV	1.3862	0.7186	0.4963	0.3528	0.3910	0.4557	2.3161	0.6730
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Maturity mismatch * TSV	-0.1275	-0.0416	-0.0731	-0.0356	-0.0704	-0.0740	-0.0736	-0.0354
	(0.000)***	(0.003)***	(0.000)***	(0.001)***	(0.000)***	(0.000)***	(0.000)***	(0.091)*
Lagged dependent variables	-0.0447	-0.0446	-0.0446	-0.0446	-0.0446	-0.0446	-0.0451	-0.0454
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Expected term premium		-0.3780	-0.3050	-0.1706	-0.2038	-0.2658		-0.3302
		(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***		(0.000)***
Short-term interest rates		-0.2546	-0.2814	-0.1389	-0.1789	-0.2422		-0.3058
		(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***		(0.000)***
# of observations	217,206	217,206	217,206	217,206	217,206	217,206	196,745	196,745
AR2 test	0.6665	0.7554	0.7715	0.7701	0.7712	0.7714	0.8159	0.8703

Notes: Maturity mismatches are measured as the difference between banks' assets and liabilities that have a maturity greater than 1 year as a fraction of their total assets. Term spread is measured as the difference between the yields of 10 year and 2 year, constant maturity U.S. Treasury Securities. TSV in the table represents the term structure variable (term spread or the term premium). Term premia, both instantaneous and forward rates, are from Kim and Wright (2005). The shadow rate is the monetary policy measure of Wu and Xia (2016). I use this rate instead of the short-term security yield to construct the term structure variable and obtain the results in the last two columns. *, **, *** significant at 10%, 5%, 1%, respectively. The numbers reported in parentheses are the p-values obtained from tests of joint significance. The statistics reported for the AR2 tests are also the p-values.

Table 3. BHCs' maturity mismatches, term premium and bank lending

	Baseline	Maturity mismatches, 3 years	Current ratio	Broader model
Maturity mismatch	0.5781	0.8796	3.6005	0.5372
	(0.001)***	(0.066)*	(0.000)***	(0.006)***
TP	1.0765	1.3483	1.8942	0.4978
	(0.014)**	(0.035)**	(0.007)***	(0.029)**
Maturity mismatch * TP	0.5196	0.1880	1.2377	0.4423
	(0.000)***	(0.000)***	(0.002)***	(0.006)***
Lagged dependent variables	-5.6664	-5.7079	-5.5702	-5.6237
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Expected term premium	-0.6033	-0.7372	-1.0031	-0.3165
	(0.015)**	(0.032)**	(0.007)***	(0.025)**
Short-term interest rates	-0.4309	-0.5361	-0.7205	-0.2466
	(0.035)**	(0.060)*	(0.010)**	(0.039)**
Profitability				0.0203
				(0.340)
Loan quality				-0.0008
				(0.914)
Capital Adequacy				-0.4437
				(0.984)
# of observations	2,900	2,900	2,900	2,900
Hansen statistic	(127.772)***	(127.602)***	(129.293)***	(112.980)***
AR2 test	0.9121	0.9763	0.9734	0.8999

Notes: The results are obtained by using the methodology to suppress the demand side effects of term premium shocks. The baseline measure for maturity mismatches is the difference between banks' assets and liabilities that have a maturity greater than 1 year as a fraction of their total assets. The current ratio is measured as the short-term assets to deposits ratio. TP represents the Kim and Wright (2005) term premium between the yields of 10 year and 2 year Treasury securities. Profitability, asset quality, and capital adequacy are represented by BHCs' net interest income to assets, gross-loan-and-lease-charge-offs (less gross recoveries) to assets, and tier 1 capital to assets ratios. *, **, *** significant at 10%, 5%, 1%, respectively. The numbers reported in parentheses are the p-values obtained from tests of joint significance. The statistics reported for the Hansen and AR2 tests are the p-values and z-values, respectively.

Table 4. Different maturities

		Different maturities - Long term bonds		Instantenous forward rates		
	Baseline	5-year	7-year	5-year	7-year	10-year
Maturity mismatch	0.5372	0.4841	0.4996	0.5416	0.5709	0.5739
	(0.006)***	(0.019)**	(0.009)***	(0.002)***	(0.002)***	(0.001)***
TP	0.4978	2.3744	1.0318	0.2743	0.5769	1.0776
	(0.029)**	(0.027)**	(0.015)**	(0.009)***	(0.023)**	(0.044)**
Maturity mismatch * TP	0.4423	0.8326	0.5618	0.4347	0.3364	0.3071
	(0.006)***	(0.001)***	(0.001)***	(0.010)**	(0.006)***	(0.001)***
Lagged dependent variables	-5.6237	-5.6218	-5.6337	-5.6022	-5.6876	-5.6439
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Expected term premium	-0.3165	-1.1965	-0.5602	-0.1692	-0.3376	-0.6970
	(0.025)**	(0.020)**	(0.009)***	(0.008)***	(0.027)**	(0.051)*
Short-term interest rates	-0.2466	-0.5974	-0.3627	-0.1802	-0.3472	-0.6942
	(0.039)**	(0.020)**	(0.010)**	(0.050)*	(0.095)*	(0.111)
Profitability	0.0203	0.0101	0.0186	0.0129	0.0179	0.0213
	(0.340)	(0.242)	(0.270)	(0.331)	(0.365)	(0.440)
Loan quality	-0.0008	-0.0009	-0.0009	-0.0009	-0.0008	-0.0010
	(0.914)	(0.880)	(0.853)	(0.859)	(0.889)	(0.812)
Capital Adequacy	-0.4437	-0.2725	-0.4367	-0.4478	-0.4192	-0.4143
	(0.984)	(0.970)	(0.981)	(0.988)	(0.986)	(0.979)
# of observations	2,900	2,900	2,900	2,900	2,900	2,900
Hansen statistic	(112.980)***	(108.280)***	(117.822)***	(116.098)***	(115.822)***	(113.835)***
AR2 test	0.8999	0.8944	0.9213	0.9026	0.8776	0.8178

Notes: The results are obtained by using the methodology to suppress the demand side effects of term premium shocks. Maturity mismatches are measured as the difference between BHCs' assets and liabilities that have a maturity greater than 1 year as a fraction of their total assets. TP represents the Kim and Wright (2005) term premia measured at the different maturities and forms as displayed in the column headers. Profitability, asset quality, and capital adequacy are represented by BHCs' net interest income to assets, gross-loan-and-lease-charge-offs (less gross recoveries) to assets, and tier 1 capital to assets ratios. *, **, *** significant at 10%, 5%, 1%, respectively. The numbers reported in parentheses are the p-values obtained from tests of joint significance. The statistics reported for the Hansen and AR2 tests are the p-values and z-values, respectively.

Table 5. Banks' maturity mismatches, term premium and bank lending

	Baseline, BHC maturity mismatches	Maturity mismatches		Long term bond maturity		Forward rates	
		1 year	3 years	5 years	7 years	5 years	7 years
Maturity mismatch	0.5372	0.2651	0.2366	0.2596	0.2714	0.2435	0.2488
	(0.006)***	(0.157)	(0.127)	(0.188)	(0.172)	(0.148)	(0.171)
TP	0.4978	1.1362	1.2666	0.5431	1.1168	0.7522	0.8735
	(0.029)**	(0.349)	(0.319)	(0.235)	(0.230)	(0.381)	(0.451)
Maturity mismatch * TP	0.4423	-0.0906	0.0404	-0.4276	-0.2309	-0.0859	0.0552
	(0.006)***	(0.463)	(0.621)	(0.499)	(0.534)	(0.393)	(0.537)
Lagged dependent variables	-5.6237	-6.4393	-6.4098	-6.3878	-6.4307	-6.4262	-6.4099
	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Expected term premium	-0.3165	-0.5632	-0.6272	-0.2375	-0.5069	-0.3183	-0.4363
	(0.025)**	(0.336)	(0.303)	(0.183)	(0.188)	(0.360)	(0.433)
Short-term interest rates	-0.2466	-0.3482	-0.3817	-0.0802	-0.2639	-0.2226	-0.3474
	(0.039)***	(0.452)	(0.410)	(0.275)	(0.291)	(0.491)	(0.645)
Profitability	0.0203	0.0039	0.0107	0.0045	0.0031	0.0006	0.0032
	(0.340)	(0.056)*	(0.125)	(0.123)	(0.092)*	(0.071)*	(0.093)*
Loan quality	-0.0008	-0.0003	-0.0003	-0.0004	-0.0003	-0.0004	-0.0003
	(0.914)	(0.023)**	(0.018)**	(0.032)**	(0.022)**	(0.047)**	(0.042)**
Capital Adequacy	-0.4437	-2.4547	-2.3411	-2.5432	-2.5128	-2.3852	-2.3779
	(0.984)	(0.014)**	(0.022)**	(0.010)**	(0.018)**	(0.021)**	(0.019)**
# of observations	2,900	2,770	2,770	2,770	2,770	2,770	2,770
Hansen statistic	(112.980)***	(201.687)***	(202.663)***	(203.252)***	(204.423)***	(201.222)***	(205.934)***
AR2 test	0.8999	0.7213	0.7071	0.6922	0.7125	0.7390	0.6956

Notes: The results are obtained by using the methodology to suppress the demand side effects of term premium shocks but using bank-specific variables instead of BHC specific variables. Maturity mismatches are measured as the difference between banks' assets and liabilities that have a maturity greater than 1 year as a fraction of their total assets. TP represents the Kim and Wright (2005) term premia measured at the different maturities and forms. Profitability, asset quality, and capital adequacy are represented by banks' net interest income to assets, gross-loan-and-lease-charge-offs (less gross recoveries) to assets, and tier 1 capital to assets ratios. *, **, *** significant at 10%, 5%, 1%, respectively. The numbers reported in parentheses are the p-values obtained from tests of joint significance. The statistics reported for the Hansen and AR2 tests are the p-values and z-values, respectively.

Table 6. Other owner-specific variables and term premium sensitivity

	Baseline (Maturity mismatches)	Profitability	Loan quality	Capital Adequacy
Owner specific variable	0.5372	1.4421	-0.0506	-0.6463
	(0.006)***	(0.325)	(0.923)	(0.730)
TP	0.4978	0.9578	1.3598	1.4148
	(0.029)**	(0.045)**	(0.007)***	(0.153)
Owner specific variable * TP	0.4423	-18.6992	-0.7234	-4.2560
	(0.006)***	(0.827)	(0.486)	(0.517)
Lagged dependent variables	-5.6237	-5.7217	-5.6715	-5.5998
	(0.000)***	(0.000)***	(0.000)***	(0.000)***
Expected term premium	-0.3165	-0.5705	-0.7685	-0.7672
	(0.025)**	(0.042)**	(0.006)***	(0.148)
Short-term interest rates	-0.2466	-0.4272	-0.5684	-0.5827
	(0.039)**	(0.074)*	(0.020)**	(0.186)
Maturity mismatches		0.0052	0.0044	0.0041
		(0.002)***	(0.006)***	(0.001)***
Profitability	0.0203		0.0045	0.0145
	(0.340)		(0.304)	(0.258)
Loan quality	-0.0008	-0.0008		-0.0008
	(0.914)	(0.759)		(0.534)
Capital Adequacy	-0.4437	-0.2497	-0.2113	
	(0.984)	(0.824)	(0.828)	
# of observations	2,900	2,900	2,900	2,900
Hansen statistic	(112.980)***	(115.288)***	(126.272)	(113.383)***
AR2 test	0.8999	0.8532	0.9263	0.7502

Notes: The results are obtained by using the methodology to suppress the demand side effects of term premium shocks but switching maturity mismatches with the characteristics in columns 2 to 4 in the estimations. Maturity mismatches are measured as the difference between BHCs' assets and liabilities that have a maturity greater than 1 year as a fraction of their total assets. TP represents the Kim and Wright (2005) term premia measured at the different maturities and forms. Profitability, asset quality, and capital adequacy are represented by banks' net interest income to assets, gross-loan-and-lease-charge-offs (less gross recoveries) to assets, and tier 1 capital to assets ratios. *, **, *** significant at 10%, 5%, 1%, respectively. The numbers reported in parentheses are the p-values obtained from tests of joint significance. The statistics reported for the Hansen and AR2 tests are the p-values and z-values, respectively.

Table 7. Monetary policy transmission

Panel A: Monetary Policy	Maturity mismatch		Maturity mismatch * MP		*Panel B: Fiscal Policy* Maturity mismatch		Maturity mismatch * FP	
Baseline	0.0056	(0.005)***	-0.0901	(0.029)**	0.5485	(0.748)	0.011	(0.014)**
Federal funds rate	0.0545	(0.085)*	-0.0838	(0.001)***				
Fiscal spending shock					1.3332	(0.054)*	0.0054	(0.021)**
Maturity mismatches, 3 years	0.0004	(0.204)	-0.0307	(0.082)*	0.9026	(0.425)	0.0068	(0.006)***
Banks' maturity mismatches	0.2502	(0.000)***	0.1839	(0.001)***	0.1052	(0.009)***	-0.0623	(0.031)**

Notes: The results are obtained by using the methodology to suppress the demand side effects of policy shocks. Maturity mismatches are measured as the difference between BHCs' assets and liabilities that have a maturity greater than 1 year as a fraction of their total assets. To obtain the results in the last row of the table, I use banks' maturity mismatches instead of BHC' maturity mismatches. MP and FP represent the monetary and fiscal policy measures, respectively. For the baseline estimations, I use the Bu, Rogers and Wu (2021) and Phillot (2025) measures to capture monetary and fiscal policy shocks, respectively. The alternative fiscal spending shock measures is the Ramey (2011) news shock series. *, **, *** significant at 10%, 5%, 1%, respectively. The numbers reported in parentheses are the p-values obtained from tests of joint significance.

Table 8. Propensity Score Matching

	Average treatment effect	
Baseline	0.02064	(0.013)**
Dropping firms with insignificant term premium sensitivity	0.11588	(0.009)***
Dropping outliers (3-standard deviation)	0.02501	(0.008)***
Top 40% versus bottom 40%	0.08937	(0.046)**
Top third versus bottom third	0.09117	(0.051)*
Treatment variable: Banks' maturity mismatches	-0.0028	(0.454)
Treatment variable: Owners' net interest income	0.01122	(0.259)
Treatment variable: Owners' asset quality	-0.0063	(0.502)
Treatment variable: Owners' capital adequacy	-0.0012	(0.749)

Notes: The results are obtained by using a two-step propensity score matching exercise. In the first stage, banks' lending sensitivity to term premium shocks are measures. In the second stage, these estimated sensitivities are used as an outcome variable in a logistic treatment propensity score matching exercise that uses BHCs' maturity mismatches as the treatment variable. Maturity mismatches are measured as the difference between BHCs' assets and liabilities that have a maturity greater than 1 year as a fraction of their total assets. Profitability, asset quality, and capital adequacy are represented by banks' net interest income to assets, gross-loan-and-lease-charge-offs (less gross recoveries) to assets, and tier 1 capital to assets ratios. The term premium measure used in the first stage is the Kim and Wright (2005) term premium between the yields of 10 year and 2 year Treasury securities. The numbers reported in the table are the estimated treatment effects and their significance. Positive coefficients imply a higher sensitivity to term premium shocks when maturity mismatches are higher. *, **, *** significant at 10%, 5%, 1%, respectively.

Table 9. Sensitivity to the term premium following an increase in maturity mismatches

	Term Premium * Maturity Mismatches		Term Premium * Maturity Mismatches * D^p	
Baseline model	0.4423	(0.006)***		
Owners with an increase in maturity mismatches	0.7651	(0.016)***	0.948	(0.071)*
Maturity mismatches : 3 years	0.6913	(0.001)***	0.8378	(0.017)**
Current ratio	0.7923	(0.000)***	0.1454	(0.165)
Long term bond maturity : 5 years	1.8813	(0.006)***	0.3075	(0.027)**
Forward rates : 5 years	0.7529	(0.013)**	0.9013	(0.046)**
Controlling for other factors	0.793	(0.011)**	0.5439	(0.052)*

Notes: This table reports the results obtained from estimations of equation (9). D^p is a dummy variable indicating whether a BHC has reported higher maturity mismatches in the second half of the sample period. To obtain the results, other than those in row 1, I restrict the sample to BHCs who reported an increase in maturity mismatches in the second half of the sample period. To obtain the results in the last row I further restricted the sample to BHCs that have relatively stable characteristics across the two periods otherwise. The results are similarly obtained by using the methodology to suppress the demand side effects of policy shocks. Maturity mismatches are measured as the difference between BHCs' assets and liabilities that have a maturity greater than 1 year as a fraction of their total assets. The baseline measure of the term premium is the Kim and Wright (2005) term premium between the yields of 10 year and 2 year Treasury securities. The current ratio is measured as the short-term assets to deposits ratio. *, **, *** significant at 10%, 5%, 1%, respectively. The numbers reported in parentheses are the p-values obtained from tests of joint significance

Table 10. Forecasting accuracy

	Root Mean Squared Error	
	High maturity mismatch	Low maturity mismatch
Baseline	10.454	14.337
Maturity mismatches, 3 years	11.229	15.101
5 year bonds	10.603	14.272
Forward rates	10.417	14.921
Without policy shocks	10.612	16.158

Notes: The table shows the root mean squared errors measured across both banks and time after computing the lending growth rate forecasts by using a random forest algorithm. High and low maturity mismatch categories include banks whose owners are in the top and bottom 50^{th} percentile of the maturity mismatch distribution in a given quarter. 5-year bonds and forwards rates refer to the two alternative measures of the term premium. For the forward rate, I use a 10-year Treasury bond. To obtain the results in the last row, I exclude the Bu, Rogers and Wu (2021) and Phillot (2025) monetary and fiscal shock series from the set of independent variables.