The Federal Reserve's Unconventional Policies and Bank Balance Sheets

HONG, SIZHE

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By
Sizhe Hong

Completed under the Supervision of:
Dr Nikos Paltalidis
And
Prof. Dennis Philip

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Abstract

In this thesis, we investigate how unconventional monetary policy affects banking and its transmission through bank lending using the data from US market. The thesis is comprised of three main studies as follows.

The first study suggests that forward guidance, via publicly committing the central bank to future actions and creating associated expectations, fundamentally affects bank-lending decisions independently of other forms of monetary policy. To test this hypothesis, we build a forward guidance measure based on the language used in the Federal Open Market Committee meetings and match this measure with syndicated loans. Our results show that expansionary forward guidance decreases corporate loan spreads and that this effect is stronger for well-capitalized banks lending to riskier firms. The results support a risk-taking channel of unconventional monetary policy.

The second study examines the effect of Odyssean forward guidance on the establishment of new borrower-lender relationship and syndication structure. Using a narrative forward guidance measure based on the FOMC statements, we find that Odyssean forward guidance, by alleviating information asymmetry, encourages bank lending to riskier borrowers and increases the participation in syndicated loans manifested in a less concentrated syndication structure. The results are consistent with the argument that forward guidance alters the risk perception of banks and can stimulate the economy through the bank lending channel.

Finally, utilising banks' heterogeneous exposure to large-scale asset purchases, the third study investigates how quantitative easing affects bank deposit funding. We find that the first and third rounds of quantitative easing significantly increase the deposit spreads and reduce the deposit amount through a liquidity effect. This indicates a shift of banks' supply curve of deposit, which is a safe and liquid asset to households. The less dependence on deposit funding of banks suggests the role of bank market power in deposits channel is weakened during monetary policy easing and the role of liquidity becomes more important. QE2 has no effect on deposit spreads, consistent with its focus on Treasury securities that is trivial in bank balance sheets, but it affects the deposit amount from the demand side.

This thesis contributes to the ongoing discussion of the transmission channel of unconventional monetary policy. The findings have important policy implications since the use of these unconventional monetary policy tools will be a new normal.

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Declaration

I declare that no part of this thesis has been submitted elsewhere for any other degree or qualification at this or any other institution. I confirm that it is all my own work except where acknowledgment has been made in the text.

Statement of Copyright

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Chapter 1 Introduction

1.1 Introduction

The transmission of monetary policy has always received vast research attention. Especially in light of recent events, the potency of bank lending channel has reignited the discussion about how monetary policy affects the loan supply and further affects the economy (for example, Jimenez et al. 2014; Dell'Ariccia, Laeven and Suarez 2017). More consideration is given to the financial factors in monetary economics due to the central role of banking sector during the 2008 global financial crisis. The financial crisis has also affected the way monetary policy is conducted. The exceptionally low level of interest rates has induced central banks to devise new monetary policy tools to deal with recurring adverse economic shocks and liquidity stringency. The unconventional monetary policy tools, notably quantitative easing (henceforth QE) and forward guidance has been widely used in the US and their effect on the economy has become a topic with heated discussion. Mixed evidence has been provided on the efficacy of unconventional monetary policy tools in stimulating the economy. Some find unconventional monetary policy stabilizes the financial sector and stimulates the economy (for example, Chodorow-Reich 2014, Rodnyansky and Darmouni 2017), while others find its effect overestimated or that it might have unintentional implications (for example, Del Negro, Giannoni and Patterson 2012; McKay, Nakamura, and Steinsson 2016; Chakraborty, Goldstein and MacKinlay 2020). However, little attention has been paid to the effect of unconventional monetary policy on the bank loan supply.

This thesis extends the literature on the transmission of unconventional monetary policy by investigating how unconventional monetary policy affects the bank lending behaviour from both the asset side and liability side of bank balance sheet. Using data from the US, we ask whether forward guidance affects the cost of corporate loans and whether it encourages banks to take more risk. We also examine how the deposit, as the main funding source for bank lending, is affected by the QE. The first two studies focus on forward guidance with a new measure based on the Federal Open Market Committee (henceforth FOMC) statements on their monetary policy decisions. The third study examines QE and focuses on the liability side of the bank balance sheet. Overall, the three studies study the role of unconventional monetary policy in the risk perception and the funding and lending decisions of banks since the financial crisis.

The first study uses a narrative approach to measure the forward guidance based on the FOMC statements. We manually identify the forward-looking languages in each FOMC statement and select the ones with clear forward guidance guided by the forward guidance lists used in literature (for example, Campbell et al. 2012). Then we create a date-based forward guidance indicator that equals to 1 (-1) when there is an expansionary (contractionary) forward guidance and 0 otherwise. We also distinguish between Odyssean and Delphic forward guidance depending on whether there is an obvious commitment about the future course of monetary policy. We acknowledge that forward guidance can also be given from other sources such as press releases and speeches. However, it is hard to clearly define which public communication can be seen as forward guidance and which cannot. Thus, we restrict our observations to the guidance given by the statements published after each FOMC meeting following the literature. Using a loan-level panel data enriched by lender and borrower information, we are able to test the causal effect of forward guidance on the cost of corporate lending measured by the loan spreads. Controlling for other monetary policy shocks, we find that forward guidance reduces the loan spreads independently and this effect is stronger for the loans borrowed by riskier firms from better capitalized banks. We demonstrate that this effect is a supply-side effect since the observations are new loans originated after forward guidance and the firm×year fixed effects absorbed the unobserved characteristics of borrowers in a certain year. These findings support the bank lending channel under the unconventional monetary policy regime and provide evidence for a forward guidance channel where central bank's commitments change the risk perception of lenders and therefore can stimulate the economy by reducing the cost of credit for firms.

Extending the first study, the second study uses the measure created in the first chapter to further investigate how forward guidance changes the relationship lending and the structure of syndicated loans. This study utilises the rich information on lead arrangers and participant lenders in the syndicated loan market, based on which we construct a deal-level dataset that contains the borrowing history of each firm and the composition of each syndication. As indicated by theories on asymmetric information, we measure the opaqueness of a firm by its reputation which depends on its past experience in the syndicated loan market. We also use the number of lead arrangers, the share held by lead arrangers and the concentration of the syndication to capture the required monitoring and joint monitoring. In additional, we measure the willingness to take part in a syndication by the number of participants and especially new participant lenders. These measures reflect how banks perceive the asymmetric information and the monitoring effort with regards to a certain borrower. The foundation of the bank lending channel is that banks have a comparative advantage in solving the information asymmetry problem. We establish a direct link between this advantage of banks and the unconventional monetary policy. We show that forward guidance increases the probability of the creation of new borrower-lender relationship, and reduces the concentration of the syndication, characterised by less share held by lead arrangers and more participants. Furthermore, the new borrowers, which are considered riskier, tend to get more reduction in the loan spreads. The results suggest that forward guidance eases the concern of problem caused by borrowers' private information and encourages bank lending. It is also consistent with the risk-taking effect of forward guidance which we find in the first study.

The third study focuses on another unconventional monetary policy tool, quantitative easing, which has been found to affect the bank lending (Rodnyansky and Darmouni 2017). However, it is unclear through what channel QE transmits to the commercial lending. We argue that the purchase of mortgage-backed securities refinances the banks staggered by the financial crisis and reduces the banks' dependence on the deposit funding as it is costlier. Following the literature (Drechsler, Savov and Schnabl 2017) we use the deposit spread to measure the opportunity cost of the deposit to households and its relative attractiveness. Exploiting the cross-sectional heterogeneity in banks' exposure to the asset purchasing programs, we use a difference-in-difference research design to compare the highly affected banks with lowly affected banks before and after the introduction of QE. We find that the QE1 and QE3 which targeted at mortgage-backed securities increase the cost of deposits (deposit spread). This is coupled by a reduction in the amount of deposits around the same time, which indicates a shift in the supply of deposit as a liquidity product to households. QE2 does not have a significant effect on deposit spread since its target asset is treasury securities that are sparsely held by banks. The findings suggest that the so-called deposits channel is asymmetric under tightening and easing monetary policy regimes and is well likely to be affected by the financial crisis. The QE programs focusing on mortgage-backed securities work through a liquidity channel where banks get injected with reserve, which they can use to expand their lending activities without issuing more deposits. The results support the bank lending channel in general with evidence from the liability side of the bank balance sheet.

The thesis contributes to the literature in the following ways. First, we provide evidence in support of the transmission of unconventional monetary policy through the bank lending channel. Second, our findings support a new transmission mechanism of central bank communication through bank lending which we name forward guidance channel. Third, we show that the private information concern can also be affected by monetary policy that targets at macroeconomic variables. Fourth, we contribute to the literature on the effect of QE by investigating the liability side of bank balance sheet.

The thesis is organised as follows: in section 1.2 we provide a comprehensive literature review on the research background and how is the thesis positioned among other works. We review the progress in the theories underpinning the monetary frameworks and the evolution of central banking. We also discuss the empirical evidence in support or against the competing theories. Chapter 2 presents the first study of the thesis in which we create the narrative measure of forward guidance and investigate its effect on cost of corporate loans using the syndicated loan data. Chapter 3 is the second study of the thesis which examines the effect of forward guidance on the borrower risk. Chapter 4 presents the third study which explores the role of QE in the funding of bank loans and its interaction with the deposits channel. Chapter 5 concludes the thesis with a summary of the findings and policy implications.

1.2 Research Background

This thesis finds its foundation in the research area of monetary policy transmission. In this section we provide a comprehensive literature review on the theories on monetary policy and central banking as well as empirical evidence related to the various transmission channels.

What is monetary policy? Monetary policy is the action a country's central bank takes to affect the supply and cost of money. The function of monetary policy derives from the central banks' aim to set an anchored nominal price, at which economic agents conduct current and intertemporal exchanges. In the modern fiat money system, monetary policy is employed by central banks to achieve goals such as economic growth and stable prices. For example, the statutory mandate of the US central bank, Federal Reserve, is to promote maximum employment and price stability. The framework of monetary policy is inflation-targeting and the instrument is a short-term interest rate at which the central banks provide fund to banks. Does monetary policy affect the real economy? Dating back to Hume (1755), the quantity theory of money states that an increase in money supply will eventually lead to a higher price level and has no real effect on the economy (the neutrality of money). This view is challenged by Keynesian economics which argues that prices are sticky in the short-run and that monetary policy can help stabilize the output over the business cycle. Building on previous theories, monetarism's view that money supply has an influence on the output in the short term and on price level in the long term has been widely accepted (Bernanke 1983; Bernanke and Blinder 1988; Romer and Romer 1989). The central bank, which essentially controls the money supply, can affect the real economy at least in the short run. Indeed, the perennial debate is not about whether monetary policy affects the economy but how does it affect the economy. Considerable literature has discussed the merits of two views of monetary policy transmission, namely the money view and credit view.

1.2.1 Money View

Pioneered by Friedman and Schwartz (1963), the money view is based on the notion that banks supply the public with money in needs for expenditure in the form of transaction deposits. The transaction deposits are issued against the bank reserves. An increase in bank reserves enables banks to issue new deposits and thus create more money, which results in a decrease in the interest rates. In contrast, a decrease caused by monetary tightening forces banks to reduce the deposits. However, to curtail the demand for transaction deposits, banks must raise the interest rates paid on other deposit alternatives, which is transmitted to longer-term interest rates and thus affect the investment decisions.

For the business cycles during the Great Moderation period, money view provides a good explanation and inspired the theoretical development of New Keynesian models (Mankiw 1989). Romer and Romer (1990) examine the behavior of financial variables and real output in a series of episodes of restrictive monetary policy comparing the explanations based on money aggregate and credit aggregate and find evidence in favor of the money view. More recently, Baker, López-Salido and Nelson (2018) reexamined the post-war data in 14 countries and find that money outperforms credit in predicting economic downturns.

The main criticism of this view is that it focuses on the liability side the bank and neglect the crucial role of banks in generating loans. Under the classical money view, the financial crisis should pose limited threat to the real economy as long as the central bank adjust the money supply to maintain the interest rates. The recent crisis has shown financial intermediation and credit factors play crucial roles in the recession followed. Another strand of criticism is that the money supply has been an unreliable indicator of monetary policy. Despite being proponents of money view, Schularick and Taylor (2012) documents a decouple of credit growth from broad money since 1970s due to financial innovation and regulatory changes. They admit we are in an Age of Credit, where money aggregate cannot be used as a proxy for credit aggregate anymore and the important structural changes that have taken place in the financial system over the past decades have led to a greater role of credit in the macroeconomy.

1.2.2 Credit View

The ideas of credit view can be traced back to Fisher (1933) debt-deflation theory of Great Depressions. Gurley and Shaw (1955) and Brainard and Tobin (1963) stressed the importance of financial intermediaries for the determination of aggregate demand in general equilibrium. Gaining popularity from 1980s, the credit view emphasizes on the special role of banks in financial intermediation. Due to the imperfect information in the capital market, financial institutions such as banks with specialization in acquiring information about default risk devise non-price mechanisms to screen out untrustworthy borrowers (credit rationing) and prevent default (contingency contracts). Therefore, even though the credit market is competitive, the borrowers are imperfect substitute to lenders whereas lenders are homogeneous to borrowers (Blinder and Stiglitz 1983). Since banks have a comparative advantage in gathering information and communicating with firms, many firms who have no access to the open market due to high transaction costs are dependent on bank loans. An increase in bank reserves would induce banks to expand their deposits in order to supply more loans to the bank-dependent firms with lower interest rates.

The two views are not mutually exclusive. The credit view is consistent with the money view that an expansionary monetary policy reduces the interest rates. However, the credit view emphasizes the banks' decision on their asset portfolios and the stimulating effect through bank lending. Therefore, it is vital in understanding the output dynamics in 2008 - 2009. The credit view provides foundation for the credit rationing models (Stiglitz and Weiss 1981; Berger and Udell 1992) and financial accelerator models (Greenwald and Stiglitz 1993; Bernanke, Gertler and Gilchrist 1996). However, opponents argue that in most models incorporating the financial accelerator, credit is largely passive and serves as a propagator of shocks, not an independent source of shocks (Hume and Sentance 2009).

1.2.3 Transmission Channels

Various channels through which monetary policy transmits have been proposed. Mishkin (1996) categorized the transmission of monetary policy into three main channels, namely traditional interest rate channel, credit channel and asset price channel. The traditional interest rate channel is also articulated as money view while the credit view identifies the credit channel. The credit channel includes bank lending channel and balance sheet channel. The asset price channel encompasses exchange rate channel, equity price channel, housing and landing price channel.[1] The credit channel and asset price channel are not independent of the interest rate channel but rather an amplifying and propagating mechanism since they work through some intermediate variables that still interact with interest rate. We mainly focus on the credit channel since we place our findings under the broad bank lending mechanism.

1.2.3.1 Bank Lending Channel

The bank lending channel is based on the notion that banks, due to their comparative advantage in solving information asymmetry problems in the credit market, play a special role the financial system. They offer credit to firms that otherwise have no access to credit. Expansionary monetary policy will increase banks' reserve and deposit which increases banks' lending to firms and thus increases the investment. The bank lending channel has been questioned since it assumes that

[1] These channels work through the monetary policy's effect on the valuation of equities (Tobin's q theory, see Tobin 1969), and the effect on the wealth of households.

banks cannot replace their retail deposit with other source of funding. Due to the regulation changes on the restriction of deposit and the development of non-bank financial intermediaries, some argue that the bank lending channel was rendered less potent (Bernanke and Gertler 1995, Adrian and Shin 2010). On the other hand, some research supports the bank lending channel by showing that banks with different characteristics (size, capitalization, and liquidity etc.) react differently to monetary policy shocks (Kashyap and Stein 2000).

1.2.3.2 Balance Sheet Channel

Unlike bank lending channel, balance sheet channel works through the borrower side. A monetary expansion can improve firms' balance sheet in three ways. First, a monetary expansion increases the valuation of firms' assets which can be used as collateral. Second, a lower nominal interest rate also boosts firms' cash flow and improves their balance sheet. Third, monetary expansion that causes an unexpected rise in the general price level can reduce the value of firms' liabilities if the debt payments are in fixed nominal terms and raise the net worth of firms. The improvement of firms' balance sheet reduces the risk the default and therefore encourages bank lending and eventually increases the investment and output (Bernanke, Gertler, and Gilchrist 1996; Oliner and Rudebusch 1996).

1.2.3.3 Risk-taking Channel

The risk-taking effect of monetary policy easing on bank lending has been discussed in the wake of the financial crisis. The risk-taking channel proposed by Borio and Zhu (2012) operates in at least three ways. First, the changes in interest rates have an impact on valuations, income, and cash flow, which affects borrowers' balance sheet and therefore change the lenders' risk tolerance.

Second, risk-taking channel can operate through the relationship between market rates and target rates of return. Due to the stickiness of target rates of return, financial intermediaries may turn to riskier assets for higher yields when short-term interest rate is low and their margin is compressed. This is the so called the "search for yield" effect (Rajan 2006). Third, it operates through the characteristics of the communication policies and the reaction function of the central bank. The transparency and the commitment about the future monetary policy path reduce the uncertainty about the future and the probability of large downside risks, therefore increase the willingness of banks to assume greater risk.

The first two mechanisms have been supported by empirical evidence. Jiménez et al. (2014) is the first to empirically study the impact of monetary policy rate on bank risk-taking. By interacting the change in the overnight interest rate with the lagged bank capital ratio and firm credit risk measure, they identify the effect of policy rate on the supply of credit. They find that a lower overnight interest rate increases bank risk-taking. Ioannidou, Ongena and Peydró (2014) find that a decrease in federal funds rate raises the hazard rate on the individual bank loans without increasing the loan spread. De Nicolò et al. (2010) and Dell'Ariccia et al. (2017) also document a negative association between federal funds rate and ex ante risk-taking. More interestingly, Paligorova and Santos (2017) find that monetary easing decreases the loan spread but this supports that risk-taking channel in the sense that a lower compensation for the same risk level manifests banks' increased risk appetite. The third mechanism of risk-taking channel is much less investigated compared with the other two because forward guidance became a popular monetary policy tool only after the financial crisis.

1.2.4 The Framework of Monetary Policy and its Challenges

The current framework of monetary policy is inflation-targeting, characterized by official target ranges for the inflation rate at different horizons while allowing for changes in the velocity of money and unexpected shocks that impede the other objectives of monetary policy. However, the framework has not always been like this and it is still evolving. In this section we discuss how has the monetary policy framework evolved along with the development in the macrofinancial theories.

Historically, there has been a debate between discretionary monetary policy and rule-based monetary policy. Behind this debate is the division that whether money is exogenous. In line with the quantity theory of money, the 19th-century British Currency School raised the currency principle that notes should be issued based on a strict convertibility to gold in order to avoid over-issuance of notes and inflation. This school of thought supported a rule-based monetary policy. The opposition British Banking School argued that the volume of paper money is affected by the demand of the public and the over-issuance is restricted by the depositors' redemption in metallic money since any excess money would return to the issuer in the form of deposits (law of reflux). Thus, they were against the regulation on the issuance of banknotes (Doroftei 2013). According to Goodhart (1989), the Currency School failed to see that deposits played an important role in money creation. The regulations advocated by the Currency School did not stop the financial crises from recurring.

The 1930s Great Depression witnessed institutional changes in monetary policy framework. The Keynesian economics became dominant and the notion of a discretionary policy became more popular. The relaxation of gold standard further removed obstacles for this change. However, some argue that this policy ideology caused the Great Inflation in the 1970s (for example, Kydland and Prescott 1977; Lubik and Matthes 2016). Monetarists are against discretionary monetary policy and in favor of rule-based monetary policy. For example, Friedman and Schwartz (1963) argue that there are long lags of stabilizing monetary policy and the supply of money should strictly follow a pre-announced k-percent rate rule. The new monetary policy framework underpinned by new Keynesian economics can be seen as a compromise between the rules and discretion, coming together with the independence of central banks. Indeed, the inflation-targeting is not a policy rule but a framework with the advantage being increased transparency and coherence of policy, and even discretionary monetary policy actions can be accommodated (Bernanke and Mishkin 1997).

The 2008 global financial crisis has again casted doubt upon the way monetary policy is conducted. The use of unconventional monetary policy tools has induced structural changes in the financial and public sectors. The two major challenges facing central banks are the massive transfer of debts to the public sectors and the financial stability concern (Aglietta and Mojon 2009). The increasing dependence of the banking system on access to funding from financial markets could also mean that central banks are forced to underwrite the entire funding market in times of distress in order to avoid the collapse of the banking system (Schularick and Taylor 2012).

Considering the crucial role played by financial intermediation in the recent crisis and the significant change in the way financial intermediaries fund themselves, new generation of macroeconomic models are called for. Some argue that credit deserved to be watched carefully and incorporated into a broader central bank policy framework. For example, Woodford (2010) suggests that changes in credit spreads should be an important indicator in setting the federal funds rate. A model incorporated a market-based financial system with frictions proposed by Cúrdia and Woodford (2009) suggests that the financial condition should be taken into account. In their model, monetary policy easing inevitably increases the leverage in the financial sector due to the effect of higher income on loan demand and supply. The higher leverage makes the disturbance in the supply of intermediation easier to occur. Thus, the consequences for financial stability of monetary policy decisions should be considered alongside with the output and inflation. However, they also acknowledge that such consideration need not to be completely symmetrical. The implications of monetary policy on financial stability is significant only when the leverage is at an extreme level and such circumstances can be avoided by better macroprudential supervision. Others call for a leaning against the wind policy such as counter-cyclical capital buffers to reduce the magnitude of crises (Olsen 2015).

1.2.5 Monetary Policy Tools

Conventionally central banks have mainly three conventional monetary policy instruments to influence the money creation, reserve requirements, discount windows, and open market operations. Essentially the target benchmark rate has been made as the dominant monetary policy tool in most developed markets. Central banks set a target level or range of this benchmark interest rate and communicate their rationale with the market participants. Since the financial crisis central banks have devised innovative instruments called unconventional monetary policy tools mainly due to the interest rate lingering at the zero lower bound. The most popular unconventional monetary policy tools are forward guidance and QE. Another innovative instrument is Operation Twist, where the Fed sells short-term government bonds and uses the proceeds to buy long-term bonds. Because its sales and purchases are of equal amount, the balance sheet of the central bank is unaffected but through its purchase of long-term bonds, it drives up their price and lowers long-term interest rates (Joyce et al. 2012). In this section we focus on forward guidance and QE as they are the main unconventional monetary policy tools this thesis investigates.

1.2.5.1 Forward guidance

Forward guidance is defined by Federal reserve as the communication with public about the likely future course of monetary policy.[2] Since early 2000s, the FOMC began to issue forward guidance in its post-meeting statements, which contain direct forward-looking language about future economic conditions and correspondent path of policy rate.[3] It provides an alternative monetary policy tool to stimulate the economy especially when the current policy rate is close to zero lower bound by credibly promising to keep the rate at zero longer than required by economic conditions. Indeed, monetary policy has been emphasising on the importance of guiding and managing private expectation about the long-term yield curve since the 2008 financial crisis due to limited choice for central banks.

Theoretical models on forward guidance has mixed results. Rudebusch and Williams (2008) use a New Keynesian model to analyse central bank interest rate projections and suggest that central bank communication of interest rate projections can better align the public's and the central bank's expectations, and this better alignment of expectations generally leads to improvements in macroeconomic performance. Del Negro, Giannoni and Patterson (2012) argue that standard medium-scale DSGE models tend to overestimate the impact of forward guidance on macro-economy (the forward guidance puzzle).

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[2] See on the website of the Federal Reserve: What is forward guidance and how is it used in the Federal Reserve's monetary policy? (https://www.federalreserve.gov/faqs/what-is-forward-guidance-how-is-it-used-in-the-federal-reserve-monetary-policy.htm)

[3] Over the past two decades, the FOMC has gone from being quite secretive in its deliberations to very transparent (Wynne, 2013). Despite several deviations from direct signals to implicit ones (for example the statements on December 21, 1999 and June 29, 2006), central banks have started to place more importance on signalling their intentions for future policy (Rudebusch and Williams 2008).

The challenge for empirical research on forward guidance is the measure since it is based on verbal communication and can be misinterpreted. The most popular measure is the Gürkaynak, Sack and Swanson (2005) method (henceforth GSS method). They use the changes in Federal Funds futures and Eurodollar futures around the window of FOMC announcement to capture the monetary policy shock and factorise the shocks into a target factor and a path factor, which together can explain the most of changes in asset prices. The target factor is highly related to the surprise changes in target federal funds rate, while the path factor is, by construction, has no effect on the current federal rate. As a result, the path factor includes any information in the statements (except the decision for the target rate) that affects the expected path for monetary policy. The path factor has a strong explaining power especially for longer-term Treasury yields. Although the path factor is not necessarily equivalent to forward guidance, it supports the idea that the forward-looking language in the statements can be a major driver of the financial market response by influencing market expectations of future policy actions. Campbell et al. (2012) further show that corporate bond yields are also affected by path factor but not target factor. They also construct an interest rate rule-based measure of forward guidance to capture guidance communicated through channels other than policy announcements and find a larger asset price effect. Using a similar method, Raskin (2013) find the date-based guidance led to a statistically significant and economically meaningful change in investors' perceptions of the FOMC's reaction function. The empirical results, however, are not always supportive for this conclusion. Swanson (2017) extend the GSS method to separately identify the effects of forward guidance and LSAPs during 2009-15 and suggest that LSAPs were a more effective policy tool than forward guidance during the ZLB period.

Building on GSS methods, Andrade and Ferroni (2021) further decompose the path factor into a Delphic factor and an Odyssean to improve the identification using the European Central Bank (henceforth ECB) announcements. They find that the Odyssean component decreases industrial production, core prices and expectations about inflation and output growth. Also employing ECB data, Altavilla et al. (2019) decompose the monetary shock into Policy target, forward guidance and QE factors to capture the variation in the yield curve. They find forward Guidance affects the middle of the yield curve most heavily while QE effects get larger as maturity increases, peaking at the 10-year maturity.

A less popular method to measure forward guidance is to employ textual analysis techniques. Hansen and McMahon (2016) use Latent Dirichlet Allocation (LDA) and dictionary methods to analyse the FOMC statements and find two dimensions in the FOMC communication that can represent the forward guidance. However, they still need to manually select the FOMC statements containing forward guidance and determine the direction of guidance in a narrative way. Based on the key words capturing the sentiment of the forward guidance they create an index and find that shocks to forward guidance has no significant effect on real economic variable using a Factor-Augmented Vector Autoregression (FAVAR) model. Galardo and Guerrieri (2017) propose an indicator of ECB's forward guidance based on frequency of future verbs used in press release and find that verbal guidance has been an effective policy instrument to signal further accommodative monetary policy stance. However their index is somewhat crude and cannot detect the tone of the guidance.

1.2.5.2 QE

Also called Large-scale Asset Purchases (LSAP), QE is the monetary policy in which central banks expand their balance sheet to lower long-term interest rates. QE was first introduced in Japan to deal with the deflation in early 2000s. Since the financial crisis other developed markets, mainly US, and the UK also adopted QE. The ECB, however, did not announce its version of QE until 2015. The objective of QE is to reduce long-term interest rates in order to spur economic activity.[4] This policy has led to a significant increase in the central bank balance sheet and therefore QE can be seen as an expansion of central bank intermediation funded essentially by government debt to offset the disruption in the private financial intermediation (Gertler and Karadi 2011).

The first round of QE in the US started in November 2008 as a complementary approach to the adjustment of interest rate. The Federal Reserve purchased $1.25 trillion mortgage-backed securities and $200 billion in federal agency debt in order to increase the availability of credit in private markets to help revive mortgage lending and the housing market. The second round began in November 2010 with a $600 billion purchase in long-term Treasury securities. The third round of QE was unexpectedly announced in September 2012 with a $40 billion per month purchase of mortgage-backed securities and started to phase out in October 2014.

The effect of QE can transmit through various channels in theory. Eggertson and Woodford (2003) argue that QE works through a signalling channel, where QE signals a low interest rate in the future longer than what an interest rate rule might call for. Vayanos and Vila (2009) propose a duration risk channel model, in which the asset purchases reduce the duration risk for the investors and thus alter the yield curve, particularly reducing long-term bond yields relative to short-term yields. Since the bank reserve is more liquid than long-term securities, the QE can also improve the liquidity of banks and decrease the liquidity premium (Krishnamurthy and Vissing-Jorgensen

[4] See the speech of president and chief executive officer of the Federal Reserve Bank of New York (https://www.newyorkfed.org/newsevents/speeches/2010/dud101001.html)

2011). The preference of investors on safe long-term assets can also play a role. Krishnamurthy and Vissing-Jorgensen (2012) argue that investors value the safety of US Treasury and are willing to pay a safety premium. This premium becomes larger when there are less safe securities in the market after the introduction of QE and therefore their preference helps lower the yields further (safety premium channel). QE also increases the inflation expectation lowers the real interest rate and operates through an inflation channel. On the other hand, critics argue that QE causes rapid increase in money supply and may lead to dramatic inflation.

The empirical evidence of the effect of QE on bank lending has no consensus. Rodnyansky and Darmouni (2017) find that QE targeted on mortgage-backed securities improves the bank balance sheet and promotes bank lending. In contrast, Chakraborty, Goldstein and MacKinlay (2020) argue that although QE boosts the mortgage lending of banks, it crowds out the commercial lending and therefore QE does not have a strong stimulating effect through bank lending channel. Churm et al. (2014) investigated whether QE fosters bank lending in the UK and find that QE mainly works through a a portfolio rebalancing channel rather than a bank lending channel. Wieladek and Pascual (2016) document a 2/3 times smaller effect of QE on real GDP in Euro Area than in the UK or US.

Chapter 2 Forward Guidance and Corporate Lending

Highlights

- This study parses the FOMC statements and constructs a categorical variable for the forward guidance based on the update of FOMC commitment on future monetary policy.
- Loans originated after an Odyssean expansionary forward guidance have lower spreads. The Delphic forward guidance and forward guidance provided before the financial crisis do not significantly affect the pricing of syndicated loans.
- The effect of Odyssean forward guidance is more pronounced for well-capitalized banks lending to riskier firms.
- The results provide evidence for a risk-taking effect of unconventional monetary policy.

2.1 Introduction

How does forward guidance affect corporate lending? The answer has important implications for the role of monetary policy on bank lending and, by extension, for real economic activity. Central banks describe forward guidance as their communication with the public about the state of the economy, the economic outlook, and the likely future course of monetary policy. Thus, forward guidance explicitly affects the future expectations of economic agents, the long-term path of interest rates, and long-term economic and financial expectations (e.g., McKay, Nakamura, and Steinsson 2016). Officially, the Board of Governors of the Federal Reserve System (Fed) acknowledges that the Federal Open Market Committee (FOMC) began using forward guidance in its post-meeting statements in the early 2000s. In the aftermath of the 2008 global financial crisis, and with consistently low policy rates, forward guidance has become an indispensable tool for central banks to fulfil the dual mandate of maximum sustainable employment and price stability.

The credit-channel literature suggests that expansionary monetary policy, exercised via low interest rates, advances banks' appetite for risk (Jiménez, Ongena, Peydró, and Saurina 2014; Delis, Hasan, and Mylonidis 2017) and generally affects credit supply (Bernanke and Blinder 1992; Kashyap and Stein 2000). With the policy rate constrained in its effective lower bound since 2008, little scope existed to change actual policy in order to affect expectations. Therefore, central banks relied on quantitative easing and forward guidance to shape expectations. Along this line, recent research has placed the spotlight on the effects of unconventional monetary policy tools. Most related to our research, Dell'Ariccia, Laeven, and Suarez (2018) suggest that asset purchases increase bank lending and reserves, a result especially pronounced for banks with weaker balance sheets.

The literature remains silent on the role of forward guidance in the credit channel of monetary policy. We hypothesize that by publicly committing the central bank to future actions and creating associated expectations, forward guidance fundamentally affects contemporary bank-lending decisions independently of the related effects of short rates and asset-purchase programs. To test our hypothesis, we build a monthly forward guidance measure based on the language used in the statements produced after the FOMC meetings. We distinguish the language used in these meetings toward accommodative or contractionary monetary policy and toward commitment to a particular course of action ("Odyssean" forward guidance) or to a likely monetary policy action ("Delphic" forward guidance). The distinction is important because Odyssean forward guidance significantly affects economic output, inflation, and the unemployment rate, while Delphic forward guidance has no such effects (Campbell, Fisher, Justiniano, and Melosi 2017).

We place the cost of loans (loan spreads over the LIBOR plus any fees) at the center of our analysis (see, e.g., Delis, Hasan, and Mylonidis 2017; Paligorova and Santos 2017). All else equal, the loan spread is an indicator of the loan-specific default probability (ex ante risk). We match the dates of forward guidance with 20,615 syndicated loans made to 3,834 US companies by 329 US banks, from May 1999 until June 2017.

Our identification strategy for a causal effect of forward guidance on the cost of loans confronts three problems. First, we disentangle the effect of forward guidance from the effects of the federal funds rate and other unconventional monetary policy innovations. Our first remedy is to control for the shadow rate (Krippner 2015), which encompasses the full stance of monetary policy (central bank rate, unconventional tools, and forward guidance), leaving the effect of forward guidance to be captured by our measure of explicit forward-looking language. In an important robustness test, we also refine our forward guidance variable to exclude FOMC meetings that are related to the three quantitative easing (QE) announcements. Further, we refine the shadow rate to disentangle its forward guidance component from the rest of monetary policy tools; or build our forward guidance variable using the unexpected changes of federal funds futures and Eurodollar futures within a window around the FOMC announcement (Gürkaynak, Sack, and Swanson, 2005; Altavilla et al., 2019).

The other two identification problems find their solution in the use of loan-level data (Delis, Hasan, and Mylonidis 2017; Ioannidou, Ongena, and Peydró 2015; Jiménez, Ongena, Peydró, and Saurina 2014). Specifically, identifying the effect of forward guidance implies identifying changes in incentives to take new risk, and this new risk must emanate from the supply (bank) side as opposed to the demand (firm) side. In these respects, syndicated loans are ideal because they allow both (i) studying the effect of forward guidance on new loans (new risk) and (ii) distinguishing between loan demand and loan supply using firm times year fixed effects and interaction terms between forward guidance and specific bank and/or firm characteristics.

Our benchmark results (without interaction terms but with firm times year fixed effects) show that expansionary forward guidance is associated with a decline in the corporate loan spreads, with this effect being highly significant in the post-2008 period over and above the effect of conventional monetary policy tools. According to our baseline specification, forward guidance yields a decline in corporate loan spreads by approximately 31 basis points (or 13.3% reduction in the loan spread) for a loan with an average spread originated one month after an Odyssean forward guidance. When we consider loans originated two months after an Odyssean forward guidance (at which point the lending markets have had time to further absorb the guidance information), the effect is more pronounced, with a decline of 36.9 basis points in corporate loan spreads (or 15.7%

reduction in the loan spread). The reduction of interest expenses for the borrowing firm is equal to USD 9.1 million for the loan with an average size and maturity.

Notably, our results support a risk-taking channel working via forward guidance. Specifically, the models that interact forward guidance with bank capital and firm risk measures show that banks with higher capital levels offer lower spreads to riskier firms, ceteris paribus. These specifications enable us to isolate the pure supply-driven effects of forward guidance on loan spreads, suggesting that banks, especially those with higher capital ratios, take on more risk after forward guidance, as evidenced by their willingness to offer cheaper loans to riskier firms. Economically, a highly capitalized bank (75th percentile) reduces the loan spread by 19.56% (13.66%) more than a less capitalized bank (25th percentile) one month (two months) after expansionary forward guidance, for a borrowing firm with high leverage (75th percentile in a standard leverage ratio).

These findings are robust (and conservative) to several robustness tests. Specifically, we use a quarterly measure of forward guidance; we run tests for Delphic forward guidance (the results are statistically insignificant); we replace the shadow rate with the federal funds rate; we use different fixed effects and alternative control variables (e.g., credit ratings); and we distinguish between term loans and credit lines (because these loan groups have important differences).

The rest of the chapter proceeds as follows. Section 2.2 places this research within the extant literature, discusses the theoretical background of the study, and formulates the testable hypotheses. Section 2.3 discusses the data and the empirical model, emphasizing the importance of distinguishing between Odyssean and Delphic forward guidance. Section 2.4 discusses the solutions to the identification problems. Section 2.5 presents the empirical results and discusses the implications for our hypotheses. Section 2.6 concludes.

2.2 Theoretical Considerations and Hypothesis Development

2.2.1 Credit Channel of Monetary Policy

The prevailing mechanism for the transmission of monetary policy is through the interest-rate channel. A monetary tightening, along with the combination of sticky prices and rational expectations, increases the real long-term interest rate. This, in turn, lowers investment spending and aggregate demand, yielding reduced output. In reexamining the transmission mechanism, both Bernanke and Blinder (1988) and Bernanke and Gertler (1995) suggest that the response to interest rate changes can be considerably larger than that implied by the conventional interest rate channel, and they put forth the role of the credit channel, further separated into the bank-lending channel and the balance sheet channel.

The bank-lending channel suggests that a monetary contraction reduces bank deposits, yielding a reduction in bank lending and the aggregate loan supply.[5] In turn, the balance sheet channel (Bernanke, Gertler, and Gilchrist 1999) suggests that shifts in monetary policy affect the financial position of both borrowers (e.g., firms, households, and consumers) and private agents. A contractionary monetary policy reduces borrowers' net worth, which triggers an increase in agency costs and motivates banks to reallocate the loan supply from riskier to safer borrowers.

The simultaneous low interest rates and increase of bank risk-taking on the road to the global financial crisis triggered renewed discussion on the credit channel. The key premise is that a prolonged period of low interest rates leads to excessive bank risk-taking for three reasons (Borio

[5] There is voluminous empirical literature on the bank-lending channel (e.g., Kashyap and Stein 2000; Kishan and Opiela 2000 and 2012; Jayaratne and Morgan 2000; Ashcraft 2006; Jiménez, Ongena, Peydró, and Saurina 2014), showing that banks with relatively weak balance sheets reduce loan supply during monetary contractions.

and Zhu 2012; Delis, Hasan, and Mylonidis 2017). First, low nominal interest rates lower the intermediation margin and induce a search for yield mechanism through the financing of riskier loans. Second, low rates lead to risk downsizing by banks through the higher asset and collateral values, and firms' net worth. Third, the commitment of a central bank for lower future interest rates in the case of a threatening shock reduces the probability of large downside risks, thereby encouraging banks to assume greater risk (the transparency effect). Several studies empirically show a potent risk-taking channel of monetary policy (e.g., Ioannidou, Ongena and Peydró 2015; Jiménez, Ongena, Peydró, and Saurina 2014; Dell'Ariccia, Laeven, and Suarez 2017; Delis, Hasan, and Mylonidis 2017).

The third mechanism of the risk-taking channel (working via central bank commitment) is particularly important for our work. This effect, also known as the Greenspan or Bernanke put, operates through expected lower interest rates rather than through the current low rates themselves. Theoretically, anticipated interest rate reductions tend to correspond to a higher-risk position when there is greater room for monetary expansion—that is, when current rates are relatively high (De Nicolò, Dell'Ariccia, Laeven, and Valencia 2010). When current rates are close to the zero lower bound, however, the focus turns to the effects of unconventional policy tools. In the next section, we discuss how forward guidance in particular might affect bank lending and loan pricing.

2.2.2 Forward Guidance and the Cost of Corporate Loans

Since the FOMC cut interest rates to the zero lower bound in December 2008, forward guidance and quantitative easing have become the key policy tools for monetary accommodation. The theoretical foundation of the effects of these tools is with macroeconomic models of forward-looking beliefs and expectations. Krugman (1999) was among the first to note that, at the zero lower bound, central banks can stimulate output by providing guidance that commits to generate inflation. In theory, such commitments affect private expectations *ex ante* (Woodford 2003; Galí 2008).

Eggertsson and Woodford (2003) show that commitment to future policy rates affects the entire path of expected future interest rates, and this dynamic in turn influences economic activity. Accordingly, Krishnamurthy and Vissing-Jorgensen (2011) find that FOMC guidance concerning asset purchase programs significantly increased asset prices. To explain these effects, Justiniano, Primiceri and Tambalotti (2011) use a macroeconomic model in which forward guidance influences both private and public expectations about the future path of the economy and alleviates uncertainty. Romer and Romer (2004) and Ellingsen and Söderström (2001) show that the use of explicit forward-guidance language facilitates changes in economic outcomes.

Central bank guidance is not always sufficiently clear and quantifiable, however, and as a result, its effects are questionable. Campbell, Evans, Fisher, and Justiniano (2012) study public statement announcements made by the FOMC. They distinguish between "Odyssean" forward guidance, which commits policymakers to specific future actions of monetary policy at a specific date (i.e., state- and time-dependent commitment), and "Delphic" forward guidance, which provides communication about future economic developments and intended monetary policy actions. Working along these lines, Carlstrom, Fuerst, and Paustian (2015) and Campbell, Fisher, Justiniano, and Melosi (2017) theoretically show that an explicit promise by the central bank to keep interest rates below the natural rate of interest for a time horizon of two years causes a significant increase in output.[6]

[6] Other studies are more sceptical about the potency of these effects. McKay, Nakamura, and Steinsson (2016) question the magnitude of the effects of forward guidance on the real economy in the long-term. Hagedorn, Luo, Manovskii, and Mitman (2019) focus on the power of forward guidance in a liquidity trap and suggest that its effects are negligible. Angeletos and Lian (2018) provide an explanation on the so-called "forward guidance puzzle" by

The relevant empirical literature is scant, whereas the effect of forward guidance on banks' loan pricing is, to the best of our knowledge, novel research. Our first hypothesis is that apart from (over and above) the direct effect of short-term rates on banks' incentives (i.e., apart from the usual effect of the interest rate channel), the central bank communication policies affect the cost of loans. Transparency, commitment, and guidance about the future monetary policy path, as well as the specific time-dependent binding actions communicated by the FOMC, reduce informational asymmetries between the central bank and lenders. The same effects prevail for the private decision makers' uncertainty about future economic and financial outcomes. This implies that anticipated interest rates induce forward-looking expectations about banks' funding costs, so that future corporate loan spreads are also better anticipated.

In theory, we should then observe that expansionary forward guidance lowers the cost of loans. Two notable issues lie behind this prediction. First, any empirical findings should be first and foremost about Odyssean forward guidance, which provides the most explicit path for future monetary policy. The effect of Delphic forward guidance does not lower the relevant informational asymmetries and should have a much lesser effect (if any) on the cost of bank loans. Second, our prediction is the opposite of the risk-taking channel's prediction, which suggests that in light of low interest rates, banks will charge higher loan spreads on average because they will expand lending to more-risky borrowers. The effect of forward guidance mitigates informational asymmetries via increased transparency and commitment. Thus, expansionary forward guidance should reduce the cost of loans despite the opposite effect of short-term interest rates.

To this end, we formulate our first hypothesis as follows:

H1: Expansionary Odyssean forward guidance lowers the cost of loans.

relaxing the assumption that agents have common understanding on the central bank's policy announcement. Their findings suggest that the effectiveness of forward guidance is time- and agent-dependent.

Very similar to the mechanisms of the bank-lending channel, forward guidance should have heterogeneous effects across banks with different balance sheet characteristics. A key bank characteristic in recent literature about the bank-lending channel is bank capitalization (Jiménez, Ongena, Peydró, and Saurina 2014; Delis, Hasan, and Mylonidis 2017). The theoretical reason behind the role of bank capitalization is that it represents a measure of the bank's ability to expand credit in conjunction with any agency conflict that besets banks' own borrowing from their financiers (Holmstrom and Tirole 1997; Freixas and Rochet 2008; Jiménez, Ongena, Peydró, and Saurina 2014).

Better-capitalized banks are better able to pass changes in forward-looking expectations along to lending rates. Specifically, in light of expansionary forward guidance and the associated developments highlighted under *H1*, the availability of bank capital implies lower loan spreads to existing borrowers or attractive rates for new borrowers. Moreover, in a period of low interest rates (as is the case when central banks use forward guidance), bank asset valuation increases, thereby increasing the availability of bank capital (Dell'Ariccia, Laeven and Marquez 2014). We expect that banks with already high levels of capital will benefit the most from such valuation effects, thereby allowing them to offer their borrowers the most attractive loan spreads.

Given the potentially important role of bank capitalization in the relation between forward guidance and loan cost, we formulate our second hypothesis as follows:

H2: The effect of Odyssean forward guidance on the cost of loans will be more potent for loans originated by highly capitalized banks.

Regardless of its financial condition, every bank aims to lend to borrowers that maximize the bank's returns. Especially in the corporate loan market, the pool generally includes a mix of relatively low-risk borrowers and relatively high-risk borrowers. For a fixed level of bank capital, we expect that expansionary forward guidance will boost the mechanisms underlying the risk-taking channel in the form of lending to riskier borrowers. The two key firm characteristics indicating firms' health are the ratio of risk-adjusted returns (*Z*-score) and leverage. When expansionary forward guidance occurs, better-capitalized banks will probably be the ones expanding lending (via the associated mechanisms highlighted in our second hypothesis). If a risk-taking channel is at work, banks (especially the better-capitalized ones) should decrease the cost of loans more for risky and leveraged firms.

To be clear about our premise here, consider an example of the same bank lending to the same firm twice within one year. The first loan originates during the period before expansionary forward guidance, and the second originates after expansionary forward guidance. The better-capitalized banks are more likely than less-capitalized banks to offer loans at lower rates but also to further decrease those rates for relatively risky firms. Thus, the lending-rate reduction would be more potent for risky firms compared with less risky ones (those that already have access to relatively low rates).

Accordingly, we formulate our third testable hypothesis as follows:

H3: The effect of Odyssean forward guidance on the cost of loans will be more potent for loans originated by highly capitalized banks and to relatively riskier borrowers.

2.3 Data and Variables

Table 2.1 summarizes all the variable definitions and the data sources. Our variables include measures of forward guidance, bank and firm characteristics, loan characteristics, and macroeconomic characteristics.

2.3.1 Forward Guidance

We measure forward guidance from the forward-looking language used in statements released by the FOMC after every meeting. Our sample begins in May 1999, when the FOMC first began disclosing information about the future stance of monetary policy in its post-meeting statements. Approximately eight regular FOMC meetings take place each year, but several post-meeting statements do not contain a clear forward-looking guidance message to the public (Rudebusch and Williams 2008; Campbell, Evans, Fisher, and Justiniano 2012; Swanson 2017).

However, since the 2008 global financial crisis, the FOMC began providing explicit forward guidance within its statements in order to improve macroeconomic outcomes by affecting agents' expectations. Campbell, Evans, Fisher, and Justiniano (2012) distinguish between two types of forward guidance: Odyssean forward guidance, in which policymakers publicly commit to a particular course of action; and Delphic forward guidance, which broadly discusses macroeconomic conditions and likely monetary policy actions without binding the central bank to future courses of action. The authors find that the use of Odyssean forward guidance effectively stimulates the economy. For this reason, our empirical analysis focuses on Odyssean forward guidance from October 2008 onwards. We also undertake tests for Delphic guidance and for the pre-crisis period, although we expect these effects to be considerably weaker.

The policy stance and the communicative language used in the statements can remain unchanged across several meetings if the committee so desires. Therefore, we consider only new guidance issued to the public, wherein the forward-looking language changed significantly from the previous statement. This procedure yields 19 Odyssean forward guidance since the global financial crisis. Appendix Table A.1 lists the dates of Odyssean forward guidance and the relevant key forward-looking phrases within the statements. Based on forward guidance dates, we construct forward guidance indicator variables corresponding to the month when the relevant statement is publicly released. In constructing the variables, we also note the direction of forward guidance, because an accommodative monetary policy and a tightening monetary policy are expected to affect bank lending differently. More precisely, for a given loan origination month *t*, we define the following:

$$Forward\ guidance\ (t-n) = \begin{cases} 1, & \text{if the most recent expansionary guidance is provided } n \text{ month(s) ago} \\ -1, & \text{if the most recent contractionary guidance is provided } n \text{ month(s) ago} \\ 0, & \text{otherwise} \end{cases} \quad (1)$$

where n = 1, 2, 3. The three forward guidance variables described in Eq. (1) measure whether the FOMC forward guidance was in play one, two, or three months before the loan origination date.

In important robustness tests, we consider several alternative measures/definitions of forward guidance. From these, two are the most important. First, we completely isolate the forward guidance dates from the three QE announcement dates (March 18, 2009, November 03, 2010, and September 13, 2012). In all our empirical models, we control for changes in other types of monetary policy using the shadow rate, which encompasses movements in the central bank rate, forward guidance, and QE. Removing the QE announcement dates serves the purpose of preventing our results capturing multicollinearities between our forward guidance measure and the shadow rate. We also serve the same purpose via regressing the shadow rate on our main forward guidance variables and using the residuals as the shadow rate control. In this case, the shadow rate does not include information on forward guidance.

Second, we measure the monetary policy shock using the unexpected changes of federal funds futures and Eurodollar futures within a window around the FOMC announcement

(Gürkaynak, Sack, and Swanson, 2005). We decompose this shock into a target factor corresponding to surprise changes in the current policy rate, and a path factor corresponding to changes in the expected future rates. The path factor measures forward guidance because it contains the monetary policy shock additional to that arising from changes to the current policy rate.

The path factor does not distinguish Odyssean from Delphic guidance. Therefore, we follow Altavilla et al. (2019) to categorize the path factor into Odyssean and Delphic by evaluating its co-movements with future interest rates, stock prices, and inflation-linked swaps. We estimate the path factor using the method of Gürkaynak, Sack, and Swanson (2005) around all announcement dates.[7] We use seven futures contracts to construct this path factor (current-month and 3-month-ahead federal funds futures contracts, and 2-, 3-, 4-, 5-, and 6-quarter-ahead Eurodollar futures contracts). Subsequently, we rescale the factor such that a unit change corresponds to 1 basis point change in the 4-quarter-ahead Eurodollar rate. Next, we compare the directional movements of the path factor with changes in S&P 500, and the 5-year Treasury Inflation-Protected Security on the same announcement dates. Forward guidance dates on which stock prices and inflation together move in the opposite direction to the path factor are Odyssean, while same directional movements are Delphic (Altavilla et al., 2019). Thus, this forward guidance measure (named *GSS forward guidance*) takes the value of the path factor on Odyssean forward guidance dates and 0 otherwise. We note here that a negative shock to this measure is associated with an expansionary Odyssean forward guidance.

[7] Following Campbell, Evans, Fisher, and Justiniano (2012), we consider all FOMC statement dates and the Board of Governors press release on November 25, 2008.

2.3.2 Loan-level Variables

The FOMC statement dates are matched with syndicated loan data, obtained from Thomson Reuters LPC's DealScan, which records the detail of syndicated loans and the identity of borrowers and lenders. Each syndicated loan is called a deal or package. Within a deal there are several facilities and each facility is financed by multiple lenders. Each facility under the same deal has different loan characteristics such as the loan spreads, loan amount, maturity etc., and therefore should be treated as different loans. Throughout the thesis, the word loan-level means facility-level.

Loans obtained by financial companies (SIC codes 6000–6999) and loans without pricing or maturity information are excluded. We match borrowers with their financial information using the Chava and Roberts (2008) DealScan–Compustat link table. Next, we manually match the lead arrangers' names and cities with call reports (for standalone commercial banks) or with FR Y-9C reports (for bank holding companies). This matching procedure allows us to obtain the lender's financial statements at the time of loan origination. Our full sample consists of 20,615 syndicated loans to 3,834 US firms from 329 US banks initiated from May 1999 to June 2017.

Among the loan-level variables, our key outcome variable is the all-in spread drawn (AISD), which reflects the total (including fees and interest) annual spread paid over LIBOR for each dollar drawn down from the loan. The literature uses this variable to identify the risk-taking channel using syndicated loans (Delis, Hasan, and Mylonidis 2017; Paligorova and Santos 2017). *Ceteris paribus*, a higher loan spread is an *ex ante* indicator of higher bank risk-taking because it reflects a riskier borrower (demand-side risk) or a riskier stance by bank management (supply-side risk).

We consider a large set of loan-level control variables, including loan amount (in USD million), loan maturity (in years), type of loan (term loan or credit line), loan purpose (corporate purpose, debt repayment, or working capital), loan category (secured or unsecured), use of dividend restrictions, and the number of lenders in the syndicate. These variables capture a rich set of information on the banks' syndication process and control for loan-level heterogeneity.

2.3.3 Bank, Firm, and Macroeconomic Characteristics

Concerning bank-level variables (quarterly data), and following our theoretical considerations, we first use the capital ratio (*Capital*) as our key identifier of banks' willingness to give out new loans following forward guidance innovations. Moreover, we use the log of total assets, a liquidity ratio, the bank's return on assets (ROA), and the bank's quarterly net loan charge-offs to proxy for additional elements of bank health. At the firm level, and following out theoretical discussion, our key proxies for firm risk are the book leverage and Altman's *Z*-score. The firm and bank variables are quarterly and enter our empirical model lagged once before a loan origination.

We aim to identify the effect of forward guidance over and above the general monetary conditions, and thus we control for the quarterly shadow rate (Krippner 2015). This measure captures the effect of both the federal funds rate and (importantly) the effect of quantitative easing after the financial crisis, when interest rates were constrained at the zero lower bound. We also control for within-year changes in the macroeconomic environment using the quarterly GDP growth rate and the CBOE Volatility Index (VIX).

2.3.4 Summary Statistics

Table 2.2 reports summary statistics for the variables used in our analysis, distinguishing between the pre-crisis period (May 1999 to September 2008) and the crisis and post-crisis period (October 2008 to June 2017). Our sample includes 13,122 syndicated loans in the pre-crisis period and 7,493 loans in the crisis and post-crisis period. In Appendix Table A.2, we report summary statistics for the full sample period.

The average AISD in the pre-crisis period is 181 basis points, rising to 235 basis points from October 2008 onward. We observe equivalent increases for loan amount and maturity. Notably, the proportion of loans offered for corporate purposes more than doubles (from 32% to 67%) after October 2008, whereas the other loan-purpose groups shrink during the same period. This trend explains the increase in credit lines vis-à-vis term loans. In terms of the syndicate composition, we observe a slight increase in the average number of lenders.

The relevant figures for bank and firm characteristics follow our theoretical priors and empirical literature. We observe increases in the average bank capital and liquidity ratios, whereas ROA drops from 0.7% to 0.4%. In addition, the average quarterly net loan charge-offs increase from 0.1% to 0.2%. The average borrower's debt composition increases; however, the average *Z*-score slightly improves.

2.4 Identification Method

For identification purposes, we conduct our analysis at the lead bank-loan facility level and estimate the following model:

$$logAISD_{l,f,b,t} = a_{f,y} + \delta_n Forward\ guidance\ (t-n) + \alpha Shadow\ rate_{t-1} + \boldsymbol{\beta}'\boldsymbol{X_{l,t}} + \boldsymbol{\gamma}'\boldsymbol{Y_{b,t-1}} + \boldsymbol{\phi}'\boldsymbol{Z_{f,t-1}} + \boldsymbol{\chi}'\boldsymbol{E_{t-1}} + \varepsilon_{l,f,b,t}\ . \quad (2)$$

The dependent variable, $logAISD_{l,f,b,t}$, is the natural log of the AISD of a syndicated loan (l) to firm (f) from bank (b) at time (t). *Forward guidance* is the indicator variable capturing Odyssean forward guidance issued one, two, or three months before the loan origination date, as defined in Eq. (1). In addition, $\boldsymbol{X_l}$, $\boldsymbol{Y_b}$, $\boldsymbol{Z_f}$, and $\boldsymbol{E}$ are vectors representing the loan, bank, firm, and macroeconomic control variables, respectively. Our coefficient of interest is δ_n, which is expected to capture the negative effect of expansionary forward guidance on the loan spread (based on *H1*).

Our identification strategy confronts three interrelated identification problems (Ioannidou, Ongena, and Peydró 2014; Delis, Hasan, and Mylonidis 2017). The first is the fact that any monetary policy innovation must affect new risk. Using syndicated loan data and the respective new loan facilities originated in the three months after forward guidance innovations provides the key to solving this problem.

Second, we must effectively control for types of monetary policy other than forward guidance. Using the shadow rate symmetrically with *Forward guidance*, as shown in Eq. (2), essentially achieves this goal. In other words, we extract the effect of forward guidance from the total effect of monetary policy as captured by the shadow rate. As suggested in Section 3.1, in robustness tests we also use a forward guidance variable that does not coincide with QE announcements or reflects Odyssean shocks.

Third, any model of the risk-taking channel aims to identify shifts in loan supply from shifts in loan demand. To this end, and in line with our testable hypotheses, we use a mix of fixed effects and interaction terms with bank and firm characteristics (Delis, Hasan, and Mylonidis 2017; Paligorova and Santos 2017). Thus, we consider a highly saturated model with triple interactions of *Forward guidance* with bank capitalization and firm risk, along with suppressing the effect from demand side using firm × year fixed effects.

The firm × year fixed effects are very important because they control for time- (year-) variant demand (firm) characteristics. Including these fixed effects comes at the expense of limiting our inferences from changes in loan spreads for firms obtaining at least two loans within the same year: Obviously, the number of these loan facilities is relatively small compared with our full sample. The structure of syndicated loans, however—with many lead banks that naturally have different characteristics—eases concerns about limiting our sample. To this end, the triple interaction term with *Capital* serves to improve the information extracted from the model. The reasons are that (i) banks provide many syndicated loans in the same year, (ii) *Capital* is observed at a quarterly level, and (iii) *Capital* is different across observations even for the same loan facility if many lead banks provide the loan.

Formally, we estimate the following model:

$$logAISD_{l,f,b,t} = a_{f,y} + \delta_n Forward\ guidance\ (t-n) + \lambda_{1n} Forward\ guidance\ (t-n) Capital_{b,t-1} + \lambda_{2n} Forward\ guidance\ (t-n) R_{f,t-1} + \lambda_{3n} Forward\ guidance\ (t-n) Capital_{b,t-1} R_{f,t-1} +$$

$$\alpha Shadow\ rate_{t-1} + \theta_1 Shadow\ rate_{t-1} Capital_{b,t-1} + \theta_2 Shadow\ rate_{t-1} R_{f,t-1} + \theta_3 Shadow\ rate_{t-1} Capital R_{f,t-1} + \theta_4 Capital_{b,t-1} R_{f,t-1} + \boldsymbol{\beta' X_{l,t}} + \boldsymbol{\gamma' Y_{b,t-1}} + \boldsymbol{\phi' Z_{f,t-1}} + \boldsymbol{\chi' E_{t-1}} + \varepsilon_{l,f,b,t}, \quad (3)$$

where *Capital* is the capital ratio of bank (b) and R_f is the firm risk measure (*Book leverage* or *Z-score*). The focus of the analysis concerns the interaction terms. In line with *H2*, a negative and statistically significant λ_{1n} implies that the negative effect of expansionary forward guidance is more pronounced for highly capitalized banks. In line with *H3*, a positive λ_{3n} indicates that the negative effect of expansionary forward guidance will be less pronounced for highly capitalized banks that lend to riskier borrowers. We symmetrically control for the effect of conventional monetary policy by including the interactions of shadow rate with the bank capital ratio and firm risk measures.

Eq. (3) represents a model that tests our three hypotheses while effectively mitigating the three identification problems. First, it identifies the pricing of *new* loans in the three months following forward-guidance innovations. Second, the model disentangles the effect of the general monetary environment from the effect of forward guidance. Third, the model saturates shifts in loan supply from shifts in loan demand via the fielding of firm × year fixed effects and the double and triple interaction terms (directly following the paradigm of, e.g., Kashyap and Stein 2000; Jiménez, Ongena, Peydro, and Saurina, 2014; Ioannidou, Ongena, and Peydro, 2015; and many others henceforth).

2.5 Empirical Results

2.5.1 Results from the Model without Interaction Terms

Table 2.3 reports the results from the estimation of Eq. (2), which serves as a benchmark to show the overall effects of the monetary environment on loan spreads. Columns 1 to 4 report the results for the Odyssean forward guidance. The results show that loan spreads decrease subsequent to expansionary forward guidance of an Odyssean nature. The effect is highest on loans originating two months after the forward guidance is issued.[8] This result is expected because the syndication process (book-running stage) usually takes several weeks to complete.

[8] Forward guidance issued more than three months before loan originations is found to be insignificant in the empirical tests.

We calculate the economic effect of forward guidance on loan spreads using the estimation results in column 4 and report them in the lower part of Table 2.3. Odyssean forward guidance issued one month ago decreases the spread of a new syndicated loan by 31.26 basis points or 13.3% compared with the loan with an average spread (that equals 235 basis points). The effect hits the peak after two months with an equivalent 15.7% reduction in loan spread, corresponding to 36.90 basis points. The corresponding reduction of interest expenses of a loan with average size and maturity issued one month after Odyssean guidance is USD7.7 million (= USD 615 million × 31.26 basis points × 4 years).

Columns 5 to 8 report the results for Delphic forward guidance. This exercise serves as a placebo test, given that Delphic forward guidance does not reflect explicit commitment. Further, this test substantially reduces the possibility that unobserved factors associated with FOMC meetings affect the syndicated loan market. Further, in columns 9–12, we examine the effect of forward guidance before the financial crisis. Because Odyssean guidance emerged after the financial crisis and as the policy rates touched the zero lower bound, we also expect the effect of forward guidance to be negligible prior to the crisis. Indeed, the coefficients on forward guidance are never significant in these falsification tests.

Figure 2.1 provides a graphical representation of how forward guidance affects loan spreads across different sample periods. Similar to Welch and Goyal (2007), we undertake the following procedure. We estimate three regression models—benchmark model, shadow rate model, and forward guidance model—using a three-year monthly moving estimation window, and record their root-mean-square errors (RMSEs). The benchmark model regresses loan spreads on the loan, bank, firm, and macroeconomic control variables. The shadow rate model includes the shadow rate as an additional independent variable to the benchmark model. The forward guidance model includes both the shadow rate and the forward guidance variables to the benchmark model, as in Eq. (2). Next, the performance of the shadow rate model is calculated as the cumulative RMSE of the benchmark model minus the cumulative RMSE of the shadow rate model. Analogously, we calculate the performance of the forward guidance model over and above the benchmark model. Finally, we plot line graphs of the performance of both the shadow rate model and the forward guidance model over time.

This graph is informative because when the line shows an upward movement, the benchmark model is weaker than the preferred model (i.e., the shadow rate model or the forward guidance model). Similarly, when the line shows a downward movement, the benchmark model performs better than the preferred model. Because the difference in cumulative errors is plotted over time in the line graph, we can gauge the performance of a preferred model for any given sample period. That is, if any two given points on the graph form an upward curve, the preferred model contributes explanatory power to the loan spread during the period between those two points.

In Figure 2.1, the dashed (dotted) line is the cumulative RMSE of the benchmark model minus the cumulative RMSE of the forward guidance model (shadow rate model). The gap between the two lines represent the extra explanatory power that forward guidance adds to the model over and above the shadow rate. In the beginning of the sample period, the two models both outperform the benchmark model but are quite close to each other. The gap widens around the third quarter of 2008. This widening coincides with the FOMC's statement with forward guidance issued on October 08, 2008, which was the first accommodating Odyssean forward guidance since May 04, 2004 in our sample. Since 2008, the forward guidance model has provided significant explanatory power over and above the shadow rate model.

Overall, consistent with *H1*, we find that forward guidance significantly affects corporate loan spreads since the beginning of the financial crisis.

2.5.2 Results from the Model with Interaction Terms

In Table 2.4, we report the results from the estimation of Eq. (3), which allows testing *H2* and *H3*. Moreover, as highlighted in Section 4, this model significantly improves the empirical identification of the supply-side effects of forward guidance, by increasing the informational content of our data using interaction terms in conjunction with the firm × year fixed effects. Given the results from Eq. (2), we focus on the crisis and post-crisis period because this is where we identify significant effects of Odyssean forward guidance.

Two important findings emerge from the results in Table 2.4. First, the negative effect of forward guidance at $t - 1$ and $t - 2$ seems to be more potent for the well-capitalized banks. In Appendix Table A.3, we show that this remains the case when we do not include the triple interaction terms within the specification. Based on the estimation in column 4 in Table A.3, the additional percentage reduction on loan spreads offered by highly capitalized banks (75th percentile) compared with less capitalized banks (25th percentile) is 8.60%, after expansionary forward guidance was issued two months before. Thus, consistent with *H2*, the results show that the negative effect of forward guidance on loan spread intensifies for loans by highly capitalized banks. Moreover, this finding is consistent with the negative effect of forward guidance being supply-driven.

Second, consistent with *H3*, the negative coefficient on the triple interactions at $t - 1$ and $t - 2$ show that the negative effect of Odyssean forward guidance on the cost of loans is more potent for loans originated by highly capitalized banks and to relatively riskier borrowers. The results are fairly similar irrespective of whether we add the forward guidance terms separately for the three periods $t - 1$ to $t - 3$ (results in columns 1 to 3) or whether we add all terms in one specification (results in column 4); the significant terms are always those including the first two lags. Further, our results are similar irrespective of the variable used to proxy firm risk. In the first four columns, we use *Book leverage* (higher values reflect higher firm risk, and hence the coefficient on the triple term is negative), and in the last four columns, we use *Z-score* (higher values reflect lower firm risk, and hence the coefficient on the triple term is positive).

This is the key finding of our paper, suggesting that banks—especially those with higher capital ratios—take on more risk after forward guidance, as evidenced by their willingness to offer cheaper loans to riskier firms. To provide inferences on the economic magnitude of the risk-taking effects for highly capitalized banks, we report in the lower part of Table 2.4 the marginal effects of the difference-in-difference—the additional percentage reduction on loan spreads offered to riskier firms (25th percentile) compared with safer firms (75th percentile) by highly capitalized banks (75th percentile), over and above the reduction offered by less capitalized banks (25th percentile). Based on model specification (4) with book leverage, a highly capitalized bank reduces the loan spread by 19.56% (13.66%) more than a less capitalized bank one month (two months) after expansionary forward guidance, for a borrowing firm with a weaker capital structure. Similarly, based on model specification (8) with *Z*-score, the loan spread difference offered by highly versus less capitalized banks for riskier borrowers are 12.48% (6.38%) lower than for safer borrowers, after expansionary forward guidance one month (two months) before. The risk-taking effect is strongest in the month after forward guidance, declines two months after the forward guidance, and is insignificant in the third month.

Note that the shadow rate and its interaction terms are also statistically significant. This result is as expected, because the shadow rate reflects the general monetary policy stance and represents the effects of quantitative easing after the financial crisis. Nonetheless, and quite importantly, the effects of forward guidance prevail over and above the effects from the shadow rates.

2.5.3 Robustness

We conduct several robustness tests on our baseline results. An important test is to assess whether the announcement dates of quantitative easing (QE) drive the forward guidance results. We note that the shadow rate control includes the impact of QE on the cost of credit and thus our results so far should not be capturing QE effects. To ensure this is the case and that our results are not driven by multicollinerarity,[9] we first remove any announcement/narrative effects of QE by excluding the three QE announcement dates (March 18, 2009, November 03, 2010, and September 13, 2012) from the Odyssean forward guidance measure. The results reported in the first three columns of Table 2.5 remain largely unaltered compared to our baseline. Further, in the last three columns of Table 2.5, we control for the shadow rate residuals (instead of the shadow rate) obtained from regressing the shadow rate on our forward guidance variables. These residuals do not include information on forward guidance, thus completely disentangling the effects of forward guidance from other types of monetary policy. Again, the results remain largely unaffected.

Next, we examine whether our findings hold when using quarterly forward guidance (quarter before the quarter of loan origination) and report the results in Table 2.6. This analysis provides more aggregate reflection on the effect of forward guidance compared to the monthly

[9] Multicollinearity comes from the inclusion of forward guidance information both in our main forward guidance variables and in the shadow rate control.

measures. Based on the first column, we find that the quarterly measure reduces loan spreads by 11%.

Importantly, in Table 2.7 we report the results using *GSS forward guidance*. We find that a negative average GSS forward guidance surprise two months ago, which lowers the one-year ahead interest rate by 6.35 basis points, reduces the loan spread by 8% (calculation based on column 1 of Table 2.6). Irrespective of the definition of forward guidance, the triple interactions in columns 2 and 3 are statistically significant, indicating that riskier firms get more reduction in loan cost subsequent to an expansionary Odyssean guidance. These results are again consistent with our baseline.

Third, we consider the effective federal funds rate, instead of the shadow rate, in the estimation of Eqs. (2) and (3). The effective federal funds rate is the most straightforward monetary policy tool used in previous research, but it disregards the novel monetary policy tools implemented in the crisis and post-crisis periods. Table 2.8 replicates the results of Table 2.3, and Table 2.9 replicates those of Table 2.4, using the federal funds rate. We note that the estimated effects of forward guidance are consistent with our baseline inferences.

Next, we split our sample into term loans and credit lines. These groups constitute the vast majority of originations (about 95%) but have some important differences. Although term loans provide new borrowers with one-time financing, credit lines allow new borrowers to revolve their debt. Notably, several term loans appeal to institutional investors (non-bank lenders) rather than banks. These loans typically include weak covenants, longer maturities, and low amortization, which would have high capital requirements if banks were to hold them. Given that banks tend not to hold such loans, we expect that our effects are stronger for credit lines. The results reported in Appendix Table A.4 show that forward guidance significantly decreases the spreads for both term loans and credit lines, and this is the reason we keep both groups in our baseline specifications. In line with our expectations, however, the economic effect is stronger for credit lines.

Importantly, our results are robust to the inclusion of additional fixed effects. Specifically, in alternative specifications, we include bank and firm fixed effects, bank × year fixed effects, and bank × firm fixed effects. These fixed effects further saturate our model from the time-invariant bank and firm characteristics, time-varying bank characteristics, and bank–firm pair characteristics, respectively. The results in Appendix Tables A.5 to A.10 replicate those of Tables 2.3 to 2.8, and show that all our main results remain essentially unchanged.

To ease any concerns that our baseline results are affected by other macroeconomic factors such as credit risk and bond market conditions, in Table A.11 we additionally control for credit spread (Moody's AAA–ABB corporate bond spread), the three-month T-bill rate and the quarterly CPI. The results are again robust to the inclusion of these additional variables.

2.6 Conclusion

Following the Great Recession and the monetary policy rates hitting the zero lower bound, unconventional tools have taken up a key role for both policymakers and researchers. Forward guidance, in particular, affects the real economy by creating expectations about the future course of monetary policy. In this study, we consider for the first time the effects of forward guidance on bank lending, using data from the syndicated loan market.

Our analysis features three novel findings. First, Odyssean forward guidance decreases the loan spreads on newly issued syndicated loans in the next three months. The effect is economically significant in the first two months after a forward guidance innovation, peaking with a 15.7%

reduction in loan spreads. This effect corresponds to a 36.90 basis points reduction in spreads or a USD 7.7 million reduction in the cost of a loan with mean size and maturity.

Second, the effect of forward guidance on loan spreads is more potent for highly capitalized banks, especially when those highly capitalized banks lend to firms with weaker capital structure or higher default probability. For example, a highly capitalized bank reduces the loan spread by an average 17% more than a less capitalized bank for a borrowing firm with a weak capital structure in the one to two months after expansionary forward guidance.

The limitation of this research is that the forward guidance measure cannot granularly capture the intensity or distinguish the tone and sentiment of the forward guidance. Using Natural Language Processing techniques to study the forward guidance and a wider range of central bank communication in order to capture shocks from more dimensions would be promising directions for future research.

Figure 2.1: Explanatory Power of Forward Guidance and Shadow Rate over Time

This figure plots the performance of shadow rate over time (dotted line), which is calculated as the cumulative RMSE of the benchmark model minus the cumulative RMSE of the shadow rate model. Analogously, the performance of forward guidance over time (dashed line) is calculated as the cumulative RMSE of the benchmark model minus the cumulative RMSE of the forward guidance model. For the construction of the graphs, three regression models are estimated – benchmark model, shadow rate model and forward guidance model – using a 3-year monthly moving estimation window, and their respective RMSEs are recorded. The benchmark model regresses loan spreads on the loan, bank, firm, and economy-level control variables. The shadow rate model includes the shadow rate as an additional independent variable to the benchmark model, while the forward guidance model includes both the shadow rate and the forward guidance variables to the benchmark model. The definitions for all the variables used in the regressions are provided in Table 2.1

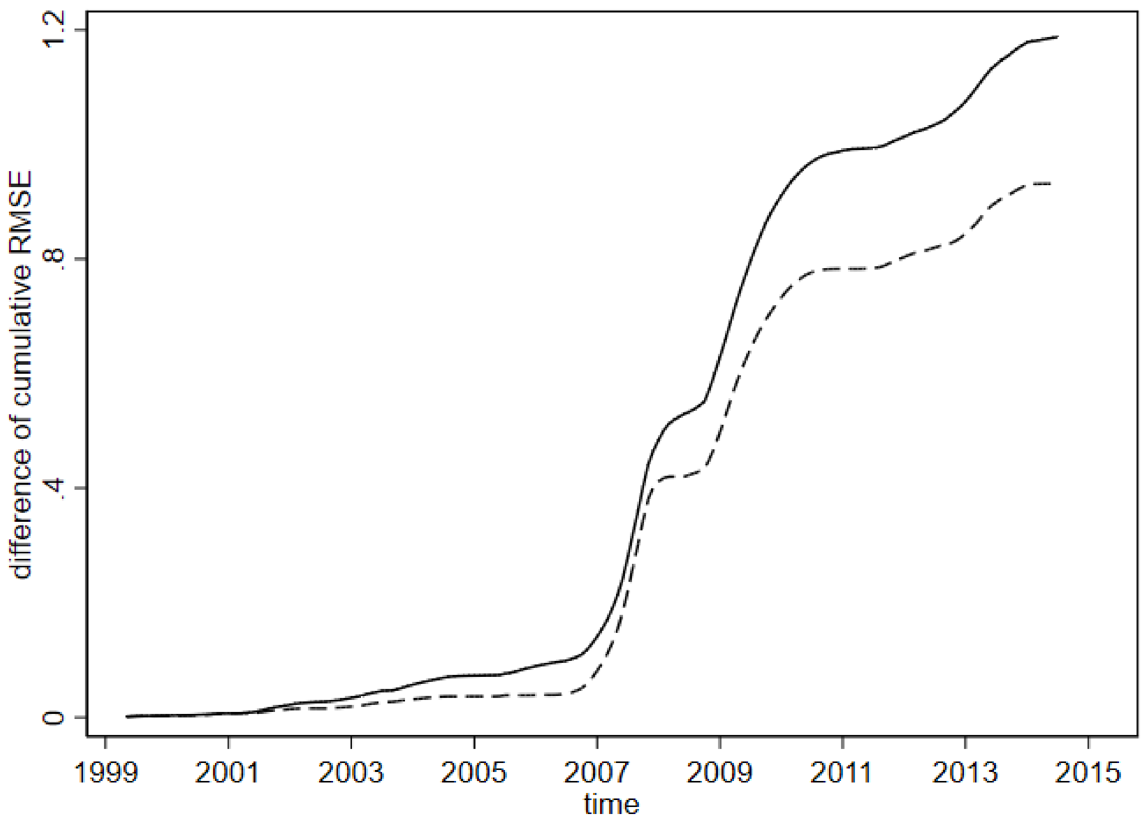


Table 2.1: Variable Definition and Source

Variable	Definition	Source
Forward-guidance variables		
Forward guidance (t – 1), Forward guidance (t – 2), Forward guidance (t – 3)	Three indicator variables measuring whether forward guidance is in play one month, two months, and three months, prior to the loan origination date (see section 3.2 for variables' construction details)	FOMC
Quarterly forward guidance	Indicator variable takes the value 1 if there is expansionary forward guidance in the previous quarter, –1 for contractionary guidance, and 0 otherwise	FOMC
GSS forward guidance	The variable takes the GSS path factor value on Odyssean forward guidance dates, and 0 otherwise.	FOMC, Bloomberg and FRED
Loan-level variables		
Loan spread	Log of all-in-spread-drawn above LIBOR (in basis points) at origination	DealScan
Loan amount	Log of loan amount (in million US dollars)	DealScan
Maturity	Maturity of the loan (in years)	DealScan
Credit line	Indicator variable equal to 1 if a loan is a credit line, and 0 otherwise	DealScan
Term loan	Indicator variable equal to 1 if a loan is a term loan, and 0 otherwise	DealScan
Corporate purpose	Indicator variable equal to 1 if a loan is used for a corporate purpose, and 0 otherwise	DealScan
Working capital	Indicator variable equal to 1 if the loan is used for working capital, and 0 otherwise	DealScan
Debt repayment	Indicator variable equal to 1 if the loan is for repayment of previous debt, and 0 otherwise	DealScan
Secured	Indicator variable equal to 2 if the loan is secured, 1 if unsecured, and 0 if the information is missing	DealScan
Dividend restriction	Indicator variable equal to 2 if a loan has to meet a dividend restriction, 1 if no such restrictions are present, and 0 if the information is missing	DealScan
Lender number	Log of the number of lenders in the syndicate	DealScan
Firm-level variables		
Book leverage	The ratio of common equity over total assets, and multiplied by -1 for ease of interpretation (higher values for the ratio indicate higher book leverage)	Compustat
Z-score	Altman's (1968) *Z*-score = (1.2*working capital + 1.4*retained earnings + 3.3*EBIT + 0.999*sales)/total assets	Compustat
Bank-level variables		
Total asset (log)	Bank total assets (RCFD2170 and BHCK2170)	Call reports and Y-9C reports
Capital ratio	The ratio of bank equity over total assets (RCFD3210 and BHCK3210)	Call reports and Y-9C reports
Liquidity	The ratio of banks' cash and treasuries over total assets (RFCD0010 and RFCD0400, BHCP6775 and BHCK1287)	Call reports and Y-9C reports
ROA	The ratio of banks' net income before taxes over total assets (RIAD4340 and BHCK4340)	Call reports and Y-9C reports
Charge-off	The ratio of bank quarterly net charge-offs over total assets (RIAD4635 and BHCK2432)	Call reports and Y-9C reports
Economy-level variables		
GDP growth	quarterly GDP growth rate	FRED

VIX	quarterly averaged VIX close	CBOE
Shadow rate	quarterly average shadow rate	Leo Krippner's website

Table 2.2: Summary Statistics

This table reports the summary statistics of all variables used in the empirical analysis. The pre–financial crisis sample period stems from May 1999 to September 2008, and the sample period following the pre-financial crisis is from October 2008 to June 2017. The definitions for all the variables are provided in Table 2.1.

	Pre-financial crisis sample period					Sample period following the pre-financial crisis				
	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Loan-level variables										
Loan spread	13,122	4.890	0.864	0.405	7.313	7,493	5.331	0.508	2.708	7.111
Loan amount	13,122	4.818	1.721	-6.639	10.309	7,493	5.602	1.380	-2.303	10.800
Maturity	13,122	3.580	1.962	0.005	20	7,493	4.482	1.459	0.083	16
Credit line	13,122	0.563	0.496	0	1	7,493	0.621	0.485	0	1
Term loan	13,122	0.246	0.431	0	1	7,493	0.330	0.470	0	1
Corporate purpose	13,122	0.320	0.467	0	1	7,493	0.671	0.470	0	1
Working capital	13,122	0.231	0.422	0	1	7,493	0.105	0.306	0	1
Debt repayment	13,122	0.115	0.319	0	1	7,493	0.030	0.170	0	1
Secured	13,122	1.246	0.856	0	2	7,493	1.249	0.859	0	2
Dividend restrictions	13,122	1.248	0.901	0	2	7,493	0.891	0.884	0	2
Number of lenders	13,122	1.677	1.041	0	5.088	7,493	1.888	0.827	0	4.248
Firm-level variables										
Book leverage	13,122	-0.409	0.198	0.000	-1.000	7,493	-0.389	0.194	0.000	-0.960
Z-score	13,122	0.629	0.823	-3.131	2.326	7,493	0.653	0.730	-3.131	2.441
Bank-level variables										
Total asset	13,122	19.808	1.330	9.501	21.279	7,493	20.884	1.225	10.555	21.586
Capital ratio	13,122	0.079	0.015	0.056	0.149	7,493	0.102	0.018	0.056	0.149
ROA	13,122	0.007	0.004	-0.012	0.048	7,493	0.004	0.004	-0.039	0.031
Liquidity	13,122	0.047	0.026	0	0.212	7,493	0.062	0.048	0	0.474
Charge-off	13,122	0.002	0.002	0	0.016	7,493	0.002	0.003	0	0.028
Economy-level variables										
GDP growth	38	1.205	0.593	0.207	2.448	35	0.766	0.750	1.858	1.888
VIX	38	20.317	6.154	11.035	35.068	35	20.675	9.620	11.692	58.596
Shadow rate	38	3.261	1.947	0.402	6.224	35	-1.677	1.905	-5.301	1.725

Table 2.3: Response of Loan Spreads to Forward Guidance: Baseline Specifications

This table reports the regression results of Eq. (2), where the dependent variable is the log of loan spread. Forward guidance indicator variables capture forward guidance issued one, two, or three months before the loan origination date. Using the sample period following the pre-financial crisis (October 2008 to June 2017), columns (1) – (4) report results for Odyssean forward guidance and columns (5) – (8) report test results for Delphic forward guidance. Columns (9) – (12) report test results for forward guidance issued during the pre-financial crisis sample period (May 1999 to September 2008). Standard errors are clustered at the bank-year level. Y indicates that the set of control variables or fixed effects is included. The list of control variables and their definitions are provided in Table 2.1. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Odyssean forward guidance				Delphic forward guidance				Forward guidance before financial crisis			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Forward guidance (t-1)	-0.089***			-0.133***	-0.021			-0.022	0.027			0.030
	(-3.16)			(-4.13)	(-0.93)			(-0.92)	(0.86)			(0.97)
Forward guidance (t-2)		-0.114***		-0.157***		-0.008		-0.012		0.023		0.027
		(-4.13)		(-5.06)		(-0.29)		(-0.39)		(0.64)		(0.76)
Forward guidance (t-3)			-0.111***	-0.150***			-0.012	-0.018			0.013	0.018
			(-3.44)	(-4.43)			(-0.21)	(-0.31)			(0.43)	(0.59)
Shadow rate	0.001	-0.001	-0.001	-0.010	0.002	0.002	0.002	0.002	-0.016*	-0.016*	-0.016*	-0.015
	(0.03)	(-0.08)	(-0.08)	(-0.66)	(0.10)	(0.14)	(0.14)	(0.12)	(-1.78)	(-1.70)	(-1.77)	(-1.63)
Loan-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bank-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Economy-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm × year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Number of observations	7,493	7,493	7,493	7,493	7,493	7,493	7,493	7,493	13,122	13,122	13,122	13,122

Economic impact of forward guidance on loans with mean spreads (in basis points)

	Forward guidance (t-1)	Forwards guidance (t-2)	Forward guidance (t-3)
Odyssean forward guidance (estimated from Column (4))	31.26	36.90	35.25

Table 2.4: Response of Loan Spreads to Forward Guidance: Triple Interactions

This table reports the regression results of Eq. (3), with the triple interaction of forward guidance, bank capital ratio and firm risk measures (denoted R). The dependent variable is the log of loan spread. The firm risk measure is book leverage in columns (1) – (4) and *Z*-score in columns (5) – (8). Forward guidance indicator variables capture Odyssean forward guidance issued one, two, or three months before the loan origination date. The sample period is from October 2008 to June 2017. Standard errors are clustered at the bank-year level. Y indicates that the set of control variables or fixed effects is included. The list of control variables and their definitions are provided in Table 2.1. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	R = Book leverage				R = *Z*-score			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Forward guidance (t-1)*Capital ratio	-11.450**			-11.920**	-5.977**			-6.132**
	(-2.19)			(-2.24)	(-2.12)			(-2.04)
Forward guidance (t-2)*Capital ratio		-8.571***		-9.525***		-4.402**		-4.822**
		(-3.16)		(-3.10)		(-2.35)		(-2.19)
Forward guidance (t-3)*Capital ratio			0.928	-1.304			2.251	0.999
			(0.20)	(-0.26)			(0.99)	(0.41)
Forward guidance (t-1)*R*Capital ratio	-25.86**			-27.250**	5.457**			5.594***
	(2.41)			(2.56)	(2.57)			(2.61)
Forward guidance (t-2)*R*Capital ratio		-15.910**		-19.010**		2.322		2.861*
		(2.32)		(2.58)		(1.48)		(1.70)
Forward guidance (t-3)*R*Capital ratio			-1.841	-6.661			-2.463	-1.436
			(0.20)	(0.67)			(-1.25)	(-0.72)
Shadow rate	-0.644***	-0.628***	-0.678***	-0.607***	-0.339***	-0.323***	-0.345***	-0.334***
	(-6.63)	(-6.30)	(-6.65)	(-6.40)	(-4.77)	(-4.59)	(-4.75)	(-5.09)
Shadow rate*Capital ratio	6.135***	5.966***	6.396***	5.696***	3.241***	3.075***	3.267***	3.115***
	(6.63)	(6.36)	(6.63)	(6.39)	(4.71)	(4.49)	(4.60)	(4.91)
Shadow rate*R*Capital ratio	13.320***	12.920***	13.70***	12.130***	-2.685***	-2.499***	-2.612***	-2.558***
	(-6.60)	(-6.12)	(-6.42)	(-6.09)	(-6.81)	(-6.42)	(-6.41)	(-6.89)
Loan-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Firm-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Bank-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Economy-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Firm × year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
Number of observations	7,493	7,493	7,493	7,493	7,493	7,493	7,493	7,493

How much additional reduction in spreads do riskier firms (25 percentile) as compared to safer firms (75 percentile) receive from highly capitalized banks (75 percentile), over and above those offered from less capitalized banks? (marginal effects of the difference-in-difference)			
	Forward guidance (t-1)	Forward guidance (t-2)	Forward guidance (t-3)
Model (4)	19.56%	13.66%	Insignificant
Model (8)	12.48%	6.38%	Insignificant

Table 2.5: Sensitivity Test: Exclusion of QE Dates and Shadow Rate Residual

This table reports the regression results of Eq. (2) and Eq. (3). The forward guidance variable in columns (1) – (3) excludes the three QE announcement dates. Columns (1) – (3) use the original shadow rate control, as defined in Table 1, while columns (4) – (6) use the shadow rate residual (obtained by regressing the shadow rate on the forward guidance variables) as control variable. The dependent variable is the log of loan spread. Forward guidance indicator variables capture Odyssean forward guidance issued one, two, or three months before the loan origination date. The sample period is from October 2008 to June 2017. Standard errors are clustered at the bank-year level. Y indicates that the set of control variables or fixed effects is included. The list of control variables and their definitions are provided in Table 2.1. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

		R=Book leverage	R=*Z*-score		R=Book leverage	R=*Z*-score
	(1)	(2)	(3)	(4)	(5)	(6)
Forward guidance (t-1)	-0.158***	0.983	0.315	-0.110**	3.143***	1.877***
	(-3.72)	(1.60)	(0.85)	(-2.03)	(5.26)	(4.76)
Forward guidance (t-2)	-0.203***	0.673**	0.147	-0.141***	0.390	0.166
	(-5.50)	(2.14)	(0.63)	(-4.77)	(1.16)	(0.77)
Forward guidance (t-3)	-0.194***	-0.642	-0.682**	-0.178***	-0.354	-0.408
	(-4.73)	(-1.08)	(-2.24)	(-4.83)	(-0.69)	(-1.51)
Forward guidance (t-1)*Capital ratio		-10.080*	-4.284		-30.19***	-18.58***
		(-1.77)	(-1.25)		(-5.49)	(-5.11)
Forward guidance (t-2)*Capital ratio		-7.903***	-2.830		-4.738	-2.641
		(-2.67)	(-1.25)		(-1.51)	(-1.27)
Forward guidance (t-3)*Capital ratio		3.877	4.796*		1.865	2.655
		(0.73)	(1.75)		(0.40)	(1.08)
Forward guidance (t-1)*R*Capital ratio		-26.200**	5.086**		-66.260***	14.910***
		(-2.39)	(2.04)		(-5.84)	(5.60)
Forward guidance (t-2)*R*Capital ratio		-16.400**	1.265		-9.866	1.946
		(-2.43)	(0.75)		(-1.31)	(1.20)
Forward guidance (t-3)*R*Capital ratio		1.752	-3.452		-0.417	-2.083
		(0.18)	(-1.45)		(-0.05)	(-1.07)
Shadow rate	-0.008	-0.639***	-0.349***	-0.0056	-0.717***	-0.450***
	(-0.59)	(-6.87)	(-5.33)	(-0.40)	(-8.27)	(-6.93)
Shadow rate*Capital ratio		5.972***	3.252***		6.731***	4.185***
		(6.84)	(5.13)		(8.77)	(6.88)
Shadow rate*R*Capital ratio		12.560***	-2.540***		14.160***	-3.004***
		(6.27)	(-6.62)		(7.85)	(-7.77)
Loan-level variables	Y	Y	Y	Y	Y	Y
Firm-level variables	Y	Y	Y	Y	Y	Y
Bank-level variables	Y	Y	Y	Y	Y	Y
Economy-level variables	Y	Y	Y	Y	Y	Y
Firm × year fixed effects	Y	Y	Y	Y	Y	Y
Number of observations	7,493	7,493	7,493	7,493	7,493	7,493

Table 2.6: Sensitivity Analysis:

Response of Loan Spreads to Forward Guidance (using Quarterly Forward Guidance)

This table reports the regression results using the quarterly forward guidance variable, which takes the value 1 if there is expansionary Odyssean guidance in the previous quarter, -1 for a contractionary guidance, and 0 otherwise. The dependent variable is the log of loan spread. Forward guidance indicator variables capture Odyssean forward guidance issued one, two, or three months before the loan origination date. The sample period is from October 2008 to June 2017. Standard errors are clustered at the bank-year level. Y indicates that the set of control variables or fixed effects is included. The list of control variables and their definitions are provided in Table 2.1. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

		R=Book leverage	R=*Z*-score
	(1)	(2)	(3)
Quarterly forward guidance (t-1)	-0.109***	0.721*	0.265
	(-3.81)	(1.94)	(1.13)
Shadow rate	-0.00783	-0.614***	-0.332***
	(-0.53)	(-6.70)	(-4.91)
Forward guidance (t-1)*Capital ratio		-8.053**	-3.524
		(-2.37)	(-1.64)
Forward guidance (t-1)*R*Capital ratio		-19.79***	2.907**
		(2.74)	(2.09)
Shadow rate*Capital ratio		5.808***	3.120***
		(6.62)	(4.71)
Shadow rate*R*Capital ratio		12.20***	-2.470***
		(-6.21)	(-6.60)
Loan-level variables	Y	Y	Y
Firm-level variables	Y	Y	Y
Bank-level variables	Y	Y	Y
Economy-level variables	Y	Y	Y
Firm × year fixed effects	Y	Y	Y
Number of observations	7,493	7,493	7,493

Table 2.7: Sensitivity Analysis:

Response of Loan Spreads to Forward Guidance (using GSS Forward Guidance)

This table reports the regression results using the GSS forward guidance variable, which takes the value of the GSS path factor on Odyssean forward guidance dates, and 0 otherwise. The dependent variable is the log of loan spread. Forward guidance variables capture shocks to path factor one, two, or three months before the loan origination date. The sample period is from October 2008 to June 2017. Standard errors are clustered at the bank-year level. Y indicates that the set of control variables or fixed effects is included. The list of control variables and their definitions are provided in Table 2.1. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

		R=Book leverage	R=*Z*-score
	(1)	(2)	(3)
GSS forward guidance (t-1)	0.003	-0.168***	-0.058***
	(1.33)	(-3.24)	(-2.81)
GSS forward guidance (t-2)	0.012***	-0.149***	-0.070**
	(2.80)	(-3.06)	(-2.57)
GSS forward guidance (t-2)	0.001	-0.138***	-0.057**
	(0.55)	(-3.43)	(-2.48)
GSS forward guidance (t-1)*Capital ratio		1.668***	0.619***
		(3.11)	(2.74)
GSS forward guidance (t-2)*Capital ratio		1.518***	0.822***
		(3.18)	(3.09)
GSS forward guidance (t-3)*Capital ratio		1.294***	0.576**
		(3.26)	(2.37)
GSS forward guidance (t-1)*R*Capital ratio		3.548***	-0.341*
		(2.78)	(-1.79)
GSS forward guidance (t-2)*R*Capital ratio		2.767***	-0.421***
		(3.03)	(-2.95)
GSS forward guidance (t-3)*R*Capital ratio		2.422***	-0.327
		(3.05)	(-1.54)
Shadow rate	0.002	-0.682***	-0.356***
	(0.11)	(-7.42)	(-4.91)
Shadow rate*Capital ratio		6.438***	3.395***
		(7.34)	(4.80)
Shadow rate*R*Capital ratio		14.100***	-2.798***
		(7.63)	(-6.85)
Loan-level variables	Y	Y	Y
Firm-level variables	Y	Y	Y
Bank-level variables	Y	Y	Y
Economy-level variables	Y	Y	Y
Firm-year FE	Y	Y	Y
Number of observations	7,493	7,493	7,493

Table 2.8: Sensitivity Analysis:

Response of Loan Spreads to Forward Guidance (using the Federal Funds Rate)

This table reports the regression results for the baseline specifications using the federal funds rate as an alternative proxy for the conventional monetary policy stance. The dependent variable is the log of loan spread. Forward guidance indicator variables capture Odyssean forward guidance issued one, two, or three months before the loan origination date. The sample period is from October 2008 to June 2017. Standard errors are clustered at the bank-year level. Y indicates that the set of control variables or fixed effects is included. The list of control variables and their definitions are provided in Table 2.1. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Forward guidance (t-1)	-0.092***			-0.132***
	(-3.14)			(-4.00)
Forward guidance (t-2)		-0.112***		-0.150***
		(-4.05)		(-4.89)
Forward guidance (t-3)			-0.110***	-0.143***
			(-3.42)	(-4.33)
Federal funds rate	0.159**	0.143*	0.150*	0.154*
	(2.07)	(1.83)	(1.90)	(1.91)
Loan-level variables	Y	Y	Y	Y
Firm-level variables	Y	Y	Y	Y
Bank-level variables	Y	Y	Y	Y
Economy-level variables	Y	Y	Y	Y
Firm × year fixed effects	Y	Y	Y	Y
Number of observations	7,493	7,493	7,493	7,493

Table 2.9: Sensitivity Analysis:

Response of Loan Spreads to Forward Guidance: Triple Interactions (using the Federal Funds Rate)

This table reports the regression results of Eq. (3), with the triple interaction of forward guidance, bank capital ratio and firm risk measures (denoted R) and using the federal funds rate as an alternative proxy for the conventional monetary policy stance. The dependent variable is the log of loan spread. The firm risk measure is book leverage in columns (1) – (4) and *Z*-score in columns (5) – (8). Forward guidance indicator variables capture Odyssean forward guidance issued one, two, or three months before the loan origination date. The sample period is from October 2008 to June 2017. Standard errors are clustered at the bank-year level. Y indicates that the set of control variables or fixed effects is included. The list of control variables and their definitions are provided in Table 2.1. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	R=Book leverage				R=Z-score			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Forward guidance (t-1)*Capital ratio	-12.400***			-14.060***	-4.335*			-5.299*
	(-2.81)			(-3.08)	(-1.75)			(-1.96)
Forward guidance (t-2)*Capital ratio		-17.180***		-18.520***		-6.412**		-7.299**
		(-5.70)		(-5.53)		(-2.43)		(-2.57)
Forward guidance (t-3)*Capital ratio			-8.049	-10.000*			-1.620	-2.938
			(-1.56)	(-1.76)			(-0.74)	(-1.24)
Forward guidance (t-1)*R*Capital ratio	-26.660***			-30.190***	3.215*			3.783*
	(3.25)			(3.64)	(1.75)			(1.90)
Forward guidance (t-2)*R*Capital ratio		-34.450***		-37.620***		2.859		3.502
		(5.07)		(5.12)		(1.11)		(1.32)
Forward guidance (t-3)*R*Capital ratio			-21.000**	-24.570**			0.775	1.547
			(2.12)	(2.21)			(0.43)	(0.81)
Federal funds rate	2.859**	2.977***	3.128***	2.792**	1.475*	1.463*	1.596*	1.455*
	(2.50)	(2.62)	(2.64)	(2.58)	(1.87)	(1.87)	(1.96)	(1.91)
Federal funds rate*Capital ratio	-28.340**	-29.260**	-31.030**	-27.750**	-14.940*	-14.840*	-16.300*	-14.730*
	(-2.18)	(-2.26)	(-2.30)	(-2.24)	(-1.71)	(-1.70)	(-1.80)	(-1.73)
Federal funds rate*R*Capital ratio	-48.530**	-51.700**	-54.070**	-47.690**	7.489	7.519	8.185	7.177
	(2.20)	(2.33)	(2.35)	(2.26)	(1.34)	(1.37)	(1.44)	(1.34)
Loan-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Firm-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Bank-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Economy-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Firm × year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
Number of observations	7,493	7,493	7,493	7,493	7,493	7,493	7,493	7,493

Chapter 3 The Effect of Forward Guidance on Relationship Lending and Syndication Structure

Highlights

- This study finds that new borrowers are more likely to get a loan with lower spreads after Odyssean expansionary forward guidance.
- The effect of forward guidance on loan spreads kicks in after 4 weeks, which is around the time needed for loan syndication. This suggests that forward guidance affects the whole syndication process.
- Subsequent to Odyssean expansionary forward guidance, the syndication structure tends to be less concentrated, especially for borrowers with less reputation in the syndicated loan market.
- The results suggest that forward guidance alters banks' risk perception and support the risk-taking channel of unconventional monetary policy.

3.1 Introduction

Bank lending is an essential channel of the monetary policy transmission to the wider economy. Examining how forward guidance affects bank lending is helpful to understand how forward guidance stimulates the economy. The previous chapter has investigated the effect of forward guidance on the cost of corporate loans. It is found that banks reduce loan spreads after an easing Odyssean forward guidance is given. We argue that the forward guidance changes banks' perception on risk and might encourage risk-taking behaviour and a lower compensation for risk. To further support this argument, this chapter explores other aspects of a syndicated loan which also embody banks' perception of risk. We focus on the aspects of borrower-lender relationship and syndication structure for they are related to the crucial issue in bank lending, asymmetry information, which is an important supply-side factor for loan contracts (Qian and Strahan 2007). Building on the previous chapter, this chapter examines more granularly how forward guidance affects the establishment of new borrower-lender relationship and syndication structure through altering the risk perception of banks.

The bank lending plays an important role in monetary policy transmission since banks have a comparative advantage of monitoring and abating the information asymmetry problem (Diamond 1984; Mishkin 1996; Borio and Zhu 2012). Some borrowers, especially small and relatively risky firms, have no access to credit market except through banks. Therefore monetary policy can stimulate the economy by providing more reserve and a more appealing interest rate environment, which encourages bank lending and especially funding to firms that are dependent on banks. There has been some recent research investigating how monetary policy affect the bank lending with regards to the amount and pricing of corporate loans (e.g. Jimenez et al. 2014; Delis, Hasan and Mylonidis 2017), supporting the potency of the bank lending channel. However, this literature focuses solely on the policy rate, while other mechanisms aimed at alleviating or eliminating information asymmetry would also increase banks' willingness to extend credit (Jappelli and Pagano 1993).

How does the expertise of banks on asymmetric information interacts with monetary policy has been largely neglected. The main reason for this lack of attention might be that monetary policy is usually targeted at macroeconomic variables whereas asymmetric information problem is a microeconomic concern caused by the private information of firms. The existent literature generally treats information asymmetry on an aggregate level. For example, Svenssion and Woodford (2004) investigate the optimal monetary policy under the assumption that private sector has more information than the policy maker. The key in the link between monetary policy shock on the macro level and the asymmetric information on the micro level is the special role of banks in financial intermediation. Banks, with information advantage, translate the ramifications induced by monetary policy change into their handling of asymmetric information, including the willingness to lend and loan contract designs.

This topic is becoming more interesting under the wide use of a relatively new monetary policy tool, forward guidance, which provides pure information instead of any actual actions. Unconventional monetary policy can not only lower default rates and raise profits, but also can reduce uncertainty and risk aversion (Chodorow-Reich 2014). The unconventional monetary policy, especially forward guidance, by revealing the intention of future monetary policy change, has an impact on the information set of banks and alters their risk perception. This would lead to a change in their lending behaviour. Following this theoretical framework, we hypothesize that Odyssean forward guidance strengthens the information advantage of banks and thus banks originate more loans to riskier borrowers as well as participate more in other syndicated loans which will lead to a less concentrated syndication structure.

The other side of bank lending is the borrower, especially those opaque firms who are more likely to be dependent on bank funding. For firms, one way to reduce the information asymmetry is to be more transparent through letting themselves be known to the market. The seminal paper of Diamond (1991) proposes the life cycle effect in borrowing. New borrowers borrow from banks initially and establish their reputation through being monitored by the bank. A good track record of repayment earns them reputation which later allows them to issue debts directly (bonds). The asymmetric information therefore can be subdued by reputation (repeated access to the market). Indeed, Chakraborty, Fernando and Mallick (2010) find that banks provide significantly higher credit limit to firms that they have been working with. This reputation is based on the argument that banks can obtain private information about the borrowers from both the loan application and the later monitoring stage (Fama 1985; Mester, Nakamura and Renault 2007).

Syndicated loans provide an interesting middle ground for companies' life cycle of borrowing. On the one hand, the origination process is similar to private loans with elements of relationship lending between firms and banks. On the other hand, the participation of other banks and the resale of the proportions after the origination are similar to bond underwriting. Thus, how borrowers' reputation in syndicated loan market interacts with lenders' monitoring and participation is of great interest. Moreover, how this link is affected by forward guidance, given that forward guidance changes banks' perception of risk, has not been investigated. The abundant information in Dealscan enables us to extract the relationship between between lead arrangers, participant banks and the borrowers based on their lending and borrowing history in the syndication market.

The previous chapter devises a narrative measure of forward guidance based on the language used in the FOMC statements. The measure codes selected statement dates, which contain an update in Odyssean forward guidance, into a categorical variable. In this chapter we employ the same measure. Similar to the previous study we focus on the Odyssean guidance since the global financial crisis as we have already shown previously that forward guidance before the crisis and the Delphic guidance does not have any impact on corporate loans. We find that Odyssean forward guidance increases the willingness of banks to lend, in terms of both origination of new loans to riskier borrowers, as well as the participation in other syndicated loans, which further results in a less concentrated syndication structure.

The rest of the chapter is structured as follow: section 3.2 reviews the literature on this topic. Section 3.3 describes the data and the construction of key variables. Section 3.4 discusses the estimation results and Section 3.5 concludes.

3.2 Related Literature

This chapter is related to three strands of literature. First, our investigation on the establishment of new borrower-lender relationship is nested in the relationship lending literature. Borrower-lender relationship plays an important role in the process of banks gathering information and setting the loan contract terms (Berger and Udell 1995). There is mixed evidence on how the borrower-lender relationship length would affect the pricing of loans (e.g. Harhoff and Korting 1998; Degryse and Cayseele 2000 among others). Brick and Palia (2007) reconcile the mixed results by jointly considering loan rates and other loan terms and find that longer borrower-lender relationship reduces the implicit interest rate. This supports the theory that banks produce information about the borrowers that is otherwise unavailable to the market through their lending relationship (Sharpe

1990; Rajan 1992). The recent work of Botsch and Vanasco (2019) find that banks acquire private information about borrowers through repeated borrowing and such private information would be used in the pricing of loans. For high quality borrowers, their loan rates would become lower as the lending relationships progress, during which they establish their reputation.

Second, we are closely related to Lee and Mullineaux (2004) and Sufi (2007) among other research on syndication structure. Lee and Mullineaux (2004) is the first paper to systematically examine the structure (size and composition) of syndicated loans. They find that syndicated loans are more concentrated, as reflected by a high HHI when the credit risk of the borrower is high since such a structure is easier for the renegotiation in the event of default. Their finding also supports the notion that the syndication is structured to enhance the monitor of the borrower, which is essential to address the adverse selection and moral hazard problem. Sufi (2007) provide evidence that the contract details, especially the structure of syndicated loans represent the information asymmetry problem facing the lenders. Using a series of proxies for the opaqueness of borrowers, they find that lead arrangers retain higher proportion of the loan and form a more concentrated syndication when the degree of information asymmetry is higher. Guo and Zhang (2019) use securitized syndicated loans to further investigate the factors determining the syndication structure. They have mixed findings. On the one hand, they find that lead bank shares are lower in securitized syndicated loans compared with non-securitized ones. This is consistent with the adverse selection theory that banks have incentive to securitize loans on which they have negative private information. On the other hand, they also find that lead banks increase their shares after a non-securitized loan becomes securitized in order to credibly signal their effort in monitoring. Their first result suffers from one flaw that they fail to consider the demand. The securitized loans, which are more liquid by nature, face a higher demand. The lower concentration or the lower share of the lead arrangers might simply be caused by the higher demand and participation of other lenders. Indeed, the adverse selection problem is less severe in corporate loans than in mortgage loans (Shivdasani and Wang 2011; Benmelech, Dlugosz, and Ivashina 2012), and therefore the information asymmetry problem plays a more important role in the form of syndication structure.

Third, this chapter is related to the research regarding the effects of unconventional monetary policy on bank lending. Chodorow-Reich (2014) discusses four channels through which unconventional monetary policy affects the financial sector. They find that expansionary unconventional monetary policy stabilizes the financial sector by raising value of their legacy assets and provokes modest risk-taking in bank lending. However, they study the monetary policy using a narrow window around the policy announcement instead of examining any specific monetary policy tools. Other research has been focused on the effect of quantitative easing. Rodnyansky and Darmouni (2017) find that banks highly affected by QE increase their corporate lending. In contrast, Chakraborty, Goldstein and MacKinlay (2020) find that banks benefiting from the MBS purchase programmes increase mortgage lending which crowds out corporate lending. So far little attention has been paid to the effect of forward guidance on bank lending especially the syndication structure.

Following the line of the previous chapter, by showing how forward guidance affects the syndication structure we support that forward guidance can reduce uncertainty and risk aversion by easing banks' concern on the information asymmetry problem. To our best knowledge this study is the first to investigate the effect of unconventional monetary policy on syndication structure.

3.3 Data and Variables

3.3.1 Data Source

The dataset in this chapter is based on the dataset constructed in the previous chapter. In particular, loan pricing analyses use the same dataset as chapter 2, whereas the syndication structure analyses aggregate the dataset to deal-level. In terms of the borrower-lender relationship, we trace back to the whole history of Dealscan to generate the relevant variables instead of only focusing on our sample.

The sample period is from October 2008 to June 2017, during which period we find forward guidance to be powerful. We restrict the sample to loans originated in the US to non-financial firms. We exclude deals with missing maturity or amount and deals without information on the borrowers' sales, industry and state. This results in 8,225 syndicated loan deals borrowed by 3,426 firms. Among them 2,048 deals have the information on shares held by lenders. The facility-level dataset has 7,493 observations after the matching with Compustat, Call reports and Y-9C reports.

3.3.2 Key Variables

The narrative measure of Odyssean forward guidance is a categorical variable based on the FOMC statements. We select dates on which the statements contain updates in the policy commitment and categorize them into expansionary or contractionary as described in the previous chapter. The advantage of this measure is that it captures the change of the forward-looking language itself rather than the correspondent reactions of the market, which is utilised by other widely used measures, notably the GSS measure. To use the numerical measure we would have to make the assumption that the loan market would interpret the forward guidance in the same way as the stock and futures market. i.e. an Odyssean forward guidance defined by the reactions of the stock market and futures market would not be interpreted by the loan market as Delphic. This might be questionable since the securities market reacts speedily to news and tends to overreact to shocks whereas the loan market moves relatively slow as shown in previous chapter. Given that the previous chapter has shown similar results from both measures, we employ only the narrative measure in this chapter.

The new borrower is defined based on a borrower's past borrowing history within a specified horizon. Since syndicated loans also have the feature of relationship lending, a firm usually sticks to the same bank to accumulate the market reputation. Therefore, a familiar borrower is considered less risky by the bank due to the private knowledge the bank has acquired from previous lending. Since we do not have the whole history of syndicated loans we define the new borrower to a bank as a firm that has not borrowed from it for the past certain years. In order to see how this riskiness is affected by the familiarity between the bank and the borrower, we consider three scenarios: 3, 5, and 8 years. A firm borrowed from the bank 8 years ago is relatively newer than a firm that borrowed from the bank 5 years ago. By comparing the results in different scenarios we can see how marginal information asymmetry contributes to the riskiness of the company.

The syndication structure is captured in three dimensions. The first one is the number of lead arrangers and the loan share held by the lead arranger which reflects the monitoring required to the borrower, since it is the lead arranger's job to monitor the borrowers. The second is the number of participants and especially new participant lenders, which indicate the banks' willingness to join in the syndication and therefore indirectly measure the information asymmetry problem of a borrower perceived by potential lenders. The third dimension is the joint monitoring since sometimes several lenders jointly hold a large portion of the loan. To capture this we calculate a Herfindahl index based on the share distribution among the lenders.

For the analysis of pricing of loans to new borrowers, we control for the same set of loan variables as in the first chapter on the facility level. For the syndication structure analysis, the key firm characteristic is the borrower reputation, which is established through repeated access to the syndication market. It is measured as natural log of one plus the number previous syndicated loans a borrower had in the past. In addition, we also control for the loan amount, maturity, number of facility indicator, collateral, loan purpose and dividend restrictions on the deal level.

3.3.3 Summary Statistics

Sample characteristics for the facility-level sample is the same as in the previous chapter for the loan characteristics. With regards to the new borrower-lender relationship, 61% of the loans are originated to new borrowers by 3-year standard; 52% by 5-year standard and 50% by 8-year standard. The percentage declines as the time horizon is extended due to the fact that syndicated loans are usually very large and therefore most firms would not have multiple syndicated loans within a short period of time.

Sample characteristics at the deal level is presented in Table 3.1 presents the deal-level. The average syndicated loan deal during the banking crisis onwards period has an amount of 391 million US dollars. The syndication consists of 1 lead arranger and 7 participant lenders. 33% of the loan deals contain more than one facility. The lead arranger holds 24% of a syndication loan on average when it is originated. The rest is distributed quite evenly judging by the HHI. The other aspects of the loan characteristics such loan purpose and whether there is a collateral are similar to the facility-level sample. More than half of the borrowers are private companies which reflects the fact that public companies have more alternative ways of financing. Table 3.2 lists the top five lead arrangers (by loan amount) and the top five participant lenders (by number of deals) in syndicated loan market for the post-2008 period. Citibank has been both the top lead arranger and the top participant with a market share more than twice of Goldman Sachs, which comes at the second place as lead arranger. The top five participant banks are involved in total around 37% of the syndicated loans in the market.

3.4 Results Analysis

3.4.1 New Borrower-lender Relationship

First, we examine the probability of a new borrower-lender relationship being established in a loan subsequent to forward guidance by estimating a linear probability model. The reason for choosing a linear probability model over a probit model is that we include fixed effects in our regression. Gomila (2020) argues that linear probit models are more effective in examining causal effects with the presence of fixed effects or interactions[10]. The model is the following:

$$New\ borrower_{l,f,b,t} = a_y + \delta_n Forward\ guidance\ (t-n) + \alpha Shadow\ rate_{t-1} +$$

$$\boldsymbol{\beta' X_{l,t}} + \boldsymbol{\gamma' Y_{b,t-1}} + \boldsymbol{\phi' Z_{f,t-1}} + \boldsymbol{\chi' E_{t-1}} + \varepsilon_{l,f,b,t} \qquad (1)$$

where $New\ borrower_{l,f,b,t}$ is the indicator variable defined as in the previous section. a_y is the year fixed effect. Other control variables are the same as used in previous chapter.

Table 3.3 reports the regression results for all the loans as well as the two dominant types of syndicated loans, namely term loans and credit lines, in order to granularly examine the credit

[10] Using a probit model does not change the result. The estimation of probit model is shown in Table B.2 in the appendix.

relationships. We find that the significance of forward guidance is driven by credit lines while term loans are not affected. The credit lines differ from the term loans since they are mainly used as working capital whereas term loans are usually transaction-driven. Therefore the loan contract terms for term loans mainly reflect the risk of the specific project the loan is financing. In contrast, credit lines, analogous to credit cards to consumers, are based on the general creditworthiness of the firms. Credit lines are also considered riskier due to the difficulty to track their final use (Chakraborty, Fernando and Mallick 2010). This result suggest that the impact of forward guidance falls on the firm level instead of project level.

The positive sign of forward guidance (t-2) indicates that a credit line originated two months after an expansionary forward guidance is more likely to be given to a new borrower. This is not found for forward guidance (t-1) since the establishment a new borrower-lending relationship takes months and the negative sign mainly reflects the impact of economic downturn. Besides, the effect is found to be stronger when the time horizon of the new borrower definition is longer. Since a borrower whose most recent loan from a bank is 8 years ago should be opaquer than a borrower whose most recent relationship with the bank is 5 years ago and thus would be considered riskier, the results further support that riskier borrowers are more likely to get credit lines subsequent to expansionary forward guidance.

Next, we investigate whether the pricing of the loans to new borrowers are also preferable. Table 3.4 and 3.5 reports the effect of forward guidance on loan spreads for all loans and by types respectively. The positive coefficients of new borrower are expected since new borrowers are considered to have more information asymmetry problem and they are given higher spreads as a compensate for the additional risk. This positive relationship is mitigated by forward guidance. The negative interaction terms indicate that new borrowers get more reduction in loan spreads when forward guidance is in place. This result is consistent with the results in previous chapter where expansionary forward guidance reduces the cost of corporate loans especially for riskier firms. Based on the estimation in column (12) in Table 3.4, a new borrower gets 8.5% lower loan spread when an expansionary forward guidance is given two months ago compared with no guidance. This translates to 19.98 basis points extra reduction in loan spreads than an established borrower for an average loan since the financial crisis. Furthermore, this effect is significant for both term loans and credit lines. It is worth noting that the result does not mean riskier firms get better deals than safer firms, rather it shows that riskier firms get disproportionately more reduction in loan spread than safer firms under the influence of forward guidance. Again, the significance only comes after two months, which suggests that the loan market needs some time to absorb the new information from the FOMC.

3.4.2 Syndication Structure

Before we look at the syndication structure we first need to understand the syndication process. The terms of loans are drawn up by the lead arrangers in the beginning of book-running, and can be altered if there is not enough interest in this deal. The book-running process usually takes around 46 days (Bruche, Malherbe, and Meisenzahl 2020). For a granular assessment, we exam the timing of the impact of forward guidance on new loan originations by constructing a weekly measure of Odyssean Forward Guidance in the same vein of chapter 2 and regress the loan spreads on the weekly measure. As shown in Table 3.6, we find that a strong negative impact of forward guidance on loan spreads emerges from week 4 onwards, with most significance seen consistently between weeks 6 and 8. This indicates that announcement of the forward guidance affects the initial stages of the book-running process, when the lead arranger proposes the terms of the loans based on market conditions. The results establish that monetary policy has significant effects on the syndication process affecting the new risk originations subsequent to the issuance of the forward guidance. In Table 3.7 the triple interaction with 8 weekly measures include 32 interaction terms and makes the model over-identified. Nevertheless, we find significance for the triple interaction terms mainly come after 4 weeks.

Next we investigate how the syndication structure is affected. In Table 3.4 and 3.5 we have shown that new borrowers to a certain lender are more likely to get a loan with lower spreads after a forward guidance, which suggests that forward guidance, by providing more certainty about the market, eases banks' concern about the information asymmetry problem of borrowers. The asymmetric information is well reflected in the structure of the syndication (Sufi 2007). Therefore, we can examine how forward guidance affects banks' perception of the information asymmetry problem by looking at how syndication structure is affected. Table 3.8 reports the general effect of forward guidance on the syndication structure. We find that forward guidance significantly reduces the number of lead arrangers while increases the number of participant banks especially participants new to borrowers. Fewer lead arrangers show that less monitoring effort is required by participant banks. A larger number of participants, especially new participant banks who have no prior relation with the borrowers, also indicates a stronger willingness to take part in the syndication. This supports the view that forward guidance eases the concern on asymmetric information and the borrowers are considered more transparent.

Finally we check how does this effect of forward guidance interact with the riskiness of the borrowers. Considering the fact that the syndicated loan market is of repeated interactions, a borrower becomes more known to lenders and establishes its reputation through repeated access to the market. Instead of a dummy indicating a new borrower-lender relationship, we construct a measure based on firms' experience in the syndicated market and interact it with forward guidance to examine whether forward guidance affects banks' information asymmetry concern given borrowing firm reputation.

Table 3.9 provides evidence on the deal-level that is consistent with the facility-level results. Forward guidance reduces the share held by lead arrangers and the share concentration measured by HHI, and increases the number of new participants, suggesting that less monitoring effort is required. The positive sign of the interaction term in column (2) shows that a lead arranger would take smaller stakes in a deal with a less reputable borrower provided a forward guidance compared with no guidance. Similarly the positive significance of the interaction term in column (5) indicates that after forward guidance a syndication deal for a less reputable borrower is less concentrated. These results again suggest that less due diligence and monitoring are given to firms that are less known to the market subsequent to forward guidance. Moreover, the negative interaction term in column (3) suggests that potential participants new to a less reputable borrower are more willing to take part in the syndication after forward guidance. The evidence suggests that banks become less concerned about the borrowers' information asymmetry problem and thus supports the theoretical framework that forward guidance increases bank risk-taking. The overall number of lead arrangers and participants, however, are not significantly affected by the interaction term, in contrast to the previous table.

3.5 Conclusion

This chapter extends the first study by examining how the unconventional monetary policy tool, reducing the policy uncertainty, also affects banks' view on asymmetry information which arises from the private information of the borrowers. In particular we investigate the effect of forward guidance on aspects other than loan spread of syndicated loans, notably new borrower-lender relationship and syndication structure, which reflect the perception of risk by the lenders. We find that forward guidance reduces the lead arranger share and the concentration for borrowers less known to the market while increases the willingness of participant banks to take part in the syndication. The result suggest that the asymmetric information concern of banks is eased by forward guidance and the monitoring incentive is less required. Thus, we argue that forward guidance, aimed at reducing the macro uncertainty, also reduces the micro uncertainty pertaining to asymmetry information through bank lending due to banks' special role in the monetary policy transmission.

Table 3.1: Summary Statistics

This table reports the summary statistics on the deal-level from October 2008 to June 2017.

Variable	Obs	Mean	Std. Dev.	Min	Max
Loan					
Number of lead arrangers	8,255	1.409	1	0	19
Number of participants	8,255	6.673	7	0	58
Deal amount (log)	8,255	5.969	1	0.172	11.019
Maturity (years)	8,255	4.248	2	0	15.083
Multiple facility	8,255	0.334	0	0	1
Secured	8,255	1.184	0.864	0	2
Corporate purpose	8,255	0.698	0.459	0	1
Working capital	8,255	0.103	0.304	0	1
Debt repayment	8,255	0.025	0.156	0	1
Dividend restrictions	8,255	0.777	0.855	0	2
Share held by lead arranger*	2,048	0.239	0.237	0	1
Concentration of syndicate (HHI)	1,879	2,097	2,379	254	10,000
Firm					
Firm sales (log)	3,426	6.804	1.780	-6.210	14.427
Private	3,426	0.552	0.497	0	1
Borrower reputation	3,426	1.479	0.931	0	3.912

*Represents the average share held by lead arrangers when there is more than one lead arranger in one deal.

Table 3.2: Top Lead Arrangers and Participant Banks

This table lists the top five lead arrangers (by deal amount) and top five participants (by total number of deals) for syndicated loans in the sample period from October 2008 to June 2017.

Lead arrangers		**Participants**	
Bank name	Market share	Bank name	Number of deals
Citibank	0.336	Citibank	858
Goldman Sachs & Co	0.118	Fifth Third Bank	699
Credit Suisse AG	0.070	Union Bank NA	632
Bank of America	0.070	Wells Fargo & Co	450
SunTrust Bank	0.043	SunTrust Bank	423
Total amount (Billion USD)	188	Total deals	3,062
Market HHI	1,450		

Table 3.3: New Borrower-lender Relationships

This table reports the LPM regression results for the dependent variable capturing whether or not the bank enters into a new borrower-lender relationship. The dependent variables take the value of 1 if the borrowing firm has not borrowed a syndicated loan from the bank in the previous 3, 5, or 8 years. The results for the new of issuance term loans and credit lines are separately reported. Forward guidance indicator variables capture Odyssean forward guidance issued one, two, or three months before the loan origination date. The sample period is from October 2008 to June 2017. Y indicates that the set of control variables or fixed effects is included. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

	All loans			Term loans			Credit lines		
	3 years	5 years	8 years	3 years	5 years	8 years	3 years	5 years	8 years
Forward guidance (t-1)	-0.0361**	-0.0135	-0.015	0.0003	0.0438	0.0250	-0.071***	-0.056***	-0.046**
	(-2.41)	(-0.86)	(-0.93)	(0.01)	(1.57)	(0.87)	(-3.76)	(-2.85)	(-2.31)
Forward guidance (t-2)	0.010	0.042***	0.047***	0.008	0.038	0.035	0.009	0.043**	0.052**
	(0.64)	(2.58)	(2.88)	(0.28)	(1.37)	(1.25)	(0.43)	(2.08)	(2.49)
Forward guidance (t-3)	-0.010	-0.003	-0.023	-0.006	-0.008	-0.027	0.0002	0.009	-0.012
	(-0.59)	(-0.15)	(-1.25)	(-0.21)	(-0.24)	(-0.84)	(0.01)	(0.41)	(-0.51)
Loan-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bank-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y
Economy-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y
Number of observations	7,493	7,493	7,493	2,469	2,469	2,469	4,654	4,654	4,654

Table 3.4: New Borrower-lender Relationships and Loan Spreads

This table reports the loan-level regression estimates, where the dependent variable is the log of loan spread. The New borrower dummy equals 1 if the borrowing firm has not borrowed a syndicated loan from the bank in the previous 3, 5, or 8 years. The results for the new of issuance term loans and credit lines are separately reported. Forward guidance indicator variables capture Odyssean forward guidance issued one, two, or three months before the loan origination date. The sample period is from October 2008 to June 2017. Standard errors are clustered at the bank-year level. Y indicates that the set of control variables or fixed effects is included. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

	Results for All loans											
	3 years				5 years				8 years			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Forward guidance (t-1)	-0.059			-0.086**	-0.094**			-0.131***	-0.100***			-0.138***
	(-1.53)			(-2.08)	(-2.55)			(-3.11)	(-2.74)			(-3.28)
Forward guidance (t-2)		-0.032		-0.064*		-0.059*		-0.101**		-0.067**		-0.110***
		(-1.01)		(-1.79)		(-1.73)		(-2.53)		(-1.98)		(-2.80)
Forward guidance (t-3)			-0.032	-0.065*			-0.078**	-0.116***			-0.076**	-0.116***
			(-0.89)	(-1.69)			(-1.99)	(-2.78)			(-2.03)	(-2.87)
New borrower	0.080***	0.091***	0.083***	0.103***	0.074***	0.090***	0.080***	0.087***	0.071***	0.088***	0.078***	0.081***
	(3.32)	(4.03)	(3.91)	(4.20)	(3.64)	(4.43)	(4.35)	(3.88)	(3.74)	(4.61)	(4.58)	(3.99)
Forward guidance (t-1)*New borrower	-0.042			-0.062	0.015			0.005	0.028			0.018
	(-1.04)			(-1.53)	(0.37)			(0.10)	(0.70)			(0.43)
Forward guidance (t-2)*New borrower		-0.130***		-0.141***		-0.100**		-0.099**		-0.089**		-0.085*
		(-3.54)		(-3.66)		(-2.34)		(-2.16)		(-2.05)		(-1.86)
Forward guidance (t-3)*New borrower			-0.113***	-0.118***			-0.052	-0.051			-0.058	-0.053
			(-2.89)	(-2.91)			(-1.25)	(-1.16)			(-1.51)	(-1.32)
Loan-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bank-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Economy-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm×year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Number of Observations	7,493	7,493	7,493	7,493	7,493	7,493	7,493	7,493	7,493	7,493	7,493	7,493

Table 3.5: New Borrower-lender Relationships and Loan Spreads: by Loan Types

This table reports the loan-level regression estimates for new borrowers. The dependent variable is the natural log of loan spread. The New borrower dummy equals 1 if the firm has not borrowed from a certain bank for 3, 5, or 8 years. All specifications include firm-year fixed effects. Standard errors are clustered at the bank-year level. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

Results for Term loans

	3 years				5 years				8 years			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Forward guidance (t-1)	-0.039			-0.0530	-0.061*			-0.077**	-0.050			-0.064*
	(-1.18)			(-1.40)	(-1.90)			(-2.10)	(-1.61)			(-1.84)
Forward guidance (t-2)		0.013		-0.008		0.013		-0.012		0.018		-0.006
		(0.52)		(-0.30)		(0.53)		(-0.39)		(0.72)		(-0.20)
Forward guidance (t-3)			-0.060*	-0.073**			-0.072	-0.088*			-0.074*	-0.088*
			(-1.72)	(-2.00)			(-1.53)	(-1.77)			(-1.69)	(-1.91)
New borrower	0.017	0.031*	0.021	0.030	0.005	0.025	0.012	0.016	0.019	0.038**	0.0232	0.031
	(0.81)	(1.67)	(1.11)	(1.10)	(0.27)	(1.40)	(0.69)	(0.65)	(0.98)	(2.22)	(1.33)	(1.34)
Forward guidance (t-1)*New borrower	0.020			0.010	0.057			0.048	0.040			0.029
	(0.44)			(0.20)	(1.28)			(1.01)	(0.92)			(0.63)
Forward guidance (t-2)*New borrower		-0.070**		-0.069*		-0.078**		-0.071**		-0.088***		-0.083**
		(-2.29)		(-1.97)		(-2.49)		(-2.01)		(-2.84)		(-2.40)
Forward guidance (t-3)*New borrower			-0.023	-0.023			-0.005	-0.003			-0.001	-0.001
			(-0.42)	(-0.39)			(-0.09)	(-0.04)			(-0.01)	(-0.01)
Loan-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bank-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Economy-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm×year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Number of Observations	2,469	2,469	2,469	2,469	2,469	2,469	2,469	2,469	2,469	2,469	2,469	2,469

Results for Credit lines

	3 year				5 year				8 year			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Forward guidance (t-1)	-0.078**			-0.088**	-0.081**			-0.096***	-0.074**			-0.090***
	(-2.01)			(-2.27)	(-2.50)			(-2.82)	(-2.35)			(-2.69)
Forward guidance (t-2)		0.000		-0.026		-0.009		-0.039		-0.014		-0.043
		(0.02)		(-0.88)		(-0.32)		(-1.25)		(-0.51)		(-1.43)
Forward guidance (t-3)			-0.002	-0.025			-0.031	-0.054			-0.034	-0.057*
			(-0.07)	(-0.75)			(-0.98)	(-1.63)			(-1.24)	(-1.89)
New borrower	0.001	0.011	0.013	0.015	0.022	0.032*	0.0315**	0.030*	0.028*	0.036**	0.035**	0.035**
	(0.06)	(0.54)	(0.72)	(0.80)	(1.31)	(1.77)	(2.02)	(1.91)	(1.74)	(2.03)	(2.36)	(2.23)
Forward guidance (t-1)*New borrower	0.007			-0.007	0.018			0.010	0.005			-0.002
	(0.16)			(-0.17)	(0.42)			(0.23)	(0.11)			(-0.05)
Forward guidance (t-2)*New borrower		-0.052		-0.056*		-0.043		-0.042		-0.036		-0.035
		(-1.58)		(-1.80)		(-1.14)		(-1.12)		(-0.93)		(-0.91)
Forward guidance (t-3)*New borrower			-0.107***	-0.104***			-0.075**	-0.072**			-0.075**	-0.072**
			(-3.06)	(-3.12)			(-2.24)	(-2.20)			(-2.57)	(-2.54)
Loan-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bank-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Economy-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm×year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Number of Observations	4,654	4,654	4,654	4,654	4,654	4,654	4,654	4,654	4,654	4,654	4,654	4,654

Table 3.6: Response of Loan Spread to Forward Guidance using Weekly Measure

This table reports the regression results related to the effect of forward guidance on loan spreads. The dependent variable is the log of loan spreads. Sample period is from October 2008 till June 2017. Forward guidance indicator variables capture Odyssean forward guidance issued one, two, three, four, five, six, seven or eight weeks before the loan origination date. Standard errors are clustered at the bank-year level. Y indicates that the set of control variables or fixed effects is included. The list of control variables and their definitions are provided in Table 2.1. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)
Weekly forward guidance (t-1)	-0.062	-0.073*
	(-1.58)	(-1.96)
Weekly forward guidance (t-2)	-0.094*	-0.086
	(-1.80)	(-1.64)
Weekly forward guidance (t-3)	-0.043	-0.024
	(-0.89)	(-0.49)
Weekly forward guidance (t-4)	-0.176***	-0.149***
	(-4.34)	(-3.71)
Weekly forward guidance (t-5)	-0.031	-0.012
	(-0.60)	(-0.21)
Weekly forward guidance (t-6)	-0.102***	-0.105**
	(-2.64)	(-2.36)
Weekly forward guidance (t-7)	-0.058*	-0.055
	(-1.70)	(-1.34)
Weekly forward guidance (t-8)	-0.174***	-0.139***
	(-4.64)	(-3.38)
Shadow rate	-0.007	-0.009
	(-0.47)	(-0.62)
Loan-level variables	Y	Y
Bank-level variables	Y	Y
Firm-lever variables	Y	
Economy-level variables	Y	
Firm × year fixed effects	Y	
Firm × month fixed effects		Y
Number of Observations	7,493	7,493

Table 3.7: Response of Loan Spread to Forward Guidance with Triple Interaction using Weekly Measure

This table reports the results of Eq. (3) in chapter 2, with the triple interactions of forward guidance, bank capital, and firm risk measures (denoted R). The dependent variable is the log of loan spread. The firm risk measure is book leverage in column (1) and credit rating in column (2). Forward guidance variables capture Odyssean forward guidance issued one to eight weeks before the loan origination date. The sample period is from October 2008 till June 2017. Standard errors are clustered at the bank-year level. Y indicates that the set of control variables or fixed effects is included. The list of control variables and their definitions are provided in Table 2.1. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	R=Book leverage	R=Z-score
	(1)	(2)
Weekly forward guidance (t-1)*R*Capital ratio	-15.02	-6.156
	(-1.23)	(-1.36)
Weekly forward guidance (t-2)*R*Capital ratio	-44.15**	3.210
	(-2.29)	(0.88)
Weekly forward guidance (t-3)*R*Capital ratio	-1.662	-3.020
	(-0.10)	(-0.78)
Weekly forward guidance (t-4)*R*Capital ratio	-7.996	2.428
	(-0.66)	(0.80)
Weekly forward guidance (t-5)*R*Capital ratio	-44.98***	6.346*
	(-3.06)	(1.70)
Weekly forward guidance (t-6)*R*Capital ratio	-19.93	7.233**
	(-1.44)	(2.02)
Weekly forward guidance (t-7)*R*Capital ratio	-12.78	3.779*
	(-1.03)	(1.89)
Weekly forward guidance (t-8)*R*Capital ratio	-6.644	-2.473
	(-0.60)	(-0.91)
Other interaction terms	Y	Y
Shadow rate and interactions	Y	Y
Loan-level variables	Y	Y
Bank-level variables	Y	Y
Firm × year fixed effects	Y	Y
Number of observations	7,493	7,493

Table 3.8: Response of Syndication Structure to Forward Guidance

This table reports the regression results related to the syndicate structure. The dependent variables are the number of lead arrangers, participants, new participant lenders, the share held by lead arrangers and a Herfindahl index (HHI) based on the shares held by all lenders. The firm controls include firm sales, an indicator variable equals to 1 if the firm is private and borrower reputation (measured as ln(1+previous loans by firm)). Forward guidance indicator variables capture Odyssean forward guidance issued one, two, or three months before the loan origination date. The sample period is from October 2008 to June 2017. Standard errors are clustered at the bank-year level. Y indicates that the set of control variables or fixed effects is included. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

	number of lead arrangers	share held by lead	number of participants	number of new participants	HHI
Forward guidance (t-1)	-0.017	-0.012	-0.157	0.052	-142.8
	(-0.35)	(-0.76)	(-0.83)	(0.35)	(-0.88)
Forward guidance (t-2)	0.013	0.017	-0.275	-0.095	222.7
	(0.24)	(0.99)	(-1.40)	(-0.67)	(1.20)
Forward guidance (t-3)	-0.145***	-0.008	0.413*	0.279*	-85.23
	(-2.74)	(-0.57)	(1.96)	(1.70)	(-0.51)
Shadow rate	-0.024	0.002	0.062	-0.020	42.67
	(-0.99)	(0.23)	(0.57)	(-0.23)	(0.54)
Borrower reputation	-0.017	-0.002	-0.012	-0.810***	-57.61
	(-0.65)	(-0.35)	(-0.10)	(-8.90)	(-0.74)
Loan controls	Y	Y	Y	Y	Y
Firm controls	Y	Y	Y	Y	Y
Economy controls	Y	Y	Y	Y	Y
Industry fixed effects	Y	Y	Y	Y	Y
Year fixed effects	Y	Y	Y	Y	Y
Number of observations	8,255	2,048	8,255	6,667	1,879

Table 3.9: Response of Syndication Structure to Forward Guidance: Interaction with Borrower Reputation

This table reports the regression results related to the syndicate structure. The dependent variables are the number of of lead arrangers, participants, new participant lenders, the share held by lead arrangers and a Herfindahl index (HHI) based on the shares held by all lenders. The firm controls include firm sales, an indicator variable equals to 1 if the firm is private and borrower reputation (measured as ln(1+previous loans by firm)). Forward guidance indicator variables capture Odyssean forward guidance issued one, two, or three months before the loan origination date. The sample period is from October 2008 to June 2017. Standard errors are clustered at the bank-year level. Y indicates that the set of control variables or fixed effects is included. The list of control variables and their definitions are provided in Table 2.1. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

	number of lead arrangers	share held by lead	number of participants	number of new participants	HHI
Forward guidance (t-1)	-0.081	-0.055*	0.131	0.365	-682.9**
	(-0.96)	(-1.73)	(0.42)	(0.99)	(-2.02)
Forward guidance (t-2)	-0.002	0.0442	-0.043	0.685*	511.7
	(-0.02)	(0.94)	(-0.12)	(1.82)	(0.98)
Forward guidance (t-3)	-0.070	-0.033	0.028	0.140	-326.9
	(-0.84)	(-0.91)	(0.07)	(0.34)	(-0.81)
Forward guidance (t-1)*Borrower reputation	0.037	0.024*	-0.164	-0.157	306.2**
	(0.73)	(1.78)	(-0.89)	(-0.91)	(2.10)
Forward guidance (t-2)*Borrower reputation	0.008	-0.015	-0.127	-0.381**	-154.0
	(0.14)	(-0.75)	(-0.67)	(-2.23)	(-0.72)
Forward guidance (t-3)*Borrower reputation	-0.042	0.0138	0.215	0.0709	133.4
	(-0.87)	(0.88)	(0.94)	(0.37)	(0.77)
Shadow rate	-0.024	0.0024	0.061	-0.016	50.62
	(-0.99)	(0.34)	(0.57)	(-0.19)	(0.65)
Loan controls	Y	Y	Y	Y	Y
Firm controls	Y	Y	Y	Y	Y
Economy controls	Y	Y	Y	Y	Y
Industry fixed effects	Y	Y	Y	Y	Y
Year fixed effects	Y	Y	Y	Y	Y
Observations	8,255	2,048	8,255	6,667	1,879

Chapter 4 The Effect of Quantitative Easing on Bank Deposits

Highlights

- This study investigates the effect of QE on bank deposits utilizing the cross-sectional variation in the position of targeted assets in bank balance sheets.
- QE1 and QE3 are found to increase the deposit spreads and decrease the deposit amount. A higher price and a lower quantity suggest that this is a supply side effect.
- QE2 does not significantly affect deposit spreads as banks hold little Treasury securities that are targeted by QE2 but it increases deposit amount from the demand side.
- Banks simultaneously adjust their mortgage rates along with the deposit rates.
- The results indicate that QE reduces banks' dependence on deposit funding through a liquidity effect. The effect goes further to the lending side through the bank balance sheet.

4.1 Introduction

Quantitative easing (QE) has been widely used by central banks as a resort to stimulate the economy following the Global Financial Crisis. Under the QE program Federal Reserve conducted three rounds (November 25, 2008, November 3, 2010 and September 13, 2012) of Large-scale Asset Purchases (LSAPs) in order to reduce yields and foster bank lending. QE has since attracted considerable research attention. There is a substantial debate on whether QE successfully stimulates the economy especially through bank lending (Rodnyansky and Darmouni 2017, Frastzscher, Lo Duca and Straub 2018; Chakraborty, Goldstein and MacKinlay 2020; Karadi and Nakov 2021). However, little attention has been paid to its effect on bank deposits, which is the main funding source for bank lending. These questions are becoming more relevant since recently the Federal Reserve has cut the target federal funds rate back to the range between 0 and 0.25 percent and announced a new round of asset purchase.

Although various channels of QE have been proposed (Krishnamurthy and Vissing-Jorgensen 2011; Curdia and Woodford, 2011; Gertler and Karadi, 2011), they mainly model the changes in the asset yields or the interest rates with regards to the balance sheet of the central bank. The role of banks, which were at the center of the financial crisis, has been neglected. A few recent researches have investigated the impact of QE on bank lending (Rodnyansky and Darmouni 2017; Chakraborty, Goldstein and MacKinlay 2020), focusing on how banks benefiting from the asset purchases change their lending behavior. The effect of QE on bank lending, however, is not complete without examining the liability side of the banks, i.e. the funding source of the lending. Deposits, as the most important source of bank funding deserve a closer examination in the context of monetary policy transmission. A novel work of Drechsler, Savov and Schnabl (2017) proposes the deposits channel, where banks contracts their deposit during monetary policy tightening by increasing the deposit spreads by virtue of their market power. This theory provides a new foundation from the liability side to the bank balance sheet channel. However, Drechsler, Savov and Schnabl (2017) only discusses the situation of monetary policy tightening, left the implication of monetary policy easing implicit. Moreover, since the bank funding structure is fragile and subject to financial crisis (Diamond and Dybvig 1983), whether this channel is affected by the financial crisis is unanswered. To provide more insights to these questions, this research investigates how the deposits channel is affected by the unconventional monetary policy in the wake of the financial crisis. We focus on QE since it by nature differentially affects the reserves of banks and thus creates a sample with heterogeneity to exploit.

In this study, we investigate how QE affects the bank deposit funding especially the pricing and the supply of deposit using a difference-in-difference strategy following Rodnyansky and Darmouni (2017). We classify banks into treatment group and control group based on their holdings of the target assets of QE. Employing a propensity score matching we are able to compare otherwise similar treated banks and control banks before and after the QE intervention, utilizing the branch-level deposit rate data from RateWatch and bank-level deposit amount data from Call Reports. The branch-level deposit rates data is helpful to the isolation of a supply side effect since they are the ex-ante prices set by branches instead of the widely used implied deposit rates calculated from the (ex-post) interest rate income. In addition, we include branch fixed effects to control for the lending demand facing different branches. We find that QE1 and QE3 significantly increase the deposit spreads for treated banks while QE2 has no effect. Further, we find that this effect of QE is not linked to bank market power. On the bank level, we find that QE1 and QE3 reduce the deposit amount while QE2 increases the deposit amount. This evidence overall supports the view that QEs targeted on mortgage-backed securities provide liquidity to banks holding a higher volume of such securities and crowd out their deposit, and the role of bank market power in deposits channel is less important during monetary policy easing. As an extension, we examine whether banks transmit the effect of QE on deposits to the mortgage lending. By looking at the interest margin (the spread of mortgage rate and deposit rate) of banks, we are able to see whether banks adjust their mortgage lending rates accordingly when the deposit rates are reduced. We find insignificant effect of QE1 on interest margin, suggesting that the mortgage rate is commensurately adjusted. QE3 significantly decreases the interest margin due to the fact that the deposit rate already has no more space to reduce during the third round of asset purchasing while the mortgage rate keeps dropping. This result indicates that at least for QE1, the effect is transmitted from the liability side to the asset side within the bank balance sheets.

This study is related to the large literature on the transmission of the monetary policy. First of all, we contribute to the literature that investigates the transmission channels of QE. Eggertsson and Woodford (2004) proposed a signaling channel based on the setting of a liquidity trap, arguing that unconventional monetary policy can benefit the economy be signaling a credible commitment to keep the interest rates low. Krishnamurthy and Vissing-Jorgensen (2011) comprehensively discussed 7 channels with empirical evidence on asset yields. The most notable three channels are the portfolio rebalancing channel, the segmentation channel and the capital constraints channel. Focusing on the bank lending, Rodnyansky and Darmouni (2017) find that QE1 works through the net worth channel where the asset purchases increase the bank net worth and hence encourages bank lending, whereas QE3 works through the liquidity channel as they are provided with more liquidity in the form of reserves. In contrast, Chakraborty, Goldstein and MacKinlay (2020) find that QE encourages new origination of mortgage and has a crowding out effect on commercial lending. Also looking at the mortgage lending, Di Maggio, Kermani and Palmer (2020) document a refinancing channel where lower mortgage rates induced by QE encourages refinancing activity of households and thereby stimulates consumption. By investigating the effect of QE on deposits, we provide more support from the liability side to the transmission of QE through bank balance sheets and also contribute to the discussion of the asset-liability synergy of banks (Diamond and Rajan 2000; Hanson, Shleifer and Vishny 2015). As far as we are concerned, there is little research on how QE affects deposits. Diamond, Jiang and Ma (2021) investigate the effect of QE on bank balance sheet which including deposit, mortgage and corporate loans. While we share the same view that banks would adjust loans and deposits simultaneously in response to the QE, this research differs from theirs in three ways. First, their finding about deposit comes from a counterfactual simulation based on a new theoretical model where the costs of deposit and loans depend on the composition of the entire balance sheet. In other words, their cost of deposit is not only affected by the amount of deposit, but also by the amount of mortgage and corporate loans. This cost of deposit incorporates cost or benefit indirectly induced by holding other assets through the "cost synergy" and is therefore not equivalent to deposit rate and not directly interpretable, whereas we focus on the real price households are paying for holding deposits. Second, they assume the loan demand curve does not change after the QE which might be questionable. In contrast, we do not make any assumptions about the loan demand. Third, their work does not distinguish different rounds of QEs.

Second, we build on a nascent literature on deposits channel, which provides more foundation to the bank balance sheet channel from the liability side of banks. Drechsler, Savov and Schnabl (2017) claim that the deposits channel accounts for the entire transmission of monetary policy through banks. Inspired by this theory we examine the deposit of banks under the unconventional monetary policy regime, providing more evidence on the key role banks play in the transmission of monetary policy. Another feature of this theory, the banks' market power, has drawn some recent attention of research which has shown mixed empirical results. Li, Ma and Zhao (2019) find that the pass-through of Treasury supply to bank deposit funding is more potent in less concentrated markets, contrary to the effect of Federal funds rate. Scharfstein and Sunderam (2016) find that the banks' market power in mortgage market seem to impede the transmission of monetary policy. We contribute to this discussion by checking how the impact of QE on deposit spreads interact with market concentration.

Third, we are also related to the banking literature about the liquidity provider role of banks during the financial crisis. Acharya and Mora (2015) find that at the onset of the financial crisis banks increase deposit rates to fulfil their undrawn credit commitments, as the aggregate inflow of deposit into banks has broken down. Contrary to this, Ben-David, Palvia, and Stulz (2019) find that deposits of distressed banks shrink and that the interest rate they pay falls as a resort to deleverage by reducing liabilities. Musto, Nini and Schwarz (2014) also find that liquidity providers showed a particular aversion at the peak of the crisis to expanding their balance sheets. Our results from the QE intervention provides additional support to the view that banks are less dependent on deposit funding since the financial crisis.

Finally, our evidence of the deposit spreads and deposit amount also contribute to the discussion on whether the deposit rates are primarily determined by the depositors (supply of fund) or banks (demand of fund). The internal capital market theory argues that the deposit rates are driven by banks based on their internal funding needs and predicts a positive relationship between deposit rate and deposit amount since the banks would increase the deposit rate in some branches to attract deposit flows in order to meet the loan demand in other branches (Gatev and Strahan 2006; Ben-David, Palvia and Spatt 2017). On the other hand, the market discipline theory argues that the deposit rates are mainly determined by the supply from households and companies. Depositors discipline banks by requiring higher deposit rates and withdrawing deposits from riskier banks (Park and Peristiani 1998; Peria and Schmukler 2001; Nier and Baumann 2006). However, there is also evidence showing that market discipline is reduced since the introduction of deposit insurance (Demirgüç-Kunt and Huizinga 2004). Our findings of an increase in deposit spreads coupled with an outflow of deposit amount show that the deposit rates are more likely to be affected by the demand of bank and therefore are in favor of the internal capital market theory.

The rest of the chapter is structured as follows: Section 4.2 discusses the previous theories and the development of our hypotheses; Section 4.3 describes the data and the identification strategy; Section 4.4 presents the regression results and Section 4.5 concludes.

4.2 Theoretical considerations and hypotheses development

The short-term debt funds the vast majority of bank lending due to the special role banks play in transforming illiquid long-term assets into liquid short-term near-money assets (Krishnamurthy and Vissing-Jorgensen 2015). This liquidity service is valued by households who have a preference for liquidity, which consists of mainly cash and deposits. Alternatively, households can invest in bonds which are illiquid and pay a return based on the benchmark interest rate such as Federal funds rate. The opportunity cost of holding deposits therefore can be measured by the difference between the benchmark interest rate and the deposit rate, namely deposit spread (Kurlat 2019). This can be seen as the price earned by banks for providing deposit products.

Therefore, banks generate profits from both households and firms by providing deposits and loans to them respectively and maximize the overall profit from the deposit service and the loan service (Drechsler, Savov and Schnabl 2017; Diamond, Jiang and Ma 2021). As providers of deposit service, banks can adjust the supply of deposits by changing the deposit rate according to the market condition in order to optimize their profit. Drawn upon this theory, we would expect banks benefiting from the QE to reduce the amount of deposits since deposits are costlier than reserves given the same level of demand from lending[11]. Moreover, the reduction in deposit amount should go in tandem with a rise in deposit spreads if it is a supply side effect. This effect is supposed to be more potent for QE1 and QE3 which include large-scale purchases of mortgage-backed securities (MBS) that constitutes a significant part of bank balance sheets, whereas QE2 which focuses on Treasury securities that are sparsely held by banks, is expected to have little effect. Therefore we formulate our first hypothesis as follows:

H1: QE1 and QE3 widen the deposit spreads and reduce deposit amount for affected banks.

Apart from the effect through bank reserves, QE might also affect the deposits channel through the change in the Treasury supply. The theories on liquidity premium predict that an increase in the Treasury supply is associated with a contraction in deposit and a widen in deposit spread since the liquid government debt crowd out part of bank lending financed by deposit (Krishnamurthy and Vissing-Jorgensen 2015; Nagel 2016; Li, Ma and Zhao 2019). A decrease in Treasury supply caused by central bank purchases therefore should increases the deposit amount since a lower Treasury yield makes deposit more attractive. However, the deposit spreads might not be affected in a symmetric way for two reasons. First, it is a demand side effect and banks should increase instead of decreasing the deposit spreads if anything. Second, during the zero lower bound the deposit rates have little room to go further down. The effect on deposit amount should be stronger for QE2 which exclusively targets at Treasury securities. For QE1 and QE3 the

[11] The cost of deposits is higher since banks need to maintain customers and they also face market discipline from depositors even with the existence of deposit insurance (Soledad, Peria and Schmukler 2001).

purchases of Treasury securities are relatively small and thus the offsetting effect to the reduction caused by the reserves should be negligible. To this end we formulate our second hypothesis as follows:

H2: QE2 does not affect deposit spreads but increases deposit amount for affected banks.

4.3 Data and Research Design

4.3.1 Data

The deposit rate data comes from RateWatch. RateWatch reports a weekly survey of interest rates paid on various types of deposits from bank branches, covering approximately 70% of total deposits in the US. We focus on the most frequently quoted deposit products in RateWatch: money market accounts requiring a minimum balance of $25,000 (MM25K) and 12-month certificates of deposit requiring a minimum balance of $10,000 (12MCD10K), representing savings and time deposits respectively. Same types of deposits with different terms and amounts are also considered as a robustness check. We restrict the sample to branches that set their own rates. The deposit amounts on the branch level and other branch characteristics come from the Summary of Deposits (SOD) of Federal Deposit Insurance Corporation (FDIC), which is merged with RateWatch data by the FDIC branch identifier (uninumber). This results in 7,606 branches with MM25K information and 7,840 branches with 12MCD10K information, corresponding to 4,415 banks. Bank-level data comes from US Call Reports and is merged with branch-level data by the bank identifier (certificate number). The federal funds rate and 1-year treasury yield are from Federal Reserve Economic Data (FRED). The shadow rate is from Krippner's Short-term shadow rate. The sample period is from 2008Q1 to 2015Q4.

The detailed definition of all the variables can be found in Table C.1 in the appendix. Following Drechsler, Savov and Schnabl (2017), we use deposit spread (the difference between federal funds rate and deposit rate) to measure the opportunity cost of holding bank deposits. Since the sample highly overlaps with the zero lower bound period, we consider two alternatives to federal funds rate, namely shadow rate and 1-year treasury yield. We also construct a Herfindahl-Hirschman Index for branches based on the shares of the deposit market in each county, which measures the market power of branches. On the bank level, we use bank size, capital ratio and return on assets (ROA) for the matching as well as control variables. The treatment status depends on the amount of MBS and Treasuries banks hold relative to their total assets. We also collect the amount of total deposit, time deposit and savings deposit for banks. Last but not the least, we construct three QE dummies for the three rounds of Large-scale Asset Purchases, which equal 0 before the respective starting dates and 1 since.

Table 4.1 reports the summary statistics of the variables. During our sample period the change of deposit spreads for both savings deposits and time deposits are negative, resulting from the drastic decrease of interest rates following the global financial crisis. The average ROA of banks is 0.7%, manifesting a low level of revenue due to the economic downturn. The average ratio of MBS holding to total assets is 8.5% with a standard deviation of 9.1%, showing that MBS is an important component in banks' balance sheets with a notable cross-sectional variation. In contrast, the average ratio of Treasuries holding to total asset is 0.5%, which comprises an insignificant fraction of the balance sheets. The average amount of total deposits a bank holds during the whole sample period is 1.96 billion USD. The Call Reports stops reporting the amount of savings deposits and time deposits since 2011. The average holdings of savings deposits and time deposits between 2008 and 2010 are 1.01 billion USD and 4.41 million USD respectively.

4.3.2 Identification

Our identification strategy exploits the cross-sectional variation of banks' exposure to the LSAP target assets. In a similar fashion to Rodnyansky and Darmouni (2017), we use a difference-in-difference methodology which relies on the interaction between the advent of the QE and the various levels of MBS or Treasury holdings among banks. The impact of QE on banks are measured by categorizing banks into treatment group and control group based on their holdings of targeted assets relative to total assets in 2008Q1 before the QE intervention. Specifically, banks below the lower quartile of the MBS-to-asset/Treasury-to-asset distribution are defined as control group, whereas banks above the upper quartile of the distribution are defined as treatment group. Although banks might react to QE by manipulating their holdings of MBS and Treasury securities, the relative size of MBS and Treasury securities are quite rigid over time. The three QE announcement dates are respectively November 25, 2008, November 3, 2010 and September 13, 2012.

The causal effect we aim to establish faces an endogeneity problem. The banks in the treatment group might have certain characteristics that simultaneously determine their MBS or Treasury holdings and the impact of QE on them. To address this issue, we use a propensity matching before regressions. First we estimate a Probit model where the dependent variable is the treatment status, and the control variables are bank size, capital ratio and ROA. Next we generate predicted probabilities (propensity score) of being treated for banks to construct a nearest-neighbor matched sample[12]. We use a one-to-one matching approach with replacement and retain the

[12] In order to avoid losing observations and to have a consistent sample across all specifications, the treatment and control groups for the propensity score matching are defined according to the median instead of quartile of the target asset holdings.

frequency weights for those observations in control group that have been matched more than once. This procedure effectively gets rid of observations in control group that are too different from the ones in treatment group based on the three covariates we considered. To evaluate whether the matching method provides a sample that the potential treatment effect is independent of the treatment assignment, we do the following assessments. First we plot the Kernel Density estimates of treatment group and control group in Figure 4.1, from which it is shown that the two groups have similar distributions of the three major bank characteristics. Second, the Probit model is re-estimated based on the matched sample. Table 4.2 presents the Probit regression estimation for the pre-match sample and the matched sample. For the pre-match sample bank size and ROA significantly explain the treatment status, while for the matched sample all the covariates lose significance and therefore cannot predict the treatment status. Moreover, the predicted probabilities of being treated for the matched sample are all in the immediate vicinity of 50%, indicating a randomness in the assignment.

To show the parallel trend between the treated group and the control group, Figure 4.2 plots the average deposit spreads for treated banks and control banks across the sample period. The two groups share a common trend before the first round of QE. We can see the deposit spreads start to increase only 2 quarters after the QE1 is announced since the interest rates responds much faster than the deposit rates. Once the effect of QE1 kicks in, the gap between two groups widens. This is more obvious for the time deposit (12MCD10K) and less visible for the savings deposit (MM25K). QE2 has little impact on the trends. In fact, the gap shrinks to some extent around QE2. After QE3, the gap again widens especially towards the end of our sample although in a very small magnitude.

4.4 Results Analysis

4.4.1 The Impact of QE on Deposit Spread

The initial test of QE impact looks at the average change in deposit spread of treated branches following each QE wave. We start our analysis from a branch-level panel regression:

$$\Delta y_{it} = \alpha_i + \beta' \boldsymbol{QE_t} + \gamma' (Treat_i \boldsymbol{QE_t}) + \varepsilon_{i,t} \tag{1}$$

where Δy_{it} is the change in the deposit spread for branch *i* at time *t*. α_i is the branch fixed effects which control for the lending opportunities facing different branches and other unobservable branch characteristics. $Treat_i$ is an indicator variable which equals to one when the parent bank of this branch is in the treatment group. For QE1 and QE3 the treatment status is defined by the quartiles of the distribution of MBS-to-asset, while for QE2 it is defined by the distribution of Treasury-to-asset. $\boldsymbol{QE_t} = \{QE_{1t}, QE_{2t}, QE_{3t}\}$ is a set of indicator variables which equal to one after the introduction of each QE program. All standard errors are clustered at the county level. The key coefficients of interest are the elements of γ, which capture the difference the branches affiliated to banks that are highly affected and less affected by each round of QE (the treatment effect). A positive γ means deposits become less attractive.

Table 4.3 and 4.4 reports the estimation results for equation (1) for savings deposits (MM25K) and time deposits (12MCD10K) respectively. The deposit spreads in columns (1) and (2) in both tables are calculated with federal funds rate, while the deposit spreads in columns (3) and (4) are calculated by shadow rate. Although our identification relies on the interaction between the treatment status and QE dummies, we also report the interaction between the continuous MBS-to-asset/Treasury-to-asset ratios and QE dummies in order to see whether the amount matters, which also enables us to utilise the full sample. Based on the estimation in column (1) of Table 4.3 and 4.4, a branch of a treated bank increases the savings deposit spread by 3.8 basis points and time deposit spread by 4.7 basis points after QE1. The effect of QE3 is much smaller even when we use the shadow rate with the changes for savings and time deposits being 0.8 and 0.6 basis points respectively based on the estimation in column (3). This is due to the fact that the deposit rates are already at a very low level around the time of QE3. However, they still remain significant. It is worth noting that this estimation is the average effect across the whole sample period, whereas later we will show the immediate effect after each QE, which is significantly larger. The specifications with the continuous MBS-to-asset and Treasury-to-asset variables show similar results. Time deposits in general offer higher rates than savings deposits especially before the financial crisis, while since the crisis the rates of two types of deposit products converge to a low level. It is therefore reasonable that the adjustment of the rates of time deposits following monetary policy changes are less constrained and thus we see a larger impact of QE1 on time deposits.

In contrast, QE2 does not significantly affect the deposit spreads for either the specification with the treatment variable or the continuous variable. Since QE2 focuses on long-term Treasury securities, which banks scantly hold, this result is expected. However, this should not be interpreted as a futility of QE2. Considering that the QE2 lowers the long-term treasury yields, it by nature changes the incentive for households on the investment decision. As we will show later, it does have an effect on the amount of deposits. Moreover, QE2 might affect banking activities in other ways which are beyond the scope of this study. This result is consistent with Rodnyansky and Darmouni (2017), who find that QE2 does not have any significant effect on bank lending.

These results suggest that banks reduce the rates of their deposit products more than the decline of interest rates and essentially make deposits less appealing following Large-scale Asset purchases that are targeted at MBS, which provides them with an extra source of financing.

4.4.2 Placebo Tests

Although the matching process addresses the problem of the non-random assignment of treatment status, the results might suffer from other two potential identification concerns. First, it cannot be ruled out that the MBS holdings itself might be an indicator of the bank behavior during monetary policy easing. In other words, banks with larger MBS holdings might simply tend to reduce deposit rates more regardless of the presence of QE. To alleviate this concern, we run a placebo test for the sub-sample before the QE intervention, controlling for the bank characteristics, county fixed effects and state×time fixed effects, which absorb the time-varying unobservable difference in different regional markets. Table 4.5 presents the estimation results with savings deposit in column (1) and time deposit in column (2), from which we can see banks with relatively larger MBS or Treasury holdings do not act differently on the deposit rates before the QE starts.

Second, since the QE was implemented during an economic downturn, it is possible that the results are driven by the simultaneous economic recession and recovery. In other words, banks with a larger holding in MBS might tend to increase the deposit spread more following a recession. In a similar vein to Rodnyansky and Darmouni (2017), we use a different sample which expands from January 2001 to December 2004 to run a placebo test. The recession following the burst of dot-com bubble in the US provides a placebo QE event that can be used to conduct the experiment. 2002Q1 serves as the placebo QE date since the recession officially ends in 2001Q1. The estimation results are shown in Table 4.6. The interaction term of the placebo QE event and the treatment status has no significant impact on the changes of deposit spreads across different types of deposits.

4.4.3 Time Effects

The baseline regression estimates the average change in deposit spreads before and after QE for highly affected banks. To see how the effect phases in and evolves we estimate the time effects by the following regression:

$$\Delta y_{it} = \alpha_i + \sum_{j=1}^{8} \delta_j (Treat_i AQE1_{jt}) + \sum_{k=1}^{10} \eta_k (Treat_i AQE3_{\boldsymbol{kt}}) + \varepsilon_{i,t} \quad (2)$$

where Δy_{it} is the change in the deposit spread for branch i at time *t*. α_i is the branch fixed effect. $Treat_i$ is defined as before. Instead of having one QE dummy for each round of QE, we generate a dummy variable for each quarter after QE. For example, $AQE1_j$ equals 1 if it is the jth quarter after QE1, and 0 otherwise. We consider the subsequent 8 quarters for QE1 in order not to overlap with QE2, and the subsequent 10 quarters for QE3 as it is the end of our sample.

The estimated coefficients δ and η and their respective confidence intervals are plotted in Figure 4.3. Panel (a) shows the time effects of QE1 on the savings deposit. The shock in the next quarter after the announcement of QE1 is negative, suggesting that interest rates reacts faster than deposit rates. In the second quarter after QE1 there is a positive shock of 30 basis points on the deposit spread of MM25K, which is around one standard deviation. The effect declines slightly and stabilizes around 20 basis points until QE2 starts. The time deposit (panel (c)) shows a similar pattern with a negative shock in the first quarter and a positive shock (40 basis points) in the second quarter which drops gradually to around 20 basis points. It is therefore hard to tell when exactly this effect dies out. Since the federal funds rate is already at the zero lower bound around the time of QE3, we do not see a flip of sign in the shocks. Besides, the shock of QE3 is much smaller compared with QE1 due to the fact that there is less capacity to adjust the deposit rates. The shock in the first quarter after QE3 is 17 basis points for savings deposit and 13 basis points for time deposit. Unlike QE1, the effect of QE3 diminishes faster although it does not completely die out at the end of our sample, indicating that the impact of QE on deposit spread lasts at least for the next 2 years.

4.4.4 Banks Market Power

The deposits channel model proposed by Drechsler, Savov and Schnabl (2017) looks at monetary policy tightening regime, during which bank market power plays an important role as banks with larger market power would increase deposit rate less. Under monetary policy easing, however, all banks would reduce deposit rates along with the decline of interest rates. As we have shown, this reduction in deposit rate is mainly affected by how much liquidity injection they received. Even though one can argue that banks with larger market power can reduce the deposit rate more than others, the magnitude would have smaller variation across banks as the deposit rates go closer to zero. Therefore we argue that bank market power become less relevant to deposits channel during QE. To test this, we sort counties into 10 bins by market concentration measured by HHI and run equation (1) for each bin. We plot the coefficients of the interaction term in each group of counties in Figure 4.4, where group 1 has the lowest HHI and group 10 has the highest HHI.

The graph shows no obvious pattern between the effect of QE on deposit spreads and bank market power. If anything, the impact of QE1 is smaller in more concentrated markets, where banks are supposed to have larger market power and increase the deposit spreads more. The effect of QE3 do not differ significantly in different markets. These results support our hypothesis that

QE provides banks with additional funding from the central bank and banks become less dependent on deposits.

4.4.5 Robustness Tests

Due to the zero lower bound, the short-term interest rate might not well reflect the return in the market. We consider an alternative way to calculate the deposit spread which uses 1-year Treasury Bill yield to replace the Federal funds rate. The results are reported in Table 4.7, with columns (1) and (2) showing savings deposits and columns (3) and (4) showing time deposits. QE1 increases the deposit spread for savings deposits by 3.7 basis points and for time deposits by 4.6 basis points, which are very close to the estimation from the baseline regressions. The effect of QE3 on savings deposits is also similar to the baseline result but loses significance for time deposits.

We also check time deposits products with different maturities and amounts. Specifically, we considered 06-month, 24-month and 36-month certificates of deposit requiring a minimum balance of $10,000 (06MCD10K, 24MCD10K and 36MCD10K) and 12-month certificates of deposit requiring a minimum balance of $100,000, $250,000 and $500,000 (12MCD100K, 12MCD250K, and 12MCD500K). The results are reported in Table 4.8. The results are generally consistent with the baseline results. Moreover, we can see that the effects of QE1 on the deposit spreads are stronger for deposit products with longer maturities and larger amounts, which generally offer higher interest rates in the first place and therefore has potential for the adjustment. This pattern, however, does not hold for QE3. We find that QE3 does not significantly affect deposit products that have a maturity longer than 12 months. For the products with a maturity shorter than 12 months, the amount does not matter. In general, the effect of QE3 is smaller than QE1 across different certificates of deposit, consistent with the baseline results.

4.4.6 The Impact of QE on Deposit Amount

An increase in deposit spread means deposits are becoming less attractive to households and therefore we should expect a decline in deposit amount. To provide more support to our hypothesis we examine the deposit amount on the bank level by regressing the following equation:

$$\log\,(deposit)_{it} = \alpha_i + v_i + \beta' \boldsymbol{QE_t} + \gamma'(Treat_i \boldsymbol{QE_t}) + \theta' X_{it} + \lambda' X_{it} \boldsymbol{QE_t} + \varepsilon_{i,t} \quad (3)$$

where α_i and v_i are bank fixed effects and state fixed effects. $Treat_i$ and $\boldsymbol{QE_t}$ are defined as previously. X_{it} includes bank size, capital ratio and ROA. The control variables are also interacted with QE indicators to allow for potential variation in the response to QE of banks with different characteristics. All standard errors are clustered at the bank level.

Table 4.9 presents the estimation results of equation (3). The first two columns show the results for the total amount of deposits. The results for savings deposits are reported in columns (3) and (4), time deposits in columns (5) and (6). Due to the lack of observations of deposit amount by type since 2011, we only show the estimation for QE1 for them. For total deposit, QE purchases targeted at MBS reduces nearly 2% of total deposits for highly affected banks. This translated to a 39-million USD quarterly reduction in total deposit for a bank with average deposit amount (196 million USD). This result is in line with the widen of the deposit spreads shown previously in the baseline regressions. Interestingly, we notice that QE2, which targets at Treasuries, increases the deposit amount. This is somewhat expected since QE2 lowers the long-term yields and therefore should make deposits, especially long-term products more appealing. By granularly looking at the two types of the deposits, we find that the reduction of deposits comes mainly from time deposits rather than savings deposits at least for QE1. Since savings account are relatively less sensitive to interests, this is consistent with our intuition. In addition, this result suggests that the CD rate is more of an indicator of the bank demand for funds rather than that of bank-specific riskiness, which is in line with Ben-David, Palvia and Spatt (2017) and therefore supports the internal capital market theory

In summary, we find that the widen of deposit spreads caused by QE1 and QE3 is associated with an outflow of deposits for the treated banks. The opposite movement of the price of deposits (deposit spreads) and quantities indicates that QE shifts the deposit supply curve rather than the demand curve. These results lend additional support to our hypothesis that the banks are less dependent on the deposit funding after the QE.

4.4.7 The Impact of QE on Bank Interest Margin

While there is evidence showing that QE stimulates mortgage lending (Chakraborty, Goldstein and MacKinlay 2020), this effect is not connected with the effect on deposit. In the section, we investigate whether the effect of QE on deposits transmit to the mortgage lending. To this end, we examine the interest margin (the spread between mortgage rate and the deposit rate) instead of amount of mortgage. Since we have shown that the effect of QE is stronger on the time deposit and the main target asset of the purchasing is 30-year mortgage, we calculate the interest margin as the difference between 30-year mortgage rate and the time deposits (12MCD10K). This spread captures whether there is a disproportionate effect of QE on deposit and mortgage and therefore serves as an indicator of the coordination of banks' liability and asset. Our model with branch fixed effects absorb all the bank-level factors that determine interest margin including banks' market power, operating costs, credit risk and interest risk (Wong 1997; Maudos and Guevara 2004). The results presented in Table 4.10 show that after QE1, banks adjust the mortgage rate along with the deposit rate and there is no significant change in the interest margin. For QE3, however, the interest margin is significantly lower after the shock, indicating that the mortgage rate declines more than the deposit rate. The explanation is that during QE3, the deposit rates are already extremely low and have no more capacity for further reduction, which is also evidenced by the small magnitude in the change of deposit spreads after QE3. This result shows the transmission of the effect of QE from banks' liability side to the asset side, which supports that the QE stimulates bank lending.

4.5 Conclusion

We show that QE, as an important unconventional monetary policy tool, has a significant effect on a large and essential asset class, deposits. This effect, however, depends on the target assets of the central bank purchases. QE1 and QE3 work through a liquidity effect, where banks get liquidity from the central bank and reduce their dependence on deposit funding by charging a higher price for the liquidity service to households. QE2 affects the yield curve and the households' demand for deposits but does not directly affect banks deposit pricing due to the fact that Treasury securities are a trivial part of bank balance sheet and banks have limited gain from the purchases. Moreover, the effect of QE1 on deposit goes further to the mortgage lending as we observe a reduction in mortgage rate.

We are the first to provide support from the liability side to the transmission of unconventional monetary policy through the broad bank lending channel. Overall, our evidence supports a liquidity effect of QE and suggests that the deposits channel during the intervention of QE is based on banks' liquidity position rather than market power. The policy implication of our findings is that the central bank could take into consideration the composition of the balance sheet of banks when assessing the impact of their policies on the market.

Figure 4.1: Kernal Density Estimation of Bank Characteristics

This figure shows the Kernal Density estimation of the bank characteristics we used for the propensity score matching, namely bank size, cpital ratio and ROA, for the treatment group and the control group.

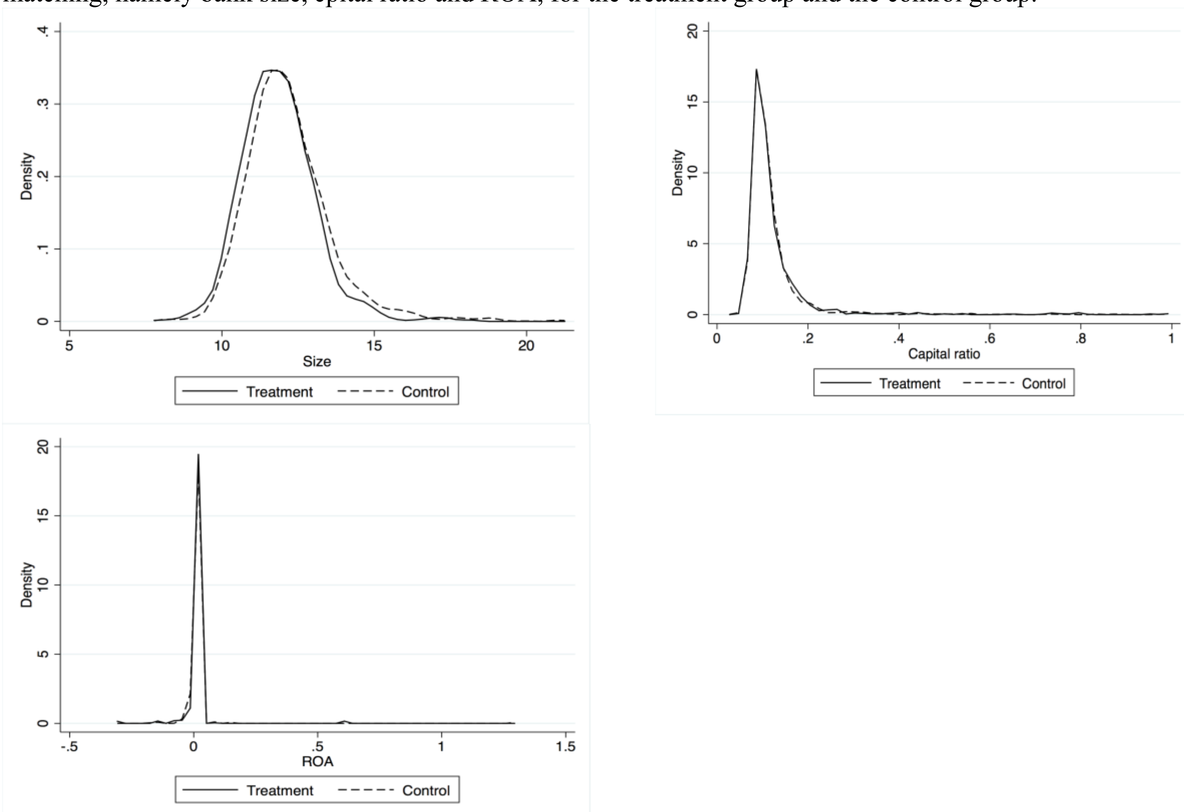
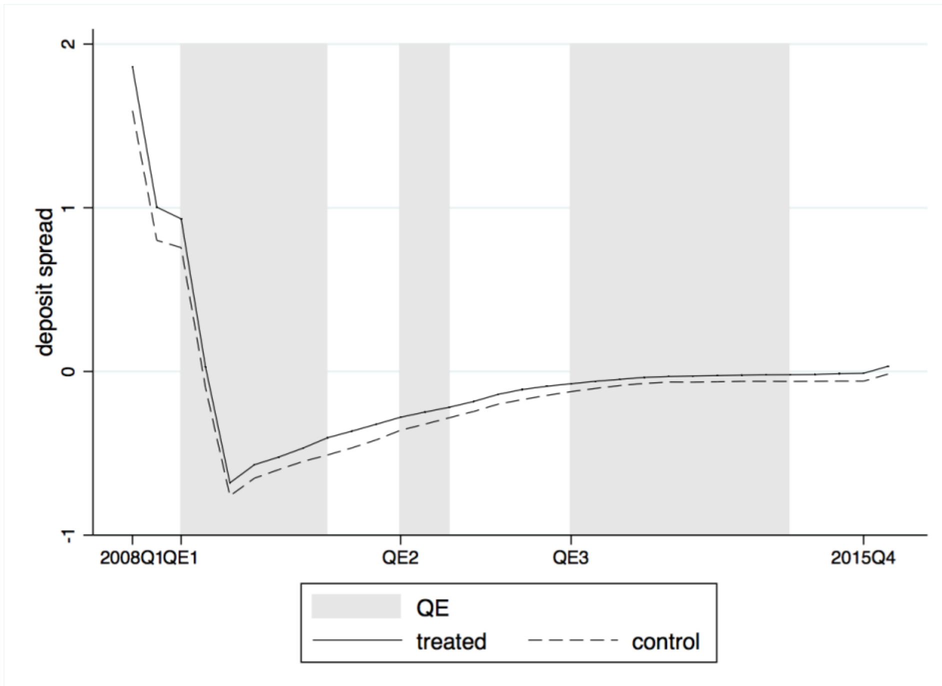


Figure 4.2: Quantitative Easing and Deposit Spreads

This figure shows the average deposit spread (in percentage points) across all treated banks and control banks from January 2008 to December 2015. The vertical shade areas are QE periods. Panel (a) and (b) display the deposit spread for money market accounts requiring a minimum balance of $25,000 (MM25K) and 12-month certificates of deposit requiring a minimum balance of $10,000 (12MCD10K) respectively.

(a) MM25K



(b) 12MCD10K

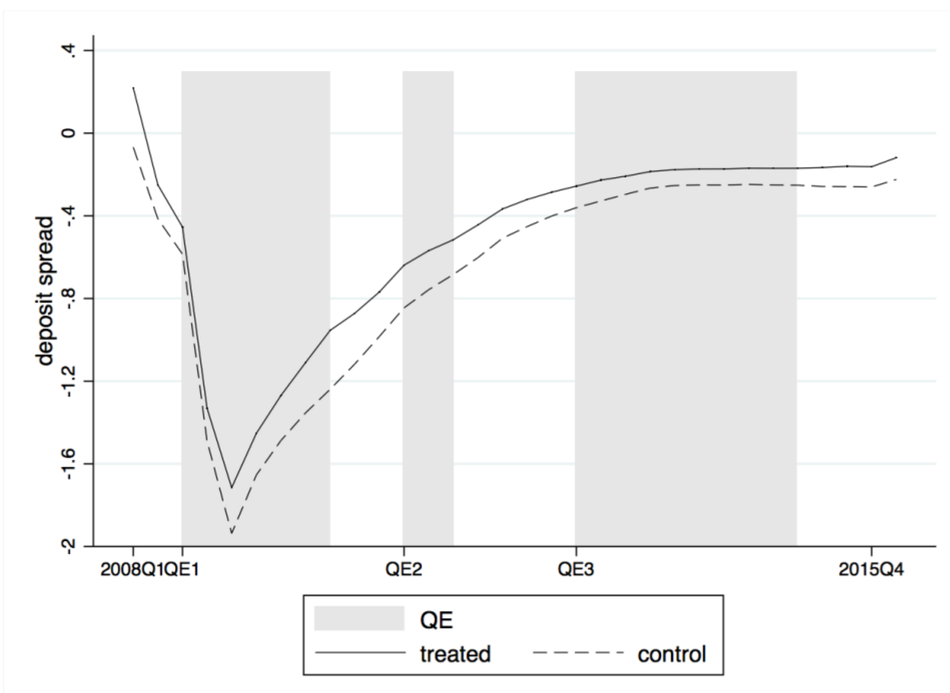
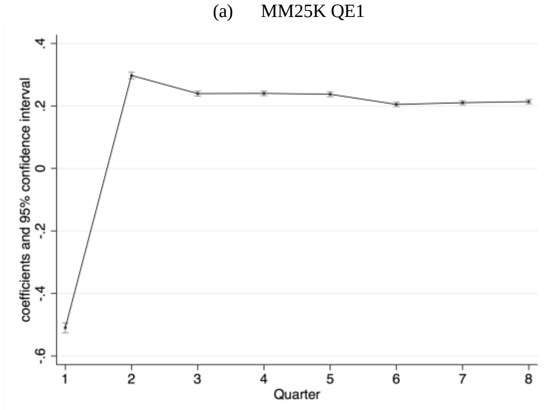


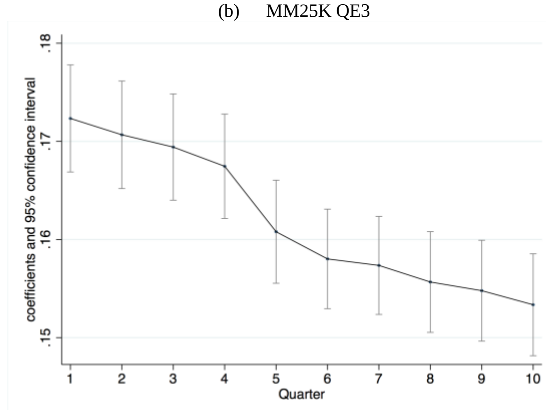
Figure 4.3: Dynamic Effect of QE

This figure shows the estimated coefficients for each quarter after QE1 and QE3 with 95% confidence intervals. Panel (a) and panel (b) present the result for money market accounts requiring a minimum balance of $25,000 (MM25K); while panel (c) and panel (d) present the result for 12-month certificates of deposit requiring a minimum balance of $10,000 (12MCD10K). For QE1 we show the subsequent 8 quarters in order to avoid the overlap with QE2, and for QE3 we show the subsequent 10 quarters until the end of our sample. The sample period is from January 2008 to December 2015. All specifications include branch fixed effects. Standard errors are clustered at the county level.

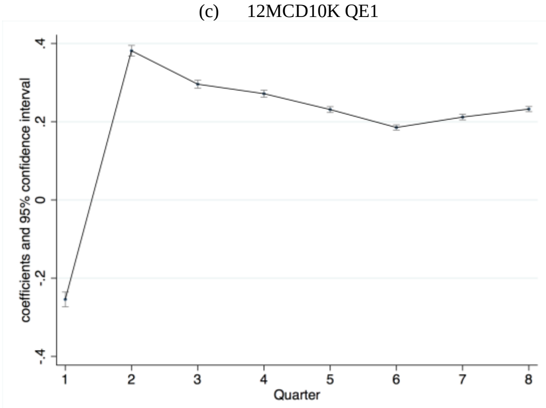
(a) MM25K QE1



(b) MM25K QE3



(c) 12MCD10K QE1



(d) 12MCD10K QE3

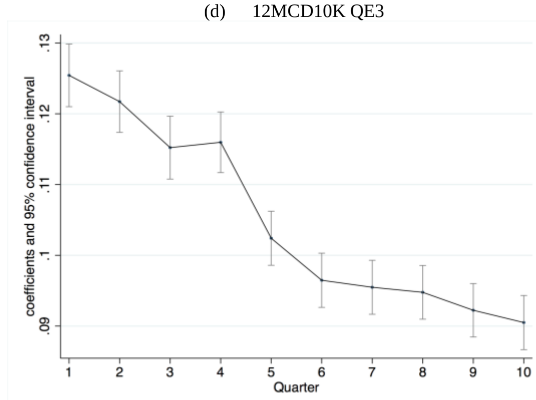


Figure 4.4: QE and Bank Market Power

This figure shows the estimated coefficients of the interaction term in equation (1) for 10 groups of counties with low to high market concentration. Panel (a) and panel (b) present the result for money market accounts requiring a minimum balance of $25,000 (MM25K); while panel (c) and panel (d) present the result for 12-month certificates of deposit requiring a minimum balance of $10,000 (12MCD10K).

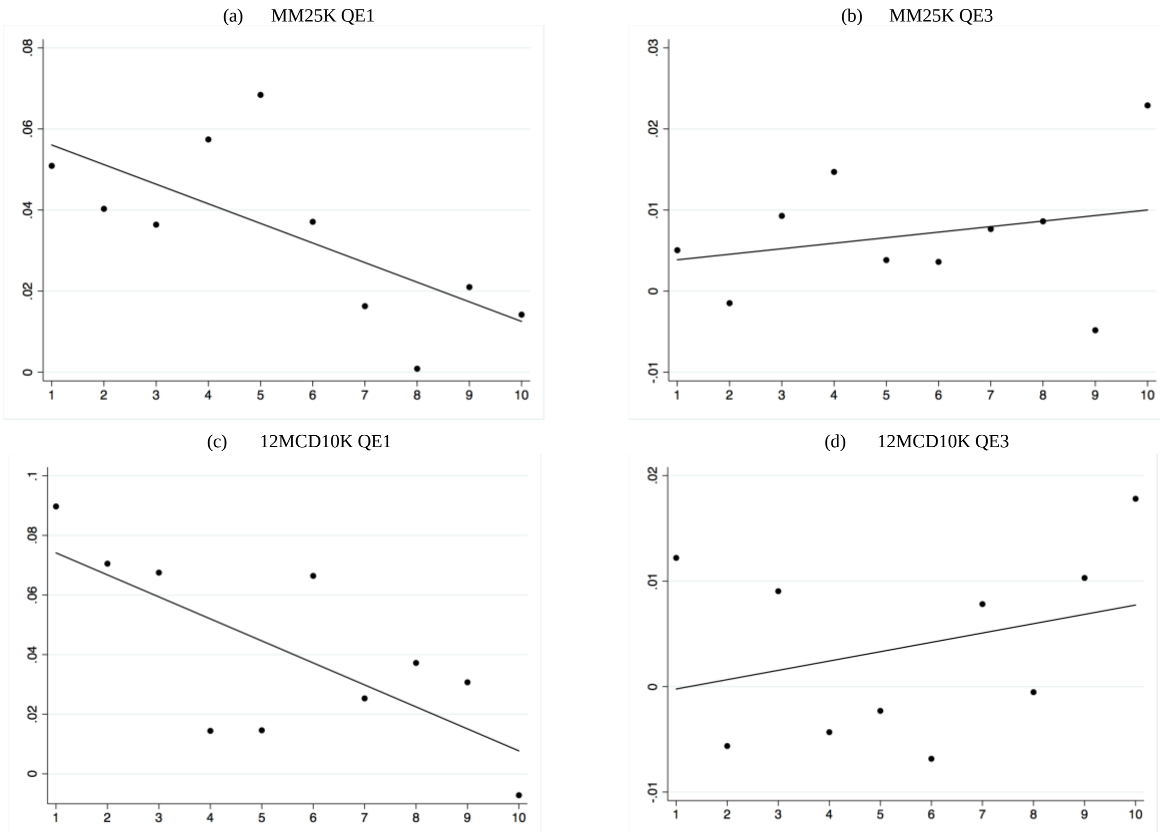


Table 4.1: Summary Statistics

This table presents the summary statistics of the variables we used in the regressions. The sample period is from January 2008 to December 2015. The changes of deposit spreads are calculated as federal funds rate (FFR) less deposit rate or shadow rate (SSR) less deposit rate for the money market accounts requiring a minimum balance of $25,000 (MM25K) and the 12-month certificates of deposit requiring a minimum balance of $10,000 (12MCD10K).

Variable	Obs	Mean	Std. Dev.	Min	Max
Branch level					
Δdeposit spread (FFR)-MM25K	145,834	-0.074	0.304	-3.134	2.379
Δdeposit spread (SSR)-MM25K	145,834	-0.087	0.748	-3.478	2.539
Δdeposit spread (FFR)-12MCD10K	152,083	-0.016	0.254	-3.280	1.500
Δdeposit spread (SSR)-12MCD10K	152,083	-0.029	0.723	-3.753	2.443
Deposit amount (million USD)	152,083	0.286	2.981	0	166
HHI	152,083	0.139	0.129	0.004	0.921
Bank level					
Size (log)	111,102	12.342	1.347	8.749	21.463
Capital ratio	111,102	0.108	0.028	0.054	0.218
ROA	111,102	0.007	0.010	-0.045	0.029
MBS/asset	111,102	0.085	0.091	0	0.708
Treasury/asset	111,102	0.005	0.029	0	0.649
Deposits (log)	111,062	12.155	1.319	7.162	20.917
Savings deposits (log)	40,580	11.038	1.458	5.011	20.221
Time deposits (log)	40,572	11.235	1.269	6.528	19.379

Table 4.2: Propensity Score Matching

This table reports the Probit regressions used in estimating the propensity scores for the treatment and control group of banks in 2008Q1. The dependent variable is a bank's treatment status. Column (1) uses the full sample prior to matching, while column (2) uses the matched sample of treated and control banks. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	pre-match	matched
Size	0.190***	-0.003
	(13.45)	(-0.21)
Capital	-0.080	-0.244
	(-0.44)	(-1.28)
ROA	-3.290**	-1.838
	(-2.51)	(-1.41)
Constant	-2.142***	0.077
	(-12.20)	(0.50)
Number of observations	5,580	5,888

Table 4.3: Savings Deposit Spreads and QE

This table presents the estimation of equation (1) using money market accounts requiring a minimum balance of $25,000 (MM25K). The dependent variable is the change of deposit spread calculated as Federal funds rate less deposit rate in column (1) and (2), and the change of deposit spread calculated as shadow rate less deposit rate in column (3) and (4). The sample period is from January 2008 to December 2015. All specifications include branch fixed effects. Standard errors are clustered at the county level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Treat_M*QE1	0.038***		0.038***	
	(3.29)		(3.40)	
Treat_T*QE2	-0.010		-0.011	
	(-1.21)		(-1.00)	
Treat_M*QE3	0.007***		0.008**	
	(2.86)		(2.50)	
(MBS/Asset)*QE1		0.210***		0.219***
		(5.04)		(5.24)
(TRE/Asset)*QE2		-0.046		0.027
		(-1.13)		(0.33)
(MBS/Asset)*QE3		0.010		0.037***
		(1.09)		(2.81)
QE1	0.487***	0.476***	0.163***	0.153***
	(47.28)	(82.82)	(16.17)	(26.50)
QE2	0.153***	0.150***	0.325***	0.321***
	(75.00)	(101.74)	(145.91)	(208.39)
QE3	-0.028***	-0.023***	0.404***	0.405***
	(-13.92)	(-23.92)	(133.74)	(228.33)
Branch fixed effects	Y	Y	Y	Y
Number of observations	68,796	145,834	68,796	145,834
R2	0.332	0.325	0.189	0.188

Table 4.4: Time Deposit Spreads and QE

This table presents the estimation of equation (1) using 12-month certificates of deposit requiring a minimum balance of $10,000 (12MCD10K). The dependent variable is the change of deposit spread calculated as Federal funds rate less deposit rate in column (1) and (2), and the change of deposit spread calculated as shadow rate less deposit rate in column (3) and (4). The sample period is from January 2008 to December 2015. All specifications include branch fixed effects. Standard errors are clustered at the county level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Treat_M*QE1	0.047***		0.047***	
	(5.32)		(5.24)	
Treat_T*QE2	0.007		0.004	
	(1.05)		(0.46)	
Treat_M*QE3	0.003		0.006*	
	(1.58)		(1.80)	
(MBS/Asset)*QE1		0.088**		0.099***
		(2.57)		(2.90)
(TRE/Asset)*QE2		0.011		0.090
		(0.27)		(1.28)
(MBS/Asset)*QE3		0.00911		0.033**
		(1.25)		(2.57)
QE1	0.315***	0.343***	-0.008	0.018***
	(42.76)	(74.47)	(-1.02)	(3.99)
QE2	0.077***	0.075***	0.247***	0.245***
	(34.44)	(41.86)	(104.98)	(139.02)
QE3	-0.052***	-0.051***	0.379***	0.378***
	(-30.45)	(-53.40)	(127.62)	(224.97)
Branch fixed effects	Y	Y	Y	Y
Number of observations	71,648	152,083	71,648	152,083
R2	0.167	0.164	0.125	0.126

Table 4.5: Does the Treatment Status Predict the Changes in Deposit Spreads?

This table reports the placebo test, where the dependent variable is the change of deposit spread calculated as Federal funds rate less deposit rate. Treat_M is the treatment status assigned according to the holdings of MBS whereas Treat_T is the treatment status assigned according to the holdings of Treasuries. Column (1) shows the result for money market accounts requiring a minimum balance of $25,000 (MM25K), while column (2) shows the result for 12-month certificates of deposit requiring a minimum balance of $10,000 (12MCD10K). The sample period is from January 2008 to September 2008. All specifications include county fixed effects and state×time fixed effects. Standard errors are clustered at the county level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)
Treat_M	-0.020	-0.022
	(-0.85)	(-1.28)
Treat_T	-0.024	0.036
	(-0.56)	(1.16)
Size	-0.023***	-0.009***
	(-6.42)	(-2.83)
Capital	0.080	-0.333*
	(0.33)	(-1.85)
ROA	-0.161	0.613*
	(-0.56)	(1.83)
County fixed effects	Y	Y
State×time fixed effects	Y	Y
Number of observations	5,711	5,914
R2	0.742	0.210

Table 4.6: Placebo QE Event

This table reports the placebo test with a placebo QE event interacting with the treatment status. The dependent variable is the change in deposit spread calculated as the difference between Federal funds rate/shadow rate and the deposit rate. Column (1) and (2) show the result for money market accounts requiring a minimum balance of $25,000 (MM25K), while column (3) and (4) show the result for 12-month certificates of deposit requiring a minimum balance of $10,000 (12MCD10K). The sample period is from January 2001 to December 2004. All specifications include county fixed effects and state×time fixed effects. Standard errors are clustered at the county level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	Δdeposit spread (FFR)	Δdeposit spread (SSR)	Δdeposit spread (FFR)	Δdeposit spread (SSR)
Treat_M*Placebo Event	0.015	0.014	0.010	0.009
	(0.52)	(0.50)	(0.42)	(0.38)
Placebo Event	0.595***	0.599***	0.341***	0.345***
	(22.91)	(23.08)	(14.56)	(14.75)
Branch fixed effects	Y	Y	Y	Y
Number of observations	21,201	21,201	22,129	22,129
R2	0.423	0.431	0.319	0.322

Table 4.7: Robustness: Deposit Spread Calculated with Treasury Yield

This table presents the estimation of equation (1), where the change of deposit spread is calculated as the difference between the yield of 1-year Treasury Bill and the deposit rate. Columns (1) and (2) use money market accounts requiring a minimum balance of $25,000 (MM25K), and columns (3) and (4) use 12-month certificates of deposit requiring a minimum balance of $10,000 (12MCD10K). The sample period is from January 2008 to December 2015. All specifications include branch fixed effects. Standard errors are clustered at the county level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)
Treat_M*QE1	0.037***		0.046***	
	(3.09)		(4.98)	
Treat_T*QE2	-0.011		0.006	
	(-1.28)		(0.97)	
Treat_M*QE3	0.007***		0.003	
	(2.90)		(1.62)	
(MBS/Asset)*QE1		0.206***		0.087**
		(4.78)		(2.51)
(TRE/Asset)*QE2		-0.051		0.004
		(-1.41)		(0.11)
(MBS/Asset)*QE3		0.011		0.010
		(1.29)		(1.47)
QE1	0.142***	0.129***	-0.029***	-0.005
	(13.37)	(21.72)	(-3.73)	(-0.99)
QE2	0.143***	0.140***	0.067***	0.065***
	(74.69)	(102.94)	(31.80)	(38.95)
QE3	-0.001	0.003***	-0.025***	-0.024***
	(-0.30)	(3.52)	(-15.24)	(-26.47)
Branch fixed effects	Y	Y	Y	Y
Number of observations	68,796	145,834	71,648	152,083
R2	0.126	0.119	0.021	0.021

Table 4.8: QE's Effect on Time Deposits with Different Maturities and Amounts

This table reports the estimation results of equation (1) using different types of certificates of deposit. The dependent variable is the change of deposit spread calculated as shadow rate less deposit rate. The Treat_T*QE2 term is dropped in the last two columns due to collinearity. All specifications include branch fixed effects. Standard errors are clustered at the county level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	06MCD10K	24MCD10K	36MCD10K	12MCD100K	12MCD250K	12MCD500K
Treat_M*QE1	0.022**	0.061***	0.077***	0.049**	0.092*	0.131**
	(2.43)	(6.45)	(7.19)	(2.37)	(1.80)	(2.01)
Treat_T*QE2	0.006	0.001	0.008	0.018	-	-
	(0.78)	(0.12)	(0.97)	(1.59)	-	-
Treat_M*QE3	0.010***	0.004	0.002	0.013***	0.023***	0.010*
	(2.79)	(1.00)	(0.36)	(2.90)	(4.78)	(1.94)
QE	Y	Y	Y	Y	Y	Y
Branch fixed effects	Y	Y	Y	Y	Y	Y
Number of observations	81,967	78,937	74,881	66,577	42,812	41,571
R2	0.163	0.173	0.184	0.147	0.144	0.145

Table 4.9: Deposit Amount and QE

This table reports the estimation of the regression of QE's effect on deposit amount. The dependent variable is the log of total deposit amount in column (1) and (2), log of savings deposit in column (3) and (4), and log of time deposit in column (5) and (6). The sample period is from January 2008 to December 2015. All specifications include state fixed effects. The standard errors are clustered at the bank level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Treat_M*QE1	-0.019***		0.032*		-0.027	
	(-2.61)		(1.66)		(-1.53)	
Treat_T*QE2	0.030***					
	(6.06)					
Treat_M*QE3	-0.018***					
	(-5.52)					
(MBS/Asset)*QE1		-0.143***		0.098		-0.304***
		(-5.66)		(1.30)		(-4.87)
(TRE/Asset)*QE2		0.101***				
		(4.11)				
(MBS/Asset)*QE3		-0.109***				
		(-6.26)				
QE	Y	Y	Y	Y	Y	Y
Bank control	Y	Y	Y	Y	Y	Y
Bank controls*QE	Y	Y	Y	Y	Y	Y
Bank fixed effects	Y	Y	Y	Y	Y	Y
State fixed effects	Y	Y	Y	Y	Y	Y
Number of observations	52,705	111,062	19,290	40,580	19,282	40,572
R2	0.991	0.992	0.941	0.939	0.937	0.939

Table 4.10: Interest Margin and QE

This table reports the estimation of the regression of QE's effect on banks' interest margin. The dependent variable is the difference between 30-year mortgage rate and rate of 12-month certificates of deposit requiring a minimum balance of $10,000 (12MCD10K). All specifications include branch fixed effects. Standard errors are clustered at the county level. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)
Treat_M*QE1	0.128	
	(1.37)	
Treat_T*QE2	0.104	
	(1.15)	
Treat_M*QE3	-0.208***	
	(-2.72)	
(MBS/Asset)*QE1		0.351
		(1.05)
(TRE/Asset)*QE2		-0.0894
		(-0.17)
(MBS/Asset)*QE3		-0.474**
		(-2.36)
QE	Y	Y
Branch fixed effects	Y	Y
Number of observations	4,822	10,506

Chapter 5 Conclusion

5.1 Overview and Concluding Remarks

In this thesis, we explore the role of unconventional monetary policy tools in bank lending activities. The bank lending channel has been documented as an important monetary policy transmission channel (see for example, Kashyap and Stein 2000; Jimenez et al. 2014). The unconventional monetary policy widely conducted since the financial crisis is expected to spur the economy in similar veins. In particular, we investigate how forward guidance affects the cost of corporate loans, the possibility for a new borrower to get a loan and the syndication structure. We also examine how QE affects the deposit funding of banks.

To measure forward guidance we construct monthly categorical variables derived from the FOMC statements. Parsing the language of each statement between May 1999 and June 2017, we identify the ones with clear forward-looking language and distinguish between Odyssean guidance and Delphic guidance depending on whether there is a clear commitment. We compared the dates we picked with the large shocks of forward guidance based on the more widely used numeric measure and find that they are well overlapped. The date-based variables are then collapsed into monthly categorical variables based on its expansionary or contractionary tendencies. This approach measures forward guidance as what is given by the central bank rather than how the market interprets it. Using this measure in the first study (see chapter 2), we find that Odyssean forward guidance significantly reduces the cost of syndicated loans originated in the subsequent quarter. The real effect is equivalent to a 7.7-million (USD) reduction in the interest expense for an average-sized loan with an average maturity. Moreover, this effect is more pronounced for loans borrowed by firms with higher leverage and less z-score from well capitalized banks. The Delphic forward guidance on the other hand has no effect on bank lending, Employing the same forward guidance measure, the second study (see chapter 3) show that following Odyssean forward guidance, banks are more willing to grant credit lines to borrowers new to them (who are by nature riskier) with more reduction in loan cost. It is also documented that Odyssean forward guidance reduces the number of lead arrangers and increases the number of participant lenders, suggesting an ease of the asymmetric information concern. This effect is stronger for borrowers with less experience in the market, indicating a risk-taking effect of forward guidance.

In the final study (see chapter 4) we examine the effect of QE on bank deposit funding within a difference-in-difference framework. We find that the central bank purchases of the MBS increase the deposit spread for highly affected banks while the purchases of treasury securities have no significant effect. The effect is valid for both savings deposit and time deposit, with a larger impact of QE1 on deposits with longer maturities and larger amounts. The increase of the pricing of deposit products is accompanied by a decrease in the deposit amount, suggesting that banks reduce the supply of deposit as a liquidity products to households as they get reserve from the central bank purchases.

Taken together, the results suggest that unconventional monetary policy can stimulate the economy through the bank lending channel since it affects bank lending from both the liability side and the asset side. Our findings have important implications to policy makers for the understanding of the transmission mechanisms of monetary policy, especially under extreme circumstances.

The US market has left the zero lower bound since the FOMC increased the federal funds rate in 2016. However, forward guidance remains a commonly used tool by the FOMC. Whether the unconventional monetary policy remains powerful in a period when there is enough space for conventional monetary policy and whether unconventional monetary policy can be used towards a monetary tightening are interesting questions to be explored by future research. We also leave it to future studies to examine the effect of unconventional monetary policy on bank lending in other markets.

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Appendix A

Forward Guidance and Corporate Lending

A.1 Additional Information and Tests

In what follows, we provide further details on the data and additional robustness tests. The results add support to the empirical work included in Chapter 2. In particular, we provide evidence concerning the validity of our measure, sample choice and identification. The tables are as follows:

- Table A.1 lists the dates of Odyssean guidance statements used in the construction of the forward guidance measures, with relevant key phrases within the statements with the forward-looking (contractionary or expansionary) language.
- Table A.2 reports the summary statistics of the loan-, firm-, bank-, and economy-level control variables for the whole sample period, May 1999 to June 2017.
- Table A.3 estimates regression models with double interaction terms between forward guidance measures and bank capital ratio. The table also reports the economic magnitude of the effects – the additional percentage reduction on loan spreads offered by highly capitalized bank (75 percentile) as compared to less capitalized bank (25 percentile), after expansionary forward guidance.
- Table A.4 test the baseline specification (estimation of Eq. (2)) for the two dominant types of syndicated loans, namely, term loans and credit lines. We find that forward guidance significantly reduces the spreads for both types of loans, with the economic magnitudes associated with credit lines being slightly stronger.
- Table A.5, A.6 and A.7 estimate the regression models in Table 3 in the paper with bank fixed effects, firm fixed effects, bank × year fixed effects and bank × firm fixed

effects, in order to test for the sensitivity of the findings. Table A.5 presents the baseline regression results using Odyssean forward guidance, Table A.6 presents the test results for the effect of Delphic forward guidance on loan spreads, and Table A.7 reports the test for the pre-crisis period. In all the sensitivity tests considered, we observe that the findings reported in the paper continue to hold.

- Table A.8, A.9 and A.10 replicates the results of Table 3 in the paper by including the effective federal funds rate and using different fixed effects specifications. Notably, all the results confirm the findings reported in the paper.
- Table A.10 replicates the main results in the paper, by additionally controlling for credit spread (Moody's AAA-ABB corporate bond spread), the 3-month T-Bill rate and the quarterly CPI to ease any concerns that the results may be influenced by other macroeconomic factors such as credit risk and bond market conditions. The results remain robust to the inclusion of these additional variables.

A.2 GSS Measure of Forward Guidance

This section demonstrates step by step how we construct the numerical forward guidance measure using the GSS method following Gürkaynak, Sack, and Swanson (2005).

Step 1

First, we collect daily changes of the following futures contracts: the current-month and 3-month-ahead federal funds futures contracts and the 2-, 3-, 4-, 5- and 6-quarter-ahead Eurodollar futures contracts on the day with a FOMC statement. Since the Federal funds futures have a payout that is based on the average effective federal funds rate that prevails over the calendar month, the changes in the current-month and 3-month-ahead federal funds futures need to be adjusted by a scaling factor constructed following Gürkaynak, Sack, and Swanson (2005) to capture the actual changes caused by the statements.

Step 2

We put the data in a matrix X, with the first two columns being the changes in the current-month and 3-month-ahead federal funds futures contracts (adjusted by a scaling factor). Using PCA we extract the first two factors and normalize them so that they have unit length. Mathematically:

$$X = F\Lambda' + \mu$$

where F is the first two principal components of X, and Λ is the coefficient matrix.

Step 3

We need to find a rotation matrix U so that F can be rotated into two new factors Z, whose first factor corresponds to surprise changes in the current federal funds rate target and the second factor corresponds to moves in interest rate expectations over the coming year that are not driven by changes in the current funds rate. To put it mathematically:

$$X = FUU'\Lambda' + \mu$$

$$Z = FU$$

The rotation matrix

$$U = \begin{bmatrix} a_1 & b_1 \\ a_2 & b_2 \end{bmatrix}$$

should satisfy the following conditions:

1. the columns of U are normalized to have unit length.
2. the new factors Z1 and Z2 should remain orthogonal to each other.
3. Z2 does not influence the current policy surprise, i.e. the element on the first row and second column of the new coefficient matrix ΛU should be 0.

Thus we have a system of equations:

$$\begin{cases} a_1^2 + a_2^2 = 1 \\ b_1^2 + b_2^2 = 1 \\ a_1 b_1 + a_2 b_2 = 0 \\ \gamma_2 a_1 - \gamma_1 a_2 = 0 \end{cases}$$

where $\gamma_1 \; and \; \gamma_2$ are the loadings of F_1 and F_2 on the changes in the current-month federal funds futures, which have been obtained from Step 2 in Λ.

Solving this system of equations we get the rotation matrix U and the new factors Z. Z1 is named as target factor as it is related to the changes in the target federal funds rate, whereas Z2 is named path factor as it is only related to changes in the future federal funds are but not related to the changes in the current rate. The path factor is used by Campbell et al. (2012) as a measure of forward guidance.

Step 4

We collapse this measure into monthly data for regression purpose. If there are more than one FOMC statements in the same month, the forward guidance measure for that month is the sum of the daily shocks from all the statement days. If there is no FOMC statement in one month, the forward guidance measure in this month is 0.

Table A.1: Forward guidance dates in FOMC statements

This table presents forward guidance dates considered Odyssean and examples of explicit forward-looking phrases (contractionary or expansionary in nature) used within the statements. Key phrases are highlighted in italics.

Date	Forward-looking language	Type
October 08, 2008	"The recent intensification of the financial crisis has augmented the downside risks to growth and thus has diminished further the upside risks to price stability. Some *easing of global monetary conditions is therefore warranted*."[13]	expansionary
December 16, 2008	"The Federal Open Market Committee decided today to establish a target range for the federal funds rate of 0 to 1/4 percent. ...The Federal Reserve will employ all available tools to promote the resumption of sustainable economic growth and to preserve price stability. In particular, *the Committee anticipates that weak economic conditions are likely to warrant exceptionally low levels of the federal funds rate for some time*."[14]	expansionary
March 18, 2009	"…economic conditions are likely to warrant *exceptionally low levels of the federal funds rate for an extended period*…The Federal Reserve has launched the Term Asset-Backed Securities Loan Facility to facilitate the extension of credit to households and small businesses and anticipates that the range of eligible collateral for this facility is likely to be expanded to include other financial assets."	expansionary
August 12, 2009	"To promote a smooth transition in markets as these purchases of Treasury securities are completed, *the Committee has decided to gradually slow the pace of these transactions and anticipates that the full amount will be purchased by the end of October*."	contractionary
December 16, 2009	"In light of ongoing improvements in the functioning of financial markets, the Committee and the Board of Governors anticipate that most of the Federal Reserve's special liquidity facilities will expire on February 1, 2010, consistent with the Federal Reserve's announcement of June 25, 2009…*The Federal Reserve expects that amounts provided under the Term Auction Facility will continue to be scaled back in early 2010*."	contractionary
November 03, 2010	"Although the Committee anticipates a gradual return to higher levels of resource utilization in a context of price stability, progress toward its objectives has been disappointingly slow. *To promote a stronger pace of economic recovery and to help ensure that inflation, over time, is at levels consistent with its mandate, the Committee decided today to expand its holdings of securities*. The Committee will maintain its existing policy of reinvesting principal payments from its securities holdings. In addition, the Committee intends to purchase a further $600 billion of longer-term Treasury securities by the end of the second quarter of 2011, a pace of about $75 billion per month. The Committee will regularly review the pace of its securities purchases and the overall size of the asset-purchase program in light of incoming information and will adjust the program as needed to best foster maximum employment and price stability."	expansionary
August 09, 2011	"The Committee currently anticipates that economic conditions--including low rates of resource utilization and a subdued outlook for inflation over the medium run--*are likely to warrant exceptionally low levels for the federal funds rate at least through mid-2013*."	expansionary

[13] This FOMC statement sets the stage for a significant shift in the direction of monetary policy from contractionary to expansionary, for the first time since the collapse of Lehman Brothers.

[14] Interest rates was at the zero lower bound for the first time then and the Fed provides guidance on keeping rates low for longer for some time.

September 21, 2011	"To support a stronger economic recovery and to help ensure that inflation, over time, is at levels consistent with the dual mandate, *the Committee decided today to extend the average maturity of its holdings of securities*...To help support conditions in mortgage markets, *the Committee will now reinvest principal payments from its holdings of agency debt and agency mortgage-backed securities in agency mortgage-backed securities*. In addition, the Committee will maintain its existing policy of rolling over maturing Treasury securities at auction."	expansionary
January 25, 2012	"...the Committee decided today to keep the target range for the federal funds rate at 0 to 1/4 percent and currently anticipates that economic conditions--including low rates of resource utilization and a subdued outlook for inflation over the medium run--are likely to warrant *exceptionally low levels for the federal funds rate at least through late 2014.*"	expansionary
September 13, 2012	"The Committee is concerned that, without further policy accommodation, economic growth might not be strong enough to generate sustained improvement in labor market conditions...the Committee agreed today to increase policy accommodation by purchasing additional agency mortgage-backed securities at a pace of $40 billion per month...If the outlook for the labor market does not improve substantially, the Committee will continue its purchases of agency mortgage-backed securities, undertake additional asset purchases, and employ its other policy tools as appropriate until such improvement is achieved in a context of price stability...In particular, the Committee also decided today to keep the target range for the federal funds rate at 0 to 1/4 percent and currently anticipates that exceptionally low levels for the federal funds rate are likely to be warranted *at least through mid-2015.*"	expansionary
December 12, 2012	"…the Committee decided to keep the target range for the federal funds rate at 0 to 1/4 percent and currently anticipates that *this exceptionally low range for the federal funds rate will be appropriate at least as long as the unemployment rate remains above 6-1/2 percent*, inflation between one and two years ahead is projected to be no more than a half percentage point above the Committee's 2 percent longer-run goal, and longer-term inflation expectations continue to be well anchored."	expansionary
December 18, 2013	"The Committee now anticipates, based on its assessment of these factors, that it likely will be appropriate to maintain the current target range for the federal funds rate *well past the time that the unemployment rate declines below 6-1/2 percent*, especially if projected inflation continues to run below the Committee's 2 percent longer-run goal."	expansionary
March 19, 2014	"…the Committee decided to make a further measured reduction in the pace of its asset purchases...The Committee continues to anticipate, based on its assessment of these factors, that it likely will be appropriate to maintain the current target range for the federal funds rate for a considerable time after the asset purchase program ends, especially if projected inflation continues to run below the Committee's 2 percent longer-run goal, and provided that longer-term inflation expectations remain well anchored...When the Committee decides to begin to remove policy accommodation, it will take a balanced approach consistent with its longer-run goals of maximum employment and inflation of 2 percent. *The Committee currently anticipates that, even after employment and inflation are near mandate-consistent levels, economic conditions may, for some time, warrant keeping the target federal funds rate below levels the Committee views as normal in the longer run.* With the unemployment rate nearing 6-1/2 percent, *the Committee has updated its forward guidance*."	expansionary
December 17, 2014	"Based on its current assessment, the Committee judges that it can be *patient in beginning to normalize the stance of monetary policy*."	expansionary

March 18, 2015	"Consistent with its previous statement, the Committee judges that *an increase in the target range for the federal funds rate remains unlikely at the April FOMC meeting.*"	expansionary
December 16, 2015	"The Committee judges that there has been considerable improvement in labor market conditions this year, and it is reasonably confident that inflation will rise, over the medium term, to its 2 percent objective. Given the economic outlook, and recognizing the time it takes for policy actions to affect future economic outcomes, the Committee decided to raise the target range for the federal funds rate to 1/4 to 1/2 percent. The stance of monetary policy remains accommodative after this increase, thereby supporting further improvement in labor market conditions and a return to 2 percent inflation...The Committee expects that economic conditions will evolve in a manner that *will warrant only gradual increases* in the federal funds rate; *the federal funds rate is likely to remain, for some time, below levels that are expected to prevail in the longer run*...The Committee is maintaining its existing policy of reinvesting principal payments from its holdings of agency debt and agency mortgage-backed securities in agency mortgage-backed securities and of rolling over maturing Treasury securities at auction, and it anticipates doing so until normalization of the level of the federal funds rate is well under way."	expansionary
September 21, 2016	"Against this backdrop, the Committee decided to maintain the target range for the federal funds rate at 1/4 to 1/2 percent. *The Committee judges that the case for an increase in the federal funds rate has strengthened but decided, for the time being, to wait for further evidence of continued progress toward its objectives.* The stance of monetary policy remains accommodative, thereby supporting further improvement in labor market conditions and a return to 2 percent inflation."	expansionary
December 14, 2016	"In view of realized and expected labor market conditions and inflation, the Committee decided to raise the target range for the federal funds rate to 1/2 to 3/4 percent. *The stance of monetary policy remains accommodative*, thereby *supporting some further strengthening in labor market* conditions and a return to 2 percent inflation."	expansionary
March 15, 2017	"In view of realized and expected labor market conditions and inflation, the Committee decided to raise the target range for the federal funds rate to 3/4 to 1 percent. *The stance of monetary policy remains accommodative*, thereby supporting some further strengthening in labor market conditions and a *sustained return to 2 percent inflation."*	expansionary

Table A.2: Summary Statistics

This table reports the summary statistics of all variables for the whole sample period, May 1999 to June 2017. The definitions for all the variables are provided in Table 2.1.

Variable	Obs	Mean	Std. Dev.	Min	Max
Loan-level variables					
Loan spread	20,615	5.050	0.783	0.405	7.313
Loan amount	20,615	5.103	1.649	-6.639	10.800
Maturity	20,615	3.908	1.847	0.005	20
Credit line	20,615	0.584	0.493	0	1
Term loan	20,615	0.276	0.447	0	1
Corporate purpose	20,615	0.448	0.497	0	1
Working capital	20,615	0.185	0.389	0	1
Debt repayment	20,615	0.084	0.277	0	1
Secured	20,615	1.247	0.857	0	2
Dividend restrictions	20,615	1.118	0.911	0	2
Number of lenders	20,615	1.754	0.974	0	5.088
Firm-level variables					
Book Leverage	20,615	-0.402	0.196	0.000	-1.000
Z-score	20,615	0.638	0.791	-3.131	2.441
Bank-level variables					
Total asset	20,615	20.199	1.392	9.501	21.586
Capital ratio	20,615	0.087	0.019	0.056	0.149
ROA	20,615	0.006	0.004	-0.039	0.048
Liquidity	20,615	0.052	0.036	0	0.474
Charge-off	20,615	0.002	0.002	0	0.028
Economy-level variables					
GDP growth	73	0.994	0.703	1.858	2.448
VIX	73	20.489	7.950	11.035	58.596
Shadow rate	73	0.893	3.136	-5.301	6.224

Table A.3: Response of Loan Spreads to Forward Guidance: Double Interactions

This table reports the regression results with the double interaction of forward guidance and bank capital ratio. The dependent variable is the log of loan spread. Forward guidance indicator variables capture Odyssean forward guidance issued one, two, or three months before the loan origination date. The sample period is from October 2008 to June 2017. Standard errors are clustered at the bank-year level. Y indicates that the set of control variables or fixed effects is included. The list of control variables and their definitions are provided in Table 2.1. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

	(1)	(2)	(3)	(4)
Forward guidance (t-1)*Capital ratio	-2.519			-2.522
	(-1.13)			(-1.00)
Forward guidance (t-2)*Capital ratio		-3.247**		-3.276*
		(-2.19)		(-1.84)
Forward guidance (t-3)*Capital ratio			1.276	0.572
			(0.59)	(0.26)
Shadow rate	-0.195***	-0.188***	-0.204***	-0.201***
	(-2.83)	(-2.76)	(-2.94)	(-3.16)
Shadow rate*Capital ratio	1.909***	1.825***	1.966***	1.875***
	(2.83)	(2.75)	(2.88)	(3.00)
Loan-level variables	Y	Y	Y	Y
Firm-level variables	Y	Y	Y	Y
Bank-level variables	Y	Y	Y	Y
Economy-level variables	Y	Y	Y	Y
Firm-year FE	Y	Y	Y	Y
Number of observations	7,493	7,493	7,493	7,493
How much additional percentage reduction on loan spreads is offered by highly capitalized bank (75 percentile) as compared to less capitalized bank (25 percentile), after expansionary forward guidance?				
Forward guidance (t-2) in Model (4)	8.60%			

Table A.4: Response of Loan Spreads to Forward Guidance: Results for Term Loans and Credit Lines

This table reports the baseline regression results of Eq. (2) for loan spreads associated to the two main types of syndicated loans, namely, term loans and credit lines. The dependent variable is the log of loan spread. Forward guidance indicator variables capture Odyssean forward guidance issued one, two, or three months before the loan origination date. The sample period is from October 2008 to June 2017. Standard errors are clustered at the bank-year level. Y indicates that the set of control variables or fixed effects is included. The list of control variables and their definitions are provided in Table 2.1. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

	Term loans	Credit lines
Forward guidance (t-1)	-0.048*	-0.094***
	(-1.87)	(-3.47)
Forward guidance (t-2)	-0.050*	-0.063**
	(-1.88)	(-2.44)
Forward guidance (t-3)	-0.090***	-0.095***
	(-2.77)	(-3.42)
Shadow rate	0.012	0.020**
	(1.42)	(2.43)
Loan-level variables	Y	Y
Firm-level variables	Y	Y
Bank-level variables	Y	Y
Economy-level variables	Y	Y
Firm × year fixed effects	Y	Y
Number of observations	2,469	4,654

Table A.5: Response of Loan Spreads to Odyssean Forward Guidance

This table reports the regression results of Eq. (2), where the dependent variable is the log of loan spread. Forward guidance indicator variables capture Odyssean forward guidance issued one, two, or three months before the loan origination date. The sample period is from October 2008 to June 2017. Columns (1) – (4) use bank fixed effects and firm fixed effects, columns (5) – (8) use bank × year fixed effects, and column (9) - (12) use bank× firm fixed effects. Standard errors are clustered at the bank-year level. Y indicates that the set of control variables or fixed effects is included. The list of control variables and their definitions are provided in Table 2.1. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Forward guidance (t-1)	-0.050**			-0.071***	-0.063**			-0.098***	-0.062**			-0.084***
	(-2.12)			(-2.89)	(-2.40)			(-3.11)	(-2.43)			(-2.96)
Forward guidance (t-2)		-0.053***		-0.076***		-0.072***		-0.107***		-0.041*		-0.069***
		(-3.01)		(-3.90)		(-2.66)		(-3.37)		(-1.92)		(-2.82)
Forward guidance (t-3)			-0.087***	-0.103***			-0.103***	-0.132***			-0.100***	-0.118***
			(-4.29)	(-4.98)			(-3.02)	(-3.59)			(-3.96)	(-4.55)
Shadow rate	0.015***	0.013***	0.013***	0.010***	0.000	-0.001	-0.002	-0.009	0.020***	0.019***	0.018***	0.015***
	(3.22)	(2.99)	(2.90)	(2.65)	(0.01)	(-0.05)	(-0.10)	(-0.45)	(3.27)	(3.19)	(3.03)	(2.92)
Loan-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bank-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Economy-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bank fixed effects	Y	Y	Y	Y								
Firm fixed effects	Y	Y	Y	Y								
Bank × year fixed effects					Y	Y	Y	Y				
Bank × firm fixed effects									Y	Y	Y	Y

Economic impact of forward guidance on loans with mean spreads (in basis points)

	Forward guidance (t-1)	Forwards guidance (t-2)	Forward guidance (t-3)
Model (4)	16.69	17.86	24.21
Model (8)	23.03	25.15	31.02
Model (12)	19.74	16.21	27.73

Table A.6: Response of Loan Spreads to Delphic Forward Guidance

This table reports the regression results of Eq. (2), where the dependent variable is the log of loan spread. Forward guidance indicator variables capture Delphic forward guidance issued one, two, or three months before the loan origination date. The sample period is from October 2008 to June 2017. Columns (1) – (4) use bank fixed effects and firm fixed effects, columns (5) – (8) use bank × year fixed effects and columns (9) – (12) use bank × firm fixed effects. Standard errors are clustered at the bank-year level. Y indicates that the set of control variables or fixed effects is included. The list of control variables and their definitions are provided in Table 2.1. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Forward guidance (t-1)	-0.013			-0.013	-0.018			-0.019	-0.023			-0.024
	(-1.26)			(-1.28)	(-0.76)			(-0.72)	(-1.13)			(-1.13)
Forward guidance (t-2)		-0.005		-0.005		0.000		-0.003		-0.013		-0.015
		(-0.35)		(-0.39)		(0.01)		(-0.10)		(-0.48)		(-0.53)
Forward guidance (t-3)			-0.027	-0.030			-0.010	-0.015			-0.048	-0.052
			(-0.52)	(-0.56)			(-0.23)	(-0.33)			(-0.79)	(-0.84)
Shadow rate	0.015***	0.015***	0.015***	0.015***	0.001	0.001	0.002	0.001	0.004	0.005	0.005	0.004
	(3.09)	(3.13)	(3.04)	(3.00)	(0.06)	(0.08)	(0.08)	(0.07)	(0.33)	(0.40)	(0.44)	(0.38)
Loan-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bank-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Economy-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bank fixed effects	Y	Y	Y	Y								
Firm fixed effects	Y	Y	Y	Y								
Bank × year fixed effects					Y	Y	Y	Y				
Bank × firm fixed effects									Y	Y	Y	Y

Table A.7: Response of Loan Spreads to Forward Guidance during the Pre-financial Crisis Sample Period

This table reports the regression results of Eq. (2), where the dependent variable is the log of loan spread. Forward guidance indicator variables capture all forward guidance issued one, two, or three months before the loan origination date. The sample period is from May 1999 to September 2008. Columns (1) – (4) use bank fixed effects, columns (5) – (8) use bank × year fixed effects and columns (9) – (12) use bank × firm fixed effects. Standard errors are clustered at the bank-year level. Y indicates that the set of control variables or fixed effects is included. The list of control variables and their definitions are provided in Table 2.1. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Forward guidance (t-1)	0.025			0.027	0.016			0.018	0.024			0.025
	(1.38)			(1.44)	(0.49)			(0.57)	(0.83)			(0.87)
Forward guidance (t-2)		0.021		0.024		0.023		0.025		0.0146		0.0162
		(1.00)		(1.12)		(0.63)		(0.67)		(0.43)		(0.48)
Forward guidance (t-3)			0.013	0.015			0.000	0.004			-0.002	0.000
			(0.70)	(0.83)			(-0.01)	(0.12)			(-0.08)	(0.01)
Shadow rate	-0.052***	-0.052***	-0.052***	-0.051***	-0.001	-0.001	-0.001	-0.001	-0.019**	-0.019**	-0.020**	-0.019**
	(-12.66)	(-11.61)	(-12.71)	(-11.63)	(-0.12)	(-0.07)	(-0.12)	(-0.06)	(-2.45)	(-2.34)	(-2.48)	(-2.27)
Loan-level variables	Y	Y	Y	Y	Y	Y	Y	Y				
Firm-level variables	Y	Y	Y	Y	Y	Y	Y	Y				
Bank-level variables	Y	Y	Y	Y	Y	Y	Y	Y				
Economy-level variables	Y	Y	Y	Y	Y	Y	Y	Y				
Bank fixed effects	Y	Y	Y	Y								
Firm fixed effects	Y	Y	Y	Y								
Bank × year fixed effects					Y	Y	Y	Y				
Bank × firm fixed effects									Y	Y	Y	Y

Table A.8: Response of Loan Spreads to Odyssean Forward Guidance, controlling for Federal Funds Rate

This table reports the regression results for the baseline specifications using the federal funds rate as an alternative proxy for the conventional monetary policy stance. The dependent variable is the log of loan spread. Forward guidance indicator variables capture Odyssean forward guidance issued one, two, or three months before the loan origination date. The sample period is from October 2008 to June 2017. Columns (1) – (4) use bank fixed effects, columns (5) – (8) use bank × year fixed effects and columns (9) – (12) use bank × firm fixed effects. Standard errors are clustered at the bank-year level. Y indicates that the set of control variables or fixed effects is included. The list of control variables and their definitions are provided in Table 2.1. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Forward guidance (t-1)	-0.049**			-0.072***	-0.068**			-0.098***	-0.092***			-0.126***
	(-2.09)			(-2.89)	(-2.45)			(-3.06)	(-3.49)			(-4.38)
Forward guidance (t-2)		-0.062***		-0.084***		-0.068**		-0.0997***		-0.107***		-0.139***
		(-3.34)		(-4.13)		(-2.48)		(-3.15)		(-4.41)		(-5.39)
Forward guidance (t-3)			-0.097***	-0.111***			-0.101***	-0.125***			-0.118***	-0.144***
			(-4.95)	(-5.58)			(-3.22)	(-3.80)			(-3.99)	(-4.96)
Federal funds rate	-0.065**	-0.069**	-0.071***	-0.058**	0.256***	0.244***	0.248***	0.249***	0.109*	0.090	0.093	0.105
	(-2.26)	(-2.51)	(-2.62)	(-2.12)	(2.98)	(2.90)	(2.89)	(2.88)	(1.72)	(1.42)	(1.44)	(1.56)
Loan-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bank-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Economy-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bank fixed effects	Y	Y	Y	Y								
Firm fixed effects	Y	Y	Y	Y								
Bank × year fixed effects					Y	Y	Y	Y				
Bank × firm fixed effects									Y	Y	Y	Y

Table A.9: Response of Loan Spreads to Delphic Forward Guidance, controlling for Federal Funds Rate

This table reports the regression results for the baseline specifications using the federal funds rate as an alternative proxy for the conventional monetary policy stance. The dependent variable is the log of loan spread. Forward guidance indicator variables capture Delphic forward guidance issued one, two, or three months before the loan origination date. The sample period is from October 2008 to June 2017. Columns (1) – (4) use bank fixed effects and firm fixed effects, columns (5) – (8) use firm × year fixed effects, columns (9) – (12) use bank × year fixed effects and columns (13) – (16) use bank × firm fixed effects. Standard errors are clustered at the bank-year level. Y indicates that the set of control variables or fixed effects is included. The list of control variables and their definitions are provided in Table 2.1. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Forward guidance (t-1)	-0.018*			-0.019*	-0.021			-0.023
	(-1.73)			(-1.70)	(-0.95)			(-0.95)
Forward guidance (t-2)		-0.003		-0.004		-0.011		-0.015
		(-0.20)		(-0.25)		(-0.39)		(-0.49)
Forward guidance (t-3)			-0.007	-0.011			-0.013	-0.02
			(-0.14)	(-0.21)			(-0.22)	(-0.33)
Federal funds rate	-0.071**	-0.071**	-0.071**	-0.070**	0.149*	0.151*	0.150*	0.151**
	(-2.49)	(-2.46)	(-2.51)	(-2.43)	(1.93)	(1.96)	(1.96)	(1.98)
Loan-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Firm-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Bank-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Economy-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Bank fixed effects	Y	Y	Y	Y				
Firm fixed effects	Y	Y	Y	Y				
Firm × year fixed effects					Y	Y	Y	Y

(continued next page)

	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Forward guidance (t-1)	-0.019			-0.02	-0.025			-0.026
	(-0.79)			(-0.77)	(-1.26)			(-1.27)
Forward guidance (t-2)		-0.005		-0.008		-0.017		-0.020
		(-0.17)		(-0.27)		(-0.63)		(-0.68)
Forward guidance (t-3)			-0.012	-0.018			-0.044	-0.050
			(-0.31)	(-0.44)			(-0.72)	(-0.79)
Federal funds rate	0.250***	0.250***	0.250***	0.251***	0.096	0.098	0.096	0.100
	(2.95)	(2.94)	(2.95)	(2.99)	(1.53)	(1.56)	(1.55)	(1.61)
Loan-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Firm-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Bank-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Economy-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Bank × year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
Bank × firm fixed effects					Y	Y	Y	Y

Table A.10: Response of Loan Spreads to Forward Guidance, controlling for Federal Funds Rate (for the Pre-financial Crisis Sample Period)

This table reports the regression results for the baseline specifications using the federal funds rate as an alternative proxy for the conventional monetary policy stance. The dependent variable is the log of loan spread. Forward guidance indicator variables capture all forward guidance issued one, two, or three months before the loan origination date. The sample period is from May 1999 to September 2008. Columns (1) – (4) use bank fixed effects and firm fixed effects, columns (5) – (8) use firm × year fixed effects, columns (9) – (12) use bank × year fixed effects and columns (13) - (16) use bank × firm fixed effects. Standard errors are clustered at the bank-year level. Y indicates that the set of control variables or fixed effects is included. The list of control variables and their definitions are provided in Table 2.1. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Forward guidance (t-1)	0.029			0.032*	0.031			0.035
	(1.58)			(1.67)	(1.01)			(1.12)
Forward guidance (t-2)		0.028		0.032		0.024		0.028
		(1.33)		(1.49)		(0.66)		(0.78)
Forward guidance (t-3)			0.022	0.025			0.013	0.018
			(1.22)	(1.37)			(0.44)	(0.61)
Federal funds rate	-0.051***	-0.051***	-0.051***	-0.050***	-0.017*	-0.017	-0.017*	-0.016
	(-11.41)	(-10.63)	(-11.46)	(-10.70)	(-1.68)	(-1.61)	(-1.68)	(-1.57)
Loan-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Firm-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Bank-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Economy-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Bank fixed effects	Y	Y	Y	Y				
Firm fixed effects	Y	Y	Y	Y				
Firm × year fixed effects					Y	Y	Y	Y

(continued next page)

	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
Forward guidance (t-1)	0.016			0.018	0.026			0.027
	(0.49)			(0.57)	(0.89)			(0.93)
Forward guidance (t-2)		0.024		0.026		0.017		0.019
		(0.65)		(0.68)		(0.52)		(0.57)
Forward guidance (t-3)			0.000	0.004			0.001	0.004
			(-0.01)	(0.13)			(0.04)	(0.14)
Federal funds rate	0.000	0.001	0.000	0.001	-0.020**	-0.020**	-0.021**	-0.020**
	(0.02)	(0.05)	(0.02)	(0.06)	(-2.36)	(-2.26)	(-2.38)	(-2.20)
Loan-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Firm-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Bank-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Economy-level variables	Y	Y	Y	Y	Y	Y	Y	Y
Bank × year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
Bank × firm fixed effects					Y	Y	Y	Y

Table A.11: Response of Loan Spreads to Forward Guidance, after controlling for Additional Economy-level Variables

This table reports the regression results for the baseline specifications, after additionally controlling for two economy-level variables, namely credit spread (Moody's AAA-ABB corporate bond spread), 3-month T-bill rate and quarterly CPI. The dependent variable is the log of loan spread. Forward guidance indicator variables capture Odyssean forward guidance issued one, two, or three months before the loan origination date. The sample period is from October 2008 to June 2017. Columns (1) – (4) use bank fixed effects and firm fixed effects, columns (5) – (8) use firm × year fixed effects and columns (9) – (12) use bank × year fixed effects. Standard errors are clustered at the bank-year level. Y indicates that the set of control variables or fixed effects is included. The list of control variables and their definitions are provided in Table 2.1. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Forward guidance (t-1)	-0.084***			-0.127***	-0.073***			-0.109***	-0.017			-0.029
	(-3.28)			(-4.42)	(-3.00)			(-3.78)	(-1.04)			(-1.62)
Forward guidance (t-2)		-0.095***		-0.140***		-0.064***		-0.105***		-0.014		-0.029**
		(-3.63)		(-4.75)		(-2.65)		(-3.64)		(-1.19)		(-1.98)
Forward guidance (t-3)			-0.140***	-0.176***			-0.117***	-0.148***			-0.0499***	-0.059***
			(-3.96)	(-4.80)			(-3.36)	(-4.02)			(-2.82)	(-3.08)
Shadow rate	0.009	0.008	0.00603	-0.003	-0.001	-0.001	-0.003	-0.011	0.020***	0.019***	0.0185***	0.017***
	(0.54)	(0.49)	(0.37)	(-0.23)	(-0.03)	(-0.04)	(-0.18)	(-0.71)	(4.70)	(4.63)	(4.33)	(3.98)
Loan-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bank-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Economy-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm × year fixed effects	Y	Y	Y	Y								
Bank × year fixed effects					Y	Y	Y	Y				
Bank × firm fixed effects									Y	Y	Y	Y
Observations	7,493	7,493	7,493	7,493	7,493	7,493	7,493	7,493	7,493	7,493	7,493	7,493

Appendix B

The Effect of Forward Guidance on Relationship Lending and Syndication Structure

B.1 Overview

This appendix provides further details on the research design and execution to assist with the digestibility of our main results. As such, we present the results of supplemental analyses conducted to add support to the main empirical work included in Chapter 3. These tables are as follows:

- Table B.1 presents the definition of variables used in the regressions.
- Table B.2 presents the results of the probit regression of the establishment of new borrower-lender relationships. The results remain unchanged.

Table B.1: Variable Definition

Variable	Definition
Loan	
Number of lead arrangers	Number of lead arrangers within a syndication deal.
Number of participants	Number of participant banks within a syndicaiton deal.
Deal amount (log)	Log of deal amount (in million US dollars).
Maturity	Maturity (in years).
Multiple facility	Takes the value of 1 if the deal has more than one facilities.
Secured	Takes the value of 2 if the loan is secured; 1 if unsecured, and zero if the information is missing.
Corporate purpose	Takes the value of 1 if a loan is used for a corporate purpose and 0 otherwise.
Working capital	Takes the value of 1 if the loan is used for working capital, and 0 otherwise.
Debt repayment	Takes the value of 1 if the loan is for repayment of previous debt and 0 otherwise
Dividend restrictions	Takes the value of two if a loan has to meet a dividend restriction, one if no such restrictions are present, and zero if the information is missing.
Share held by lead arranger	The percentage of the deal amount held by the leader arranger.
Concentration of syndicate (HHI)	The Herfindahl Index based on the shares held by all the lenders in a syndication deal
Firm	
Firm sales (log)	Log of the sales of the firm.
Private	Takes the value of 1 if the firm is private.
Borrower reputation	Log (1+the number of previous syndicated loans a firm has).

Table B.2: New Borrower-lender Relationships with Probit Model

This table reports the Probit regression results for the dependent variable capturing whether or not the bank enters into a new borrower-lender relationship. The dependent variables take the value of 1 if the borrowing firm has not borrowed a syndicated loan from the bank in the previous 3, 5, or 8 years. The results for the new of issuance term loans and credit lines are separately reported. Forward guidance indicator variables capture Odyssean forward guidance issued one, two, or three months before the loan origination date. The sample period is from October 2008 to June 2017. Y indicates that the set of control variables or fixed effects is included. ***, ** and * indicate statistical significance at the 1, 5 and 10 percent, respectively.

	All loans			Term loans			Credit lines		
	3 years	5 years	8 years	3 years	5 years	8 years	3 years	5 years	8 years
Forward guidance (t-1)	-0.123***	-0.043	-0.047	-0.003	0.122	0.062	-0.238***	-0.169***	-0.136**
	(-2.76)	(-0.98)	(-1.07)	(-0.04)	(1.55)	(0.79)	(-4.15)	(-3.01)	(-2.42)
Forward guidance (t-2)	0.029	0.116***	0.127***	0.035	0.111	0.098	0.021	0.121**	0.144**
	(0.64)	(2.63)	(2.89)	(0.46)	(1.49)	(1.32)	(0.34)	(2.09)	(2.50)
Forward guidance (t-3)	-0.036	-0.008	-0.066	-0.015	-0.015	-0.070	-0.009	0.020	-0.041
	(-0.71)	(-0.16)	(-1.31)	(-0.18)	(-0.17)	(-0.81)	(-0.14)	(0.32)	(-0.64)
Loan-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y
Firm-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y
Bank-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y
Economy-level variables	Y	Y	Y	Y	Y	Y	Y	Y	Y
Year fixed effects	Y	Y	Y	Y	Y	Y	Y	Y	Y
Observations	7,493	7,493	7,493	2,469	2,469	2,469	4,654	4,654	4,654

Appendix C

The Effect of Quantitative Easing on Bank Deposit Funding

C.1 Overview

In this appendix, we provide the additional supplementary material to the dataset used in Chapter 4. All the branch-level data come from RateWatch and SoD of FDIC while the bank-level data is sourced from FDIC Call reports (RCFD, RCON and RIAD series). The figure and tables presented are as follow:

- Figure C.1 provides a graphic view of the deposit market concentration measured by the HHI in each county. The HHI is calculated each year and then averaged over our sample period. The graph shows a similar pattern to the one in Drechsler, Savov and Schnabl (2017), indicating that there is a large diversity in the concentration in local deposit markets and the concentration is relatively stable over time.
- Table C.1 presents the definition of all branch-level and bank-level variables we used in our regressions. Note that RIAD series reports year-to-date value of net income, we transform it into quarterly by getting the difference and annualize it.

Figure C.1: HHI

This figure shows the HHI for each county in the US based on the shares of the deposit market from 2008 to 2015.

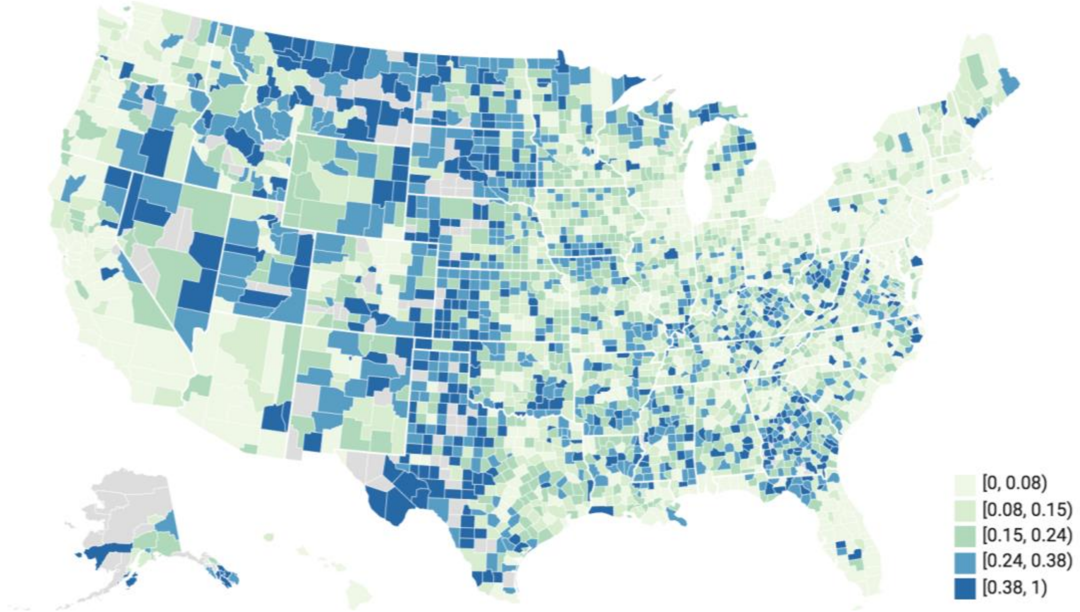

Table C.1: Variable Definition

This table presents the definition of the branch-level and bank-level variables used in regressions. Data sources are: RateWatch, SoD, and Call Reports. The sample period is from January 2008 to December 2015.

Variable	Definition
Branch level	
Δdeposit spread	The difference between benchmark interest rate (federal funds rate/shadow rate) and deposit rate.
Deposit amount	The amount of deposit held by the branch.
HHI	Herfindahl-Hirschman Index based on the average market share of branches in each county during our sample.
Bank level	
Size (log)	Log of total assets (RCFD2170).
Capital ratio	The ratio of total equity (RCFD3210) divided by total assets.
ROA*	The ratio of net income (RIAD4340) divided by total assets.
MBS	Amortized cost of held-to-maturity MBS (RCFD8508) plus fair value of available-for-sale MBS (RCFD8511).
Treasury	Amortized cost of held-to-maturity US treasury securities (RCFD0211) plus fair value of available-for-sale US treasury securities (RCFD1287).
Deposits (log)	Log of total deposits held by the bank (RCON2200).
Savings deposits (log)	Log of total time and savings deposit (RCFD2350) minus time deposit.
Time deposits (log)	Log of total time deposit smaller that $100K (RCON6648) plus total time deposit larger than $100K (RCON2604).