What Drives Bank Credit Lines? Wholesale Funding and Bank Liquidity Creation*

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Abstract

Liquidity creation is one of the primary functions of banks, and bank credit lines are one of the largest sources of it. Existing theories of banks' supply of credit lines have highlighted the central role of traditional retail deposits. In this paper, I revisit those results and find little evidence to support those claims. Instead, I document that sources of non-retail funding – wholesale funding – have been an important driver of banks' contingent commitments. I show that banks with greater wholesale funding ratios lent more through off-balance sheet commitments during the 1990-2008 period. Estimates from two identification strategies suggest a 1% increase in wholesale funding leads to 0.3-0.4% increase in contingent commitments. These results run contrary to the prevailing deposit-based theories of banks' commitment lending and have important implications for banks' "specialness" in commitment lending, aggregate liquidity risk, and post-2008 liquidity regulations for banks.

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1 Introduction

Credit lines, or commitments to provide liquidity on demand, have gained prominence as a major source of financing in the US economy over the last three decades.[1] Banks are the single largest providers of such commitments – consistent with their role as optimal providers of liquidity as argued in Holmström and Tirole (1998). Credit line drawdowns accounted for more than 50% of overall bank lending to firms in the US between 2013-2019 (Greenwald, Krainer and Paul, 2020).[2] Firms use credit lines not only to insulate themselves from negative profitability shocks, but also to fund growth opportunities needs.[3] Moreover, they play a central role in the transmission of macroeconomic shocks to firm credit (Greenwald, Krainer and Paul, 2020). Naturally, it becomes important to understand the supply-side drivers of these contingent commitments. What are the determinants of banks' supply of credit lines? What kinds of bank liability structures support contingent commitment growth? Existing research on credit lines has (rightly) focused on the dynamics of credit line drawdowns around times of aggregate uncertainty such as the financial crisis of 2008 and COVID-19 crisis.[4] However, a more upstream question of the determinants of system-wide contingent liquidity during normal times – in the form of bank credit lines – is equally important and remains under explored in the literature.

In this paper, I aim to fill this gap by proposing a novel channel that links a bank's credit lines to the bank's wholesale funding, and outline the underlying mechanism driving this relationship. Using publicly available regulatory data on US banks' balance sheets (quarterly Call Reports and FRY-9C reports), I document that banks with greater wholesale funding ratios lent more using off-balance sheet commitments in the two decades prior to the 2008 crisis. This positive relationship holds over time for banks in the aggregate, across banks, and within banks. Using exogenous monetary policy shocks in a local projection setting, I show that banks respond by increasing their wholesale funding and credit line commitments after

[1] Credit lines allow borrowers to withdraw credit up to a pre-specified amount, at a pre-determined spread (usually over a reference rate such as the Federal Funds rate). Undrawn portion of credit lines are reported as off-balance sheets items on regulatory reports filed by banks. Once they are drawn, they are recorded as loan assets.

[2] Credit lines to firms form the largest component of banks' contingent commitment. Other types of credit lines include home equity lines of credit, credit card lines, and credit lines to fund loans to commercial real estate.

[3] Lins, Servaes and Tufano (2010), using survey evidence, find that credit lines give firms the option to exploit future business opportunities. Campello, Graham and Harvey (2010) find that constrained firms drew down more heavily on credit lines during 2008. Brown, Gustafson and Ivanov (2021) find that firms respond to exogenous weather shocks by drawing down on credit lines and increasing its size.

[4] Acharya and Mora (2015) document that commitments-exposed banks experienced weak deposit growth during the first half of the 2008 crisis, and were forced to reduce new credit line originations. Ivashina and Scharfstein (2010) find that banks that co-syndicated a greater number of credit lines with Lehman experienced greater drawdowns. Other papers include Greenwald, Krainer and Paul (2020), Campello, Graham and Harvey (2010), Campello et al. (2011), Acharya and Steffen (2020), Campello et al. (2012), Cornett et al. (2011).

an exogenous fed funds rate shock. I exploit two identification strategies to isolate exogenous variation in wholesale funding and study its impact on commitments: (1) membership dates of banks to the Federal Home Loan Bank (FHLB) system in a staggered Difference-in-differences (DiD) exercise and (2) shift-share instrument design using exogeneity of component shares of wholesale funding in the construction of the Bartik instrument. Estimates from these exercises suggest that banks' contingent commitments increase by 0.3 to 0.4% in response to a 1% increase in wholesale funding. I rule out reverse causality in a standard DiD design using an exogenous regulatory change which made it relatively costly for treated banks to increase their supply of off-balance sheet commitments. While commitments growth reduces in an expected manner following the regulatory change, wholesale funding growth remains unchanged between treated and untreated banks.

What is so special about wholesale funding? Wholesale funding is typically deployed as an umbrella term to capture different types of funding sources of banks. These sources differ from each other along various dimensions ranging from maturity to collateralization.[5] However, there are three unifying characteristics that make them distinct from the other broad category of bank funding I consider – demandable deposits.[6] First, wholesale funding, for the most part, is short-term guaranteed funding issued and exhausted at the discretion of banks unlike demandable deposits.[7] Second, they are competitively priced unlike demandable deposits where banks traditionally have some monopoly power and enjoy a "deposit spread" (Drechsler, Savov and Schnabl (2017)). Third, wholesale funding is uninsured whereas demandable deposits are (mostly) insured by a government guarantee.

These distinct features of wholesale funding are at the heart of the mechanism underlying the relationship between banks' wholesale funding and off-balance sheet commitments. Uninsured wholesale funding providers have a higher incentive to (imperfectly) monitor and refuse rolling over maturing debt in the event of bad news or a noisy public signal about the bank, leaving banks unable to refinance maturing short-term debt (Huang and Ratnovski (2011), Calomiris and Kahn (1991)). Demandable deposits, on the other hand, are usually not

[5]Wholesale funding is the sum of five types of fundings sources as defined in the banks' regulatory reports following Acharya and Mora (2015): (1) Federal funds purchased and repurchase agreements sold under agreement to repurchase, (2) Foreign deposits, (3) Large time deposits ($\$ > 100,000$), (4) Other borrowed money, and (5) Subordinated notes.

[6]Demandable deposits, formally defined, comprise of transaction and savings accounts deposits. As the name suggests, they have a high degree of "demandability" – depositors can freely put in money and take it out. They are traditionally made up of retail deposits and salary accounts of corporations.

[7]Most sources of wholesale funding have a rollover component with funding guaranteed for the duration of its maturity. In case of repo funding, the maturity can be as short as a day while large time deposits can have a maturity in years. Banks can choose to not rollover their funding and raise greater wholesale funding (issue a new Certificate of Deposit) if the need arose. In theory, banks can adjust their volume of demandable deposits by opening and closing branches, but it will most likely be a gradual process and require significant investments. Banks' inability to optimally control deposit flows is discussed in more detail in Bolton et al. (2020)

the first to run.[8] Thus, while wholesale funding offers banks greater funding flexibility, the cost lies in their fragility and sensitivity to (imperfect) information. Ratnovski (2013) argues that banks keep higher liquidity buffers as they increase their dependence on wholesale funding in order to avoid such refinancing risk.[9]I empirically confirm the predictions of their theoretical model. Banks with a higher wholesale funding ratios in their liability structure hold a higher share of liquid securities.

Cash or liquid securities are costly for banks.[10] Once the motivation for keeping liquidity buffers is established, the link between bank credit lines and wholesale funding follows from a synergy argument similar to Kashyap, Rajan and Stein (2002) (KRS). In their theoretical model, banks hold a (costly) stockpile of liquid assets in anticipation of deposit withdrawals. Economic efficiencies arise when banks make contingent commitments as the same stockpile of liquid assets can be used to fund credit line drawdowns as well as deposit withdrawals as long as they are imperfectly correlated. Thus, banks combine deposit-taking and commitment-based lending under one roof because they can get away with keeping less cash on hand as long as deposits and commitments aren't drawn down at the same time.

The mechanism in this paper differs from KRS in the kind of liabilities against which a bank holds liquidity buffers. KRS identify *transaction deposits* as the empirical counterpart of "demandable deposits" in their theoretical model. Using data from 1992-96, they document a positive relationship between *transaction deposits*, liquid securities, and banks' contingent commitments. I successfully replicate their findings for the original time period of the publication, but find no statistical relationship when the data is extended till 2008. On the other hand, I find a statistically meaningful relationship between *wholesale funding*, liquid securities, and banks' contingent commitments for the same time period. Suggestive evidence for the lack of a relationship between *transaction deposits* and commitments is evident from the aggregate time series for both. Nominal aggregate values of transaction deposits remained flat – between $600 - $800 billion – in the two decades leading up to the crisis. Meanwhile, total off-balance sheet commitments increased more than threefold during that time, going from $600 billion to $2.2 trillion . Moreover, it is well understood that "demandable deposits" withdrawals are sluggish in nature, price-controlled by banks due to their monopoly power, and easily substitutable with wholesale funding as they carry little information content (Drechsler, Savov and Schnabl

[8]As evidenced in Shin (2009), retail depositors were the last to exit in the run on Northern Rock.

[9]In Sundaresan and Xiao (2024), intermediaries hold a liquidity buffer in order to meet withdrawals from short-term creditors.

[10]Kashyap, Rajan and Stein (2002) argue that the deadweight costs of holding liquidity buffers on balance sheets can be understood in terms of low returns on such securities or agency costs associated with holding liquid assets.

(2017)). As such, there is weak support for the notion that banks keep meaningful levels of liquidity buffers to fund deposit withdrawals.[11]

The mechanism in this paper, thus, can be seen as a matter of correctly interpreting "demandable deposits" in the theoretical model of KRS. Reinterpreting them as wholesale funding instead of transaction deposits leads to the same synergy argument with two exceptions. First, in KRS, the efficiency argument behind banks' "specialness" in supplying contingent commitments relies on an imperfect correlation between deposit withdrawal and credit line drawdowns. Replacing transaction deposits with wholesale funding requires a similar assumption of imperfect correlation between wholesale funding refinancing shocks and credit line drawdowns. However, Ippolito et al. (2016) provide evidence of double bank runs during the 2008 crisis, reflecting the dangers of wholesale funding-backed credit line commitments in times of aggregate shocks. Their finding, in the context of this paper, highlights a fundamental source of aggregate risk in the banking system – correlated drawdowns of credit lines and negative wholesale funding shocks. If wholesale funding providers overlap with beneficiaries of bank credit lines, events characterized by aggregate uncertainty will systematically lead to system-wide scarcity of liquidity. This reasoning will undoubtedly lead a central planner to reduce banks' dependence on wholesale funding. On the other hand, excessive curbing of wholesale funding markets runs the risk of going too far and result in lower than optimal level of credit line commitments. Optimal regulation, thus, has to contend with this tradeoff.

Second, a wholesale funding-driven model of commitments diminishes the core reasoning behind banks' "specialness" in extending credit line commitments. Transaction deposits, obtained through banks' deposit franchise, are at the core of the theoretical justification for the dominance of bank-like structures in commitment lending. Contrary to the arguments grounded in banks' transaction deposits, I show that US branches foreign banks were large providers of commitments in the US despite a negligible amount of transaction deposits in their liabilities.[12] If the deposit franchise with demandable deposits – a feature unique to commercial banks – is not central to commitment-based liquidity creation, then what explains banks' dominance in commitment-based lending? Holmström and Tirole (1998) and Acharya

[11] On the other hand, the fragility of wholesale funding – and the provisioning of higher liquid assets against it – has been codified into the Basel III regulations after the 2008 crisis. Runoff rates attached to different types of wholesale funding range from 5% to 100%, representing higher provisioning of high-quality liquid assets (HQLA) against wholesale funding. Runoff rates for demand deposits are typically lower, between 3% to 10% (BIS, 2013).

[12] Starting 1991, US branches of foreign banks were prohibited from any domestic retail banking activities which was defined as the acceptance of retail deposits under $100,000. Establishment of US branches and agencies is the most common form in which foreign banks operate in the United States and are largely funding by wholesale funding See section 8 for more details.

et al. (2014) provide a rationale grounded in the monitoring role of banks. Gatev and Strahan (2006) highlight the hedging aspect of deposit inflows during times of credit line drawdowns which could be consistent with a wholesale funding-based model of banks' commitments. However, as pointed out in Acharya and Mora (2015), the inflows of deposit may not always occur as evidenced during the first half of the 2008 crisis.

I employ two identification strategies to isolate exogenous variation in wholesale funding and study its effect on off-balance sheet commitments. The first one uses the staggered dates of banks' membership to FHLB system between 1990-2008. The FHLB system, originally designed to fund housing and community lending, has come to be known as "the Lender of Next-to-Last Resort" over time due to its role as a reliable provider of wholesale funding (Ashcraft, Bech and Frame, 2010). It provides low-cost, collaterlized funding to its member institutions on demand. Membership of the FHLB system is voluntary, and a necessary pre-requisite for tapping FHLB funding.[13] I link the dates of membership of each member bank[14] to the Call Reports data, and study its impact on wholesale funding and off-balance sheet commitments growth in a staggered DiD design with not-yet-treated banks.

The identifying assumption here is one of parallel trends i.e. trends in the outcome variable (commitments) would have been the same in "treated" banks as "not-yet-treated" banks absent FHLB membership. While not directly testable, I show that there are no meaningful pre-trends in my results. The plausibility of the parallel trends assumption is further underscored by the fact that contingent commitments don't require actual dollar funding unless they are withdrawn. On the other hand, if banks' application to the FHLB system is driven by banks' need to raise wholesale funding to meet growing loan demand – and loan demand is positively correlated with commitments demand – then the parallel trends assumption is likely to be violated. Thus, if there is selection on unobservables such as time-varying, bank-level commitment demand, estimands from the staggered DiD design will not have a causal interpretation. If there is selection on observables, I can assume a conditional parallel trends assumption. While not testable, I show that there are no significant pre-trends in my results using both real assets as a covariate and without any covariates. Estimates from this exercise suggest that a 1% increase in wholesale funding leads to a 0.41% increase in off-balance sheet commitments.

Due to concerns of endogeneity of banks' membership to the FHLB system, I employ

[13]To gain membership, a bank must apply to the appropriate District Bank furnishing required materials. After a review process, the District banks may choose to approve or deny membership. Within 60 days of membership approval, the filing institution must initiate a membership stock purchase in order to be considered a member.

[14]The dates are available on the website of the Federal Housing Finance Agency (FHFA)

a second identification strategy using the various components of wholesale funding to construct a shift-share instrument. The shift-share instrument is constructed as the inner product of (bank-level) lagged, wholesale funding component shares, and aggregate changes in those components. Following Goldsmith-Pinkham, Sorkin and Swift (2020), the identification of the Bartik instrument in this context rests on an exogeneity assumption of the wholesale funding component shares. The exclusion restriction, thus, rests on justifying the exogeneity of component shares.[15] Using aggregate evidence from Call reports and anecdotal evidence from Bank of England (2015), I argue that there is a high degree of substitution and diversification across various components of wholesale funding. As such, there seems to be suggestive evidence that off-balance sheet commitments respond to overall changes in wholesale funding rather than specific components of wholesale funding. Moreover, lagged component shares address the threat of simultaneity bias in the form of commitments responding in anticipation of aggregate (component-level) shocks. The shift-share instrument design suggests that an exogenous 1% increase in wholesale funding leads to a 0.3% increase in contingent commitments.

Finally, I address concerns about reverse causality using an unanticipated regulatory change concerning banks' off-balance sheet commitments – introduction of regulation FIN 46. Reverse causality in this context – the notion that wholesale funding is acquired (or exhausted) in response to changes in commitments – seems implausible mainly because provisioning of credit lines doesn't require actual dollar funding unless withdrawn. However, a possible channel for such a relationship could be through banks' liquidity commitments to asset-backed commercial paper (ABCP) conduits.[16] The introduction of FIN 46 regulation, first proposed in 2002, allows me to rule out such a channel. In a nutshell, the FIN 46 directive mandated banks to hold 100% risk-weighted equity capital against previously exempt assets of ABCP conduit-like entities which were beneficiaries of liquidity guarantees by banks. Historically, such liquidity commitments made by banks were exempt from any equity capital requirements (Acharya, Schnabl and Suarez, 2013). As such, the new regulation discontinuously increased the cost of providing new liquidity commitments and servicing existing ones for all banks. Since the new

[15] Borusyak, Hull and Jaravel (2022) propose a complementary framework where the identification of the shift-share instrument follows from the exogeneity of the shocks, allowing exposure shares to be endogenous. However, the former research design is more appropriate in the current setting since the estimator in the latter design is consistent only when the number of components included in the shift-share instrument is large (Goldsmith-Pinkham, Sorkin and Swift, 2020)

[16] Shin (2009) documents the rapid growth of Northern Rock's balance sheet on account of non-deposit funding such as securitized notes and interbank deposits. Unlike US banks where ABCP conduits are kept off-balance sheets, accounting rules in the UK required banks to consolidate these conduits on their balance sheet. Securitized notes – a form of wholesale funding – were used mainly to fund these on-balance sheet ABCP conduits as pointed out in Figure 2 of Shin (2009). While the focus of this paper is US banks, it is possible that some of the wholesale funding raised to fund off-balance ABCP conduits might find its way on the balance sheets of US banks.

regulation applied uniformly to all liquidity commitments, including ones made before its introduction, it disproportionately affected banks already engaged in such activities. Using a standard, dynamic DiD design, I find that commitments for treated banks decreased by 19.8% over 7 quarters from the time of the introduction of FIN 46 (Q3 2002) to the date of its reversal (Q2 2004). At the same time, I don't find any statistically signficant changes in wholesale funding growth for treated banks. If the causality ran from commitments to wholesale funding, we would expect the latter to have behaved in a similar fashion. Additionally, lack of pre-trends suggest that FIN 46 was an exogenous shock, adding to the evidence documented in Bens and Monahan (2008).

2 Related Literature

This paper makes four important contributions to the literature. First, it attempts to resolve a potential disconnect between the theoretical and empirical literature on credit line commitments. On the one hand, banking theories predict that banks make credit line commitments on the back of greater demandable deposits. And the mechanism operates through its holding of costly liquidity buffers. The post-2008 crisis empirical literature, however, consistently finds evidence of double bank runs i.e. banks with greater ex-ante wholesale funding exposure experienced a simultaneous run on their credit line commitments owing to the shocks in the wholesale funding markets.[17] The impetus for firms to run on credit lines from banks prone to wholesale funding shocks is hard to reconcile with deposit-backed theories of commitments since deposits remained flat during this period.[18] If banks were backing up credit lines with greater deposits which remained stable during the crisis, the motivation for credit lines runs becomes hard to justify on account of wholesale funding shocks. A wholesale funding-backed model of credit lines, as argued in this paper, is more susceptible to such instances of double bank runs.

Second, this paper is connected to the strand of literature studying banks' "specialness" as liquidity providers starting with one of the seminal papers in this field by Kashyap, Rajan and Stein (2002). They propose an equilibrium (positive) relationship between banks' trans-

[17] Ippolito et al. (2016), using data on Italian banks, find evidence for double bank runs during the European interbank freeze of 2007. They find that a firm with multiple credit lines from different banks chooses to drawdown on credit lines from banks hit most by the wholesale funding shock.

[18] Ivashina and Scharfstein (2010) briefly touch upon this disconnect – *"The analysis is further complicated by the fact that banks that extend more credit lines are more prone to fund themselves with deposits."* They come to the conclusion that banks extending more credit lines are less prone to the risk of runs by short-term creditors. For evidence on lack of outflows of deposits, see Acharya and Mora (2015) and Cornett et al. (2011). Cornett et al. (2011) find that retail deposits increased in the banking system following the collapse of Lehman Brothers in September 2008.

action deposits and commitments operating through the bank's holding of liquid securities. However, they do not focus on wholesale funding markets. Empirical evidence in this paper suggests that the equilibrium relationship may have shifted, perhaps with the development of wholesale funding markets. The lack of relevance of a bank's deposit franchise to its credit line extensions, as argued in this paper, leads one to ask what is it that a bank can do that non-bank financial intermediaries cannot. A non-bank finance company funded solely by short-term debt should, in theory, be up to the task.[19] In Holmström and Tirole (1998), banks implement the optimal allocation of intertemporal liquidity by issuing credit lines to firms. Credit lines allow firms to commit to drawing down contingent commitments solely to meet realized liquidity shocks and, thus, avoid the moral hazard problem associated with a financial markets solution. In essence, the optimality of bank credit lines boils down to monitoring in their paper. The ability of banks to impose constraints on how firms use the cash from credit line drawdowns (namely, for realized liquidity shocks) is at the core of their argument for the optimality of bank credit lines. As such, if banks have a comparative advantage in disciplining firms' end use of drawn funds, bank-like structures will be uniquely placed in providing credit lines to firms.[20] Gatev and Strahan (2006) highlight a negative relationship between commitment withdrawals and deposit outflows during episodes of system-wide decline in liquidity. Acharya and Mora (2015) provide evidence that deposit inflow did not occur in the first half of the financial crisis of 2008 at the time of widespread credit line withdrawals. Ratnovski (2013) develops a theoretical model linking wholesale funding with greater liquidity buffers. I empirically confirm the predictions of their model and extend it further to connect liquidity buffers to off-balance sheet commitments. This research paper is closest in its findings to Correa, Sapriza and Zlate (2021). They find that US branches of euro-area banks materially decreased their supply of revolving credit to US firms in response to wholesale funding shocks following the European sovereign debt crisis in 2011. While their focus is on the cross-border transmissions of funding shocks, I restrict my attention to US banks.

Third, if wholesale funding is, indeed, systematically linked to bank credit lines, a number of policy implications emerge. As argued in Thakor (2018), post-crisis regulations have focused excessively on liquidity requirements instead of capital requirements. The Liquidity Coverage Ratio (LCR), introduced in 2013 as part of the Basel-III regulations, lays down high

[19] As documented in Lewis (2023), securities dealers often provide credit lines to mortgage companies.

[20] Sufi (2009) finds that cash-flow based covenants are most commonly observed in bank credit lines than any other type of covenant. To the extent on-balance sheet cash disciplines credit line drawdowns of firms, the lack of substitutability between cash and credit lines could be due to banks' need to monitor. Berger and Udell (1995) find that banks gain valuable information over the course of their relationship with firms and that plays a significant role in setting terms of lines of credit offered to small firms.

runoff rates for wholesale funding sources (5-100%) as well as unused commitments of banks (5-100%). Banks are, thus, required to hold high quality liquid assets (HQLA) against both (BIS, 2013). Research on liquidity regulations is still evolving and there is a lack of consensus on optimal liquidity regulation (Sundaresan and Xiao (2024), Diamond and Kashyap (2016), Allen and Gale (2018)). A wholesale-funding backed model of commitments uncovers another dimension for the debate on optimal liquidity regulation. If banks were using the same liquidity buffer to insulate themselves against wholesale funding shocks as well as credit line withdrawals, these regulations might have a distortionary impact on banks' supply of credit lines to firms. Figure 1 plots the volume of wholesale funding along with three measures of banks' off-balance sheet commitments. It took approximately 6-7 years for the aggregate nominal dollar volume of commitments to reach their pre-crisis peaks. Using data on drawn and undrawn credit from Capital IQ, I plot the aggregate time-series dynamics of revolving credit facilities available to US incorporated, non-financial firms in Figure 2. The results echo the findings from the aggregate graphs plotted using data from banks' call reports. On the extensive margin, the percentage of firms with revolving credit facilities never recovered from the pre-crisis peak of 62.4%, falling to a low of 52.5% in 2020-21 with a sustained decline over the last decade (Panel 2a). A similar narrative emerges when looking at the extensive margin. Revolving credit as a percentage of total firm assets (total debt) declined from a pre-crisis peak of 8.5% (30%) to a low of 6.5% (19.3%) in 2020-21. Undoubtedly, the post-GFC period is confounded with various forces at play, including regulatory forces,[21] and this is, at best, suggestive evidence for the decline in banks' commitments. For the same reason, I restrict most of my analysis to the period between 1990-2008 in order to insulate my analysis from post-GFC regulatory changes and central bank actions. However, to the extent wholesale funding access is tied to banks' supply of commitments, optimal regulation restricting wholesale funding markets will have to confront this tradeoff.

Fourth, this paper also contributes to the literature analyzing periods of banking crises and drivers of systemic risk. The results in this paper suggest there was an active build-up of aggregate liquidity risk going into the 2008 crisis given the fragility of wholesale funding markets and the high probability of simultaneous drawdowns on credit lines. A potential way to interpret the findings of this paper is that banks were aware of the possibility of double runs, but discounted its severity á la neglected risk model of Gennaioli, Shleifer and Vishny (2012) or relied on government intervention during period of aggregate shocks as in Holmström and Tirole (1998). Acharya et al. (2023) caution that claims on banks' liquidity have increased both

[21] Acharya et al. (2023) find that central bank reserves are linked to banks' credit line commitments in the post-crisis period.

on and off-balance sheet even as the central bank has been shrinking its balance sheet. Ivashina and Scharfstein (2010) argue that banks that extend higher credit lines also fund themselves using stable deposit funding following the theoretical argument in Kashyap, Rajan and Stein (2002). However, I find that banks that entered the crisis with greater wholesale funding shares also gave out more credit lines. Ippolito et al. (2016), using Italian credit registry data, find that banks experienced aggregate double runs on wholesale funding and credit lines following the 2007 freeze of European interbank markets. Their empirical finding neatly fits a model of banks' commitments centered around wholesale funding rather than retail deposits. Similarly, Chava et al. (2023) find that banks reduced credit card limits – a form of bank commitments – following wholesale funding shocks in 2008. This paper also relates to the literature studying systemic risk. Acharya et al. (2023) caution that claims on banks' liquidity have increased both on and off-balance sheet even as the central bank has been shrinking its balance sheet.

This paper proceeds as follows. Section 3 describes the data and variable construction. Section 4 and 5 provides aggregate time-series and cross-sectional evidence, including panel regressions. Section 6 discusses three causal identification strategies. Section 7 lays down the theoretical underpinnings of the mechanism and provides empirical evidence to support it. Section 8 provides evidence from domestic branches of foreign banks. And lastly, Section 9 concludes.

3 Data and Variable Description

3.1 Data

This section discusses the various datasets employed in the analysis. The baseline aggregate and cross-sectional analysis is carried out using data from the FR Y-9C reports filed every quarter by domestic Bank Holding Companies in a consolidated form. For robustness, I repeat my analysis using quarterly *Call Reports* data filed by commercial banks. The data on bank liquidity creation is from Berger and Bouwman (2009). In addition, I use the branch level deposits data from Summary of Deposits (SOD) in order to construct measures of bank-level market power. More details about the datasets have been laid out in section B.

3.2 Variable Description

In order to construct time-consistent definitions of variables in my analysis, I provide a detailed mapping of variable definitions and their regulatory counterparts in the quarterly filings data. The mapping for Bank Holding Companies and Commercial Banks can be found in Tables A.1 and A.2, respectively. In particular, I construct three proxies for off-balance sheet commitments which account for the different components of off-balance sheet commitments[22]:

1. **Off-balance sheet liquidity creation ratio (LC_OBS)**: This measure is directly available from Berger and Bouwman (2009) for Commercial Banks. Thus, I merge the liquidity creation data with the Call Reports data for Commercial Banks using the unique identifier for banks. For BHC data, I construct this measure using the methodology outlined in Berger and Bouwman (2009).[23] This measure spans all kinds of off-balance sheet commitments (including derivatives), permits comparisons with on-balance sheet liquidity creation, and can be easily aggregated across banks since it is expressed in nominal dollar terms.

2. **Unused Commitments ratio (COMMIT)**: The construction of this proxy for commitments follows the logic outlined in Acharya and Mora (2015) and Kashyap, Rajan and Stein (2002). The measure includes components of off-balance sheet commitments which have a more realistic chance of being drawn upon. For instance, this measure excludes credit card commitments since most households pay their entire balance every month. Thus, the dollar value of stock of credit line commitments outstanding will likely overstate the amount of real liquidity service provided (Kashyap, Rajan and Stein (2002)). Standby letters of credit, similarly, are excluded since banks tend to have an advance warning when such funding is triggered.

3. **Unused C&I Commitments ratio (CICOMMIT)**: Following Kashyap, Rajan and Stein (2002), I create this proxy of off-balance sheet commitments specifically related to Commercial and Industrial (C&I) firms for additional robustness.

I classify bank's funding sources, broadly, to be of two types: (1) wholesale funding and (2) demandable deposits. The latter funding source fits our notion of the liability side of a traditional bank more closely – retail deposits residing at the bank which can be easily called upon when needed, the "runnable" deposits envisioned in Diamond and Dybvig (1983). As

[22] Detailed construction of these measures is available in Tables A.1 and A.2

[23] Some components of the BHC data don't permit a one-to-one mapping for this measure. For instance, in my construction of this measure using BHC data, I could not find sensible counterparts for variables related to Liquid Derivatives and Liquid Guarantees mentioned in Berger and Bouwman (2009).

such, checkings accounts or transaction deposits most aptly fit the definition of demandable deposits (see Kashyap, Rajan and Stein (2002)). Savings accounts, on the other hand, were historically allowed only a few monthly transactions[24] and in theory, provided a relatively lower degree of liquidity on demand for account holders. However, owing to the large share of savings deposits in the banking system and the high absolute degree of flexibility afforded by these accounts even with the six-withdrawals limit[25], I club these deposits with transaction deposits in my classification of "demandable" deposits.

Wholesale funding, following previous literature (Acharya and Mora (2015), Acharya, Engle and Steffen (2021)), is defined as the sum of five sources of funding: (1) Federal funds purchased and repurchase agreements sold under agreement to repurchase, (2) Foreign deposits, (3) Large time deposits (>$100,000), (4) Other borrowed money, and (5) Subordinated notes. These sources of funding differ along various dimensions. They might have different maturities –overnight repos vs. large time deposits with maturity greater than a year; have different investors – Federal Home Loan Bank (FHLB) loans (which form a part of other borrowed money) vs. large time deposits usually funded by large corporations, Money Market Mutual Funds (MMFs), etc.); secured vs. unsecured – repos are secured by collateral whereas federal funds and large time deposits are not. The unifying theme across these various sources of funding lies along three dimensions. First, interest expenses (see Bolton et al. (2020)) are usually higher for wholesale funding. Unlike retail deposits, banks compete with other financial intermediaries like MMFs, treasuries, etc. in attracting this source of funding (Drechsler, Savov and Schnabl (2017)) and thus, pay at least the prevailing interest rate set by the central banking i.e. federal funds rate. Second, all sources of wholesale funding are uninsured. Third, these sources of financing have a finite maturity along with an element of debt rollover at regular intervals unlike retail deposits which are long-term contracts without a well-defined maturity (Bolton et al. (2020)). The frequent rollover of wholesale debt permits fair pricing of risky debt (Della Seta, Morellec and Zucchi (2020)). Small time deposits (<$100,000) present a challenge to our classification because they are not "demandable", but they are insured by the

[24] Savings accounts have no specified maturity and can be interest-bearing. However, the defining characteristic of a savings account from a regulatory perspective lies in the number "convenient" transactions allowed per month. Savings accounts were allowed a maximum of six transfers or withdrawals per month. Kashyap, Rajan and Stein (2002) document that the number may have been even lower (three transactions per month) in the 90's. A federal rule called "Regulation D" governed the classification of savings account (see https://www.federalreserve.gov/boarddocs/supmanual/cch/int_depos.pdf). In light of the increasing funding needs of consumers during the COVID pandemic, the Federal Reserve (Fed) suspended the restrictions on the number of transactions allowed on savings accounts in April, 2020 (see https://www.federalreserve.gov/newsevents/pressreleases/bcreg20200424a.htm).

[25] Regulation D, while restricting the number of transactions, imposed no limits on the amounts that can be transacted with savings accounts. Moreover, certain transactions like withdrawals by mail, ATM, or in person, had no restrictions.

government.[26] Since small time deposits form a non-trivial share of bank's aggregate funding, I include them in the total funding of banks but refrain from classifying them as demandable deposits or wholesale funding. I construct the following measures of banks' funding sources:

1. **Wholesale funding:** This is the sum of (1) Federal funds purchased and repurchase agreements sold under agreement to repurchase, (2) Foreign deposits, (3) Large time deposits (>$100,000), (4) Other borrowed money, and (5) Subordinated notes.

2. **Demandable deposits:** This is the sum of (1) transaction deposits and (2) savings deposits.[27].

3. **Total Funding:** Banks' total funding is the sum of (1) wholesale funding, (2) demandable deposits, and (3) Small-time deposits (>$100,000).

4 Aggregate Time-Series Evidence

4.1 Wholesale funding and off-balance sheet commitments

As previously mentioned, off-balance sheet commitments of banks are synonymous with bank liquidity creation. While this might seem intuitively true, can we empirically assess the liquidity creation role of contingent commitments? Has it increased over time and what is its distribution in the cross-section? Berger and Bouwman (2009) provide an answer by developing comprehensive measures of bank liquidity creation using Call reports data. They classify banks' assets, liabilities, and off-balance sheet items into three liquidity classifications (liquid, semiliquid, and illiquid) and assign weights to them to create a panel of liquidity creation measures for banks.[28] The weight assignment follows the following principle: liquidity is created when illiquid assets are transformed into liquid liabilities and liquidity is destroyed when liquid assets are transformed into illiquid liabilities. They find that off-balance sheet commitments of banks were responsible for half of the $2.8 trillion of total liquidity created by banks between 1993-2003.

To create aggregate measures of liquidity creation, I aggregate the panel dataset from Berger and Bouwman (2009) to create a time series of liquidity created (in nominal dollar terms)

[26] Early withdrawal of time deposits invites penalties

[27] Transaction deposits, as reported in Call Reports data, subsumes demand deposits. However, this is not the case with FR Y-9C reports. Demand deposits are reported separately from transaction deposits. Thus, for BHC data, demandable deposits is the sum of (1) Demand Deposits, (2) Transaction Deposits, and (3) Savings Deposits. For more details, please see Tables A.2 and A.1.

[28] See Table 1 of Berger and Bouwman (2009) for assignment of weights to balance sheet items.

by the overall banking system ("catfat" measure), and compare it with the aggregate liquidity creation solely on account of off-balance sheet commitments. I merge the liquidity creation data from Berger and Bouwman (2009) with the Commercial Bank data from Call Reports to form a comparable time series for wholesale funding.[29] Figure 3a plots these aggregate time-series. We can see that off-balance sheet liquidity creation accounts for a significant share of overall bank liquidity creation. It increases from 48% in 1990 to a peak of 65% right before the crisis. The average share during this period was 57%. In nominal dollar terms, off-balance sheet liquidity creation stood at a peak of $3.6 trillion dollars right before the crisis. Overall liquidity creation ("catfat") also peaked around then, reaching a high of $5.7 trillion. The fall around the 2008 crisis is steep and sustained – increasing after 12 quarters, in 2011. Off-balance sheet liquidity creation never recovers to its pre-crisis highs whereas overall liquidity creation measure ("catfat") climbs back to it pre-crisis levels in 2014 mainly due to the increase in liquid liabilities like savings and transaction deposits.

Strikingly, wholesale funding tracks the dynamics of off-balance sheet liquidity creation quite closely both in levels as well as annual growth rates. Figure 3b plots the (annual) growth rates of these three series. The pairwise correlation between wholesale funding and lc_obs is 0.84. For robustness, I repeat the same exercise for BHC data from FR Y-9C reports in Figure A.1. The liquidity creation measures are constructed using the methodology outlined in Berger and Bouwman (2009) for the BHC data. The nominal dollar volume of overall liquidity creation ("catfat") is lower than the numbers observed for Commercial banks data using call reports ($4.6 trillion for BHC data vs $5.7 trillion for Call Reports for 2007 Q4)). The off-balance sheet liquidity creation, on the other hand, closely matches the numbers observed for Call Reports data. The average share of OBS liquidity creation in the overall liquidity creation ("catfat") was 60% during 1990-2008 with a peak of 75% right before the crisis. The pairwise correlation between log annual changes in wholesale funding and OBS liquidity creation was 0.62.

There seems to be preliminary evidence of wholesale funding being positively correlated with off-balance sheet liquidity creation in the aggregate. However, OBS liquidity creation is a constructed measure with appropriate weights based on liquidity profiles of different components of banks' balance sheets. Moreover, OBS liquidity creation measure includes all kinds of off-balance sheet exposures including derivatives as well credit card lines to consumers. Next, I explore the aggregate relationships between wholesale funding and two measures of unused commitments – COMMIT and CICOMMIT as described in Section 3.2.

[29] As previously mentioned, liquidity creation measures in Berger and Bouwman (2009) are created at the Commercial Bank level. Thus, they can be easily merged with Call reports data. For BHC data, I create the liquidity creation data following the methodology outlined in Berger and Bouwman (2009)

Figures 4 and A.3 plot the two measures of unused commitments (COMMIT and CICOMMIT) alongside wholesale funding for BHCs and Commercial banks, respectively. A similar pattern emerges – wholesale funding is positively correlated with both the measures of aggregate unused commitments. For BHCs, the correlation between log changes in wholesale funding and COMMIT (CICOMMIT) was 0.59 (0.66) for the 1990-2008 period, while for commercial banks, the correlation was 0.69 (0.80) for the same time period. Figure 1 plots all three measures of off-balance sheet commitments along with wholesale funding (green dashed-line) from 1990-2020 using Call reports data.[30] Wholesale funding peaked during the crisis and never recovered from its pre-crisis high, even in nominal dollar terms. Measures of contingent commitments declined after the crisis and reached their pre-crisis levels in nominal dollar terms roughly around 2014, a full 6 years after the 2008 crisis. Does the post-crisis decline in banks' commitments get reflected in firm-level data? Has credit line availability declined for firms after the crisis?

To answer these questions, I employ firm-level data on credit lines from Capital IQ to create aggregate measures of total revolving credit available to firms. Figure 2 plots the aggregate time-series dynamics of revolving credit facilities available to US incorporated, non-financial firms from 2002-2023. Total revolving credit size is estimated by summing up drawn and undrawn revolving credit reported in Capital IQ following Mathers and Giacomini (2015). The results echo the findings from the aggregate graphs plotted using data from banks' Call reports. On the extensive margin, the percentage of firms with revolving credit facilities never recovered from the pre-crisis peak of 62.4%, falling to a low of 52.5% in 2020-21 with a sustained decline over the last decade (Panel 2a). A similar narrative emerges when looking at the intensive margin. As shown in Figures 2b and 2d, total revolving credit as a percentage of total firm assets (total debt) declined from a pre-crisis peak of 8.5% (30%) to a low of 6.5% (19.3%) in 2020-21.[31] Moreover, similar to the patterns observed for wholesale funding and bank commitments from Call reports, we observe a steep rise in firm credit lines in the five years preceding the 2008 crisis. In summary, there is a positive correlation between aggregate wholesale funding of banks and their off-balance sheet commitments, especially during the two decades prior to the 2008 crisis. These aggregate results hold true both from the bank-side (Call reports and BHC data) as well as the firm-side (Capital IQ data).[32]

[30]Liquidity creation measure from Berger and Bouwman (2009) ends in 2016.

[31]The aggregate statistics reported here are roughly in the same range as those reported in Sufi (2009). He manually constructs size measures of credit lines from annual 10-K filings for a random sample of 300 firms from the *Compustat* universe of non-financial, US-based firms between the years 1996-2003. The median value of credit lines in his sample is 11.2% of total assets, and 74.8% firm-years have a credit line.

[32]Firm-side results lining up with the bank-side is important to preclude the possibility of new entrants in the market.

The positive co-movement between (aggregate) wholesale funding and commitments is, at best, suggestive evidence for role of wholesale funding in the decline in banks' commitments after the crisis. Figure A.2 documents the slew of post-GFC regulations enacted primarily to reduce banks' dependence on wholesale funding. If contingent commitments are intrinsically linked to wholesale funding access of banks, these regulations might impact banks' supply of credit lines to firms. Undoubtedly, the post-GFC period is confounded with various forces at play, including regulatory forces.[33] For this reason, I restrict most of my analysis to the period between 1990-2008 to avoid confounding effects from post-GFC regulatory changes and central bank actions.

4.2 Demandable deposits and off-balance sheet commitments

These results seem especially surprising when juxtaposed against the time-series evolution of transaction deposits – the prevailing liability-side driver of bank commitments in the literature. Kashyap, Rajan and Stein (2002) build a theoretical model of bank commitments and empirically demonstrate that transaction deposits – the logical empirical counterpart of demandable deposits in their model – are positively correlated with off-balance sheet commitments. The two measures of unused commitments they employ are constructed exactly as COMMIT and CICOMMIT in this paper, but their sample is restricted to the period 1992-1997. Figures 5 and A.4 plot the time-series of transaction deposits against the two measures of commitments for Commercial Banks and BHCs, respectively.

Nominal aggregate values of transaction deposits remained flat – between \$600 - \$800 billion – in the two decades leading up to the crisis. Meanwhile, total banking assets increased more than threefold during that time. Transaction deposits, as a share of total assets, decreased from a high of 20% in the mid-90's to a low of 6% right before the crisis. On the other hand, unused commitments kept pace with the aggregate asset growth in the banking system (Figure 5b). The pairwise correlation between log annual changes in aggregate transaction deposits and COMMIT (CICOMMIT) was -0.64 (-0.67) for BHCs, and -0.53 (-0.53) for Commercial Banks (Figures 5c and A.4c). These results don't align with the main message of Kashyap, Rajan and Stein (2002) – the synergy between demandable deposits and commitments. Their argument makes it hard to rationalize the fact that the stock of demandable deposits remained flat while commitments grew significantly in the two decades leading up to the crisis.

Although banks can't sell their commitments in a secondary market like the Collateralized Loan Obligations (CLO) markets (Berger and Bouwman (2009)), it could be possible that firms substituted banks with other financial intermediaries for credit lines.

[33] Acharya et al. (2023) find that central bank reserves are linked to banks' credit line commitments in the post-crisis period.

A more liberal interpretation of demandable deposits would be to include savings deposits along with transaction deposits in its empirical definition. As mentioned in Section 3.2, savings deposits enjoy a high degree of absolute flexibility even under the six-withdrawal limit specified in "Regulation D". Savings deposits grew considerably during 1990-2008. They increased from 17% of total banking assets in 1990 to 30% of banking assets before the crisis of 2008 for commercial banks. Figure 6 plots the sum of aggregate transaction and savings deposits against the two measures of unused commitments for commercial banks. We can see that the sum of transaction and savings deposits form a substantial share of total assets rising up to 40% during the early 90's and mid-2000's. Figure 6b, however, indicate that the two series are negatively correlated. The pairwise correlation between log annual changes in aggregate demandable deposits and COMMIT (CICOMMIT) was -0.63 (-0.64) for BHCs, and -0.63 (0.70) for Commercial Banks for the period 1990-2008. These results, at least in the aggregate, run contrary to predictions of theories of bank commitments centered around synergies with traditional deposits.

5 Cross-sectional Analysis

Aggregate evidence points towards a positive correlation between wholesale funding and contingent commitments. Next, we exploit the panel structure of our datasets to see if the relationships hold in the cross-section.

5.1 Regression Variables

Call reports data is available at the individual Commercial Bank level. Liquidity creation measures from Berger and Bouwman (2009), also available at the individual bank level, are merged with the call reports data using the unique identifier. Individual bank data is aggregated to the holding company level using a variable (RSSD9348) which specifies the unique ID of the highest regulatory holding company of the bank (Acharya and Mora (2015), Kashyap, Rajan and Stein (2002)). I sort the banks on measures of commitments and classify them into large, medium, and small banks (for more details, see section A.1). There are non-trivial differences between Call Reports data and FR Y-9C data for BHCs (see Section C). Thus, I use BHC data as well Call reports data in my analysis for robustness.

The main dependant variables are three ratios of off-balance sheet commitments[34] which proxy for different types of off-balance sheet commitments:

1. OBS liquidity creation ratio = $\frac{\text{OBS Liquidity creation}}{\text{OBS Liquidity creation + Total Loans}}$
2. Unused commitments ratio = $\frac{\text{COMMIT}}{\text{COMMIT + Total Loans}}$
3. Unused C&I commitments ratio = $\frac{\text{CICOMMIT}}{\text{CICOMMIT + C\&I Loans}}$

The construction of these ratios follows previous literature (Acharya and Mora (2015), Kashyap, Rajan and Stein (2002)). The denominator is defined in this manner to minimize the impact of outliers. It is scaled by gross total loans instead of assets in order to avoid confounding banks' lending decision with their liquid assets holding decision (Kashyap, Rajan and Stein (2002)). The main explanatory variable is: Wholesale Funding Ratio = $\frac{\text{Wholesale Funding}}{\text{Wholesale Funding + Demandable Deposit + Small Time Deposits}}$. The denominator captures all non-equity funding sources of a bank and the ratio provides a direct comparison of wholesale funding share against demandable deposits share of a bank's liability side.

Bank size might be a significant confounder in my analysis. Thus, I control for log assets as well its square to account for non-linearities. Other controls include Capital ratio $\left(\frac{\text{Bank Equity}}{\text{Total Assets}}\right)$, Transaction Deposits ratio[35] $\left(\frac{\text{Transaction deposits}}{\text{Total deposits}}\right)$, components of wholesale funding as a share of wholesale funding (four different ratios for the five components of wholesale funding).

5.2 Summary Statistics

Tables 1 and 2 present summary statistics for large banks using Call Reports and FR Y-9C data, respectively. Summary statistics for medium and small banks are provided in Tables A.3 and A.5 for Commercial Banks, and Tables A.4 and A.6 for BHC data, respectively. Panel A in the tables provide summary statistics for banks sorted on nominal values of LC_OBS, and accordingly classified as large, medium, and small. Similary, Panels B and C sort on COMMIT and CICOMMIT for bank classification. The size effect is apparent in the number of banks that account for large banks every quarter. For example, a median number of 80 banks accounted for 90% of aggregate commitments (as measured using COMMIT) every quarter (Panel B of Table 1). The median assets of these banks was $18 billion across all quarters.

[34]For definitions of OBS liquidity creation, COMMIT, and CICOMMIT please refer to Section 3.2 and Tables A.2 and A.1.
[35]Kashyap, Rajan and Stein (2002) find a statistically significant relationship between transaction deposits and unused commitments for the time period 1992-1997.

The median value of wholesale funding ratio across the different sorts is around 35% for large banks. This value drops closer to 20% for medium banks and 15% for small banks, consistent with the idea that larger banks find it relatively easier to access wholesale funding markets. There is significant variation in the components of wholesale funding between BHC data and Call reports for large banks. The average wholesale funding shares of Fed Funds and Large Time Deposits were 31% and 33% for call reports data (Panel B of Table 1). The values were lower for BHC data (27% and 28% from Panel B 2) owing to the much larger share of Other Borrowed money observed for BHCs (28% in BHC data vs 17% for Commercial Banks). As mentioned in Section C, the aggregate nominal values of funding classified as "other borrowed money" in the BHC data is much higher than the aggregate values observed for their counterparts in Call Reports data. Differences in aggregate values of wholesale funding sources suggest that Bank Holding Companies report higher values of some wholesale funding sources than their commercial bank counterparts that file Call reports. For this reason, I employ both datasets in my analysis.

5.3 Short Discussion of Transaction Deposits

Previous literature has underscored the importance of demandable deposits in driving bank credit lines (Ivashina and Scharfstein (2010), Kashyap, Rajan and Stein (2002), Acharya and Mora (2015)). Theoretical underpinnings of the mechanism driving this relationship lie in the synergy between demandable deposits and off-balance sheet commitments (Kashyap, Rajan and Stein (2002), Gatev and Strahan (2006)). As long as withdrawals on both sides are not perfectly correlated, banks will have a natural advantage in providing liquidity through credit lines because they can share the costs of the liquid-asset stockpile. Holding liquid assets is costly compared to investing in illiquid loans. Since demandable deposits can be withdrawn at any time, banks with a greater share of demandable deposits will keep a higher stock of liquid assets on hand to meet unanticipated consumption shocks of depositors. The higher costs of keeping liquid assets on banks' balance sheet can be shared by giving out credit lines. Thus, banks with a higher share of demandable deposits will keep a greater amount of liquid assets and give out more credit lines.

Kashyap, Rajan and Stein (2002) build a theoretical model articulating this mechanism and test its predictions empirically using Call Reports data from 1992-96. They identify transaction deposits as the empirical counterpart of demandable deposits in their model. I replicate their main findings in Table C.1.[36] All regression variables in Kashyap, Rajan and Stein (2002) are time-averaged over a span of 5 years from 1992-1996. As such, the regressions are cross-sectional and their results are in line with the predictions of their model across bank size distribution.

I extend their empirical specification beyond 1992-96, one year at a time, and plot the results in C.1. Panel C.1b plots the coefficient on the main explanatory variable DEPRAT – transaction deposits ratio – when regressed against COMRAT (unused commitments ratio). The coefficient on DEPRAT for the year 1996 is from a time-averaged, cross-sectional regression using data for the previous five years (1992-96). For 1997, I move one year ahead and perform the same regression using data of the last five years (1993-97). I repeat the process for every year till 2008. Panel C.1b shows that the coefficients on DEPRAT are not significant after 2000 for large banks. However, none of the coefficients are statistically different from the original coefficient in Kashyap, Rajan and Stein (2002). Moreover, the results hold well for medium and small banks over time. This is consistent with the aggregate results observed in Figures 5 and A.4. Aggregate time-series is going to be driven by large banks. Taken together, aggregate evidence along with the results in C.1 suggest revisiting the mechanism driving (large) banks' off-balance sheet commitments.

5.4 Panel Regressions

In order to test the cross-sectional relationship between off-balance sheet commitments and wholesale funding, I exploit the panel structure of Call Reports and FR Y-9C data. Figure 7a plots the binscatter plot of unused commitments ratio against wholesale funding ratios for large providers of credit line commitments. To formally test the positive relationship, I run panel regressions with the following specification:

$$Y_{b,t} = \alpha_b + \delta_t + \beta_w \text{Wholesale Funding Ratio}_{b,t} + \beta_s X_{b,t}^{\text{size}} + \beta_x X_{b,t} + \varepsilon_{i,t} \quad (1)$$

where the dependent variable $Y_{b,t}$ is the commitment measure for bank b at time t, Wholesale Funding Ratio$_{b,t}$ is the ratio of wholesale funding and total funding (see Section 3.2) for bank b at time t. Size related controls, $X_{b,t}^{\text{size}}$, are (1) log of assets and (2) log of assets squared.

[36] I was able to replicate all their regression results to a high degree of accuracy. There seems to be a significant difference in the number of banks in my sample in Panel 3 compared to Table VI of their paper. The regression coefficients, however, are quite similar. I conjecture that some of these differences might be due to data revisions.

Other controls, $X_{b,t}$ include (1) Capital ratio (2) Transaction deposits ratio, (3) Large time deposits share of wholesale funding (4) other borrowed money share of wholesale funding, (5) subordinated notes' share of wholesale funding, and (6) foreign deposits share of wholesale funding. α_b and δ_t are bank and time fixed effects, respectively.

I employ three measures of banks' off-balance sheet commitments ($Y_{b,t}$) as described in Sections 3.2 and 5.1: (1) LC_OBS, (2) COMMIT, (3) CICOMMIT. For each measure of banks' off-balance sheet commitments, I sort banks in decreasing order of their nominal dollar values of the measure every quarter. Next, I classify banks into large, medium, and small if they account for the top 90%, next 5%, and the rest of the aggregate nominal value of the measure in each quarter (see Section A.1). I do this separately for Call Reports and FR Y-9C data.

Tables 3 and 4 present the regression results for large banks using Call reports and FR Y-9C data, respectively. Panel A of Table 3 presents the results for the dependent variable LC_OBS. Column (1) runs a panel regression with time fixed effects and no controls. Columns (3) and (4) add size and other controls, respectively. Lastly, column (5) adds bank fixed effect in addition to time fixed effects and all other controls. For commercial banks and BHCs, the positive and significant coefficients on wholesale funding ratio in columns (3) and (4) imply a positive relationship across and within banks.

5.5 Evidence from monetary policy shocks

In this section, I shed new light on the effect of monetary policy on banks' credit line commitments and wholesale funding in the cross-section. Drechsler, Savov and Schnabl (2017) document that banks maximize their deposit rents as the short rate rises by increasing their deposit spreads. Deposits (transactions and savings accounts) experience an outflow and banks partially offset the decrease in deposits with wholesale funding. The exercise in this section is, thus, motivated by the findings of the deposits channel – if banks substitute towards wholesale funding during episodes of monetary policy shocks, do they also increase their stock of unused commitments?

To investigate the effects of monetary policy on banks' assets and liabilities variables, I follow the literature on local projections (Jordà (2005)) and estimate the following specification for the cross-section of banks:

$$y_{i,t+h} - y_{i,t-1} = \alpha_i + \beta_h \Delta\varepsilon_t + \theta B_{i,t-1} + \nu_{i,t+h} \quad (2)$$

where $y_{i,t}$ denotes the log of the outcome variable (wholesale funding, credit line commitments) of bank i in time t and $h = 0, 1, 2, ..., 16$ where h is in quarters. The vector $B_{i,t-1}$ controls for four lags of total assets, square of log assets, bank equity ratio, four lags of the monetary policy shocks and four lags of the growth of the outcome variable for bank i.

The specification in equation 2 estimates the bank-specific response of a log change in the outcome variable y for each bank i at horizon h w.r.t to $t - 1$. The exogenous monetary policy shock measure, $\Delta\varepsilon_t$, used in my baseline results comes from Nakamura and Steinsson (2018). Their measure of high-frequency monetary policy shocks is identified as the first principal component of the change in federal funds and Eurodollar futures from one quarter out to four quarters. This change is taken over a narrow 30-minute window around FOMC statement releases. The point estimate β_h measures the cumulative response of the outcome variable in quarter $t + h$ to a monetary policy surprise in quarter t for the banks in my sample.

Panels 9a and 9b plot the impulse response function (IRF) for wholesale funding and demandable deposits. Consistent with the deposits channel of monetary policy, banks experience an outflow of demandable deposits and substitute them with greater wholesale funding. Panels 9c and 9d plot the impulse response function for unused commitments and short-term liquid securities, respectively. These figures provide evidence that neatly sums up the mechanism in this paper. Banks increase their holdings of short-term liquid securities[37] as they substitute their deposits with wholesale funding. The increase in liquidity buffers and wholesale funding motivates the banks' increased supply of credit line commitments. The IRFs for C&I loans and real-estate loans are plotted in panels 9e and 9f. There are two key takeaways from these plots. First, the increase in banks' C&I loans response is in line with the existing puzzle related to rising business lending following a contractionary monetary policy. Second, combining the results from panels 9c and 9e, the increase in unused commitments is observed in addition to the increase in business lending. Thus, while some on-balance sheet loans might be a direct consequence commitment drawdowns(Acharya, Jager and Steffen (2023)), the potential (unobserved) decrease in the stock of unused commitments is more than offset by the increase in the supply of credit line commitments.

Taken together, the evidence from local projections exercise seem to suggest a positive correlation between wholesale funding and credit line commitments (through its effect on short-term securities). However, it is subject to a common identification challenge. If banks' commitment lending opportunities increase when the fed funds rate rises, they would make more commitments while increasing their stock of wholesale funding. To disentangle the

[37] Short-term liquid securities are defined as securities less 3 years of maturity.

commitment supply channel from commitment demand channel, I explore two identification strategies.

6 Causal Identification

Reduced form regressions in the previous sections point towards a positive relationship between wholesale funding share and off-balance sheet commitments of a bank. In this section, I attempt to provide causal estimates of the impact of wholesale funding on banks' off-balance sheet commitments using two novel approaches: (1) Banks' membership of the Federal Home Loan Bank (FHLB) system in a staggered difference-in-differences setting and (2) Using shares of different components of wholesale funding as a Bartik instrument.

6.1 FHLB Membership

The FHLB system originally began as a Government Sponsored Enterprise (GSE) during the Great Depression of 1932 to meet the liquidity needs of member institutions to finance housing and community development related lending. Membership of the system was initially restricted to Thrift institutions. In wake of the Savings and Loans crisis during the 80's, the Financial Institutions Reform, Recovery, and Enforcement Act of 1989 (FIRREA) expanded FHLB membership to federally insured commercial banks and credit unions. The FHLB system currently consists of 11 (formerly 12) separate, government-chartered, member-owned District banks servicing members in their geographically assigned districts along with an Office of Finance which raises funding for the District banks in a consolidated manner.

The main function of the FHLB system is to provide low-cost, collateralized funding to its member institutions – known as "advances" – on demand. An implicit Government backing coupled with collateralized lending allows the FHLB system to provide low-cost funding to its members institutions. As securitization took off during the 90's, the emergence of Mortgage-backed Securities (MBS) as eligibile collateral for FHLB advances made the FHLB system an attractive source of liquidity for Commercial Banks. During the period of 1990-2008, 2,498 insured commercial banks became members of the FHLB system.[38] FHLB advances outstanding to Commercial Banks stood at USD 875 Billion at the end of 2007. While the originally stated purpose of the FHLB system was to fund housing and community lending,

[38]Using FHLB membership data from the website of Federal Housing Finance Agency (FHFA)

the FHLB system has come to be known as "the Lender of Next-to-Last Resort" (Ashcraft, Bech and Frame, 2010) over time due to its role as a reliable provider of wholesale funding.

Membership of the FHLB system for Commercial Banks is voluntary. To gain membership, a bank must apply to the appropriate District Bank furnishing required materials. After a review process, the District banks may choose to approve or deny membership. Within 60 days of membership approval, the filing institution must initiate a membership stock purchase[39] in order to be considered a member. The website of the Federal Housing Finance Agency (FHFA) provides the precise membership dates (along with approval dates) of each member bank which can be linked to the Call Reports data. I exploit the staggered membership dates of banks to study the causal impact of FHLB membership on Banks' off-balance sheet commitments.

As previously mentioned, FHLB membership provides a cheap and reliable source of wholesale funding for banks. As such, FHLB membership would not only enable greater wholesale funding in nominal dollar terms, but also raise the potential to tap wholesale funding in future if the need arose. Thus, one would expect wholesale funding capacity to go up after FHLB membership. The staggered FHLB membership dates during 1990-2008, thus, act as a discrete jump in banks' access to wholesale funding and allows us to study the impact of the "treatment" on banks' off balance sheet commitments.

The identifying assumption here is one of parallel trends i.e. trends in the outcome variable (commitments) would have been the same in "treated" banks as "not-yet-treated" banks absent FHLB membership. While not directly testable, I show that there are no meaningful pre-trends in my results. The plausibility of the parallel trends assumption is further underscored by the fact that contingent commitments don't require actual dollar funding unless they are withdrawn. On the other hand, if banks' application to the FHLB system is driven by banks' need to raise wholesale funding to meet growing loan demand – and loan demand is positively correlated with commitments demand – then the parallel trends assumption is likely to be violated. Thus, if there is selection on unobservables such as time-varying, bank-level commitment demand, estimands from the staggered DiD design will not have a causal interpretation. If there is selection on observables, I can assume a conditional parallel trends assumption. While not testable, I show that there are no significant pre-trends in my results using both real assets as a covariate and without any covariates.

To construct the sample for the staggered difference-in-differences test on FHLB member-

[39] A District FHLBank is required to issue its capital stock to a new member only after it has approved the institution for membership and received payment in full for the par value of the Bank stock.

ship dates, I start by first removing the confounding effect of bank mergers and acquisitions. The dependent variables in the staggered DiD is the logged value of variables of interest. First-stage and second-stage staggered DiDs use log value of wholesale funding and COMMIT as the dependent variables, respectively. Thus, to avoid large (percentage) changes in the cumulative treatment effects, I remove all post-merger bank observations using Transformations data on the website of Federal Financial Institutions Examinantion Council (FFIEC). Transformations data provides the precise merger dates along with unique identifiers of merged/acquired entity. I restrict my attention to banks greater than USD 100 million in average real assets. To avoid the problem of "Logs with zeros" (Chen and Roth, 2024), I remove all observations with average COMMIT-to-assets ratio less than 5%. Thus, the average treatment effects exclusively measure the impact on the intensive margin of unused commitments. Lastly, I remove all banks which were treated prior to 1990 ("always treated") and after 2007 ("never treated") to restrict my attention to "not-yet-treated" banks. The final sample consists of 781 unique banks treated in a staggered manner between 1990-2008.

Figure 10 shows the treatment (FHLB membership) dates by year in my final sample. The treatment dates are converted to quarterly dates to match the frequency of Call Reports data. Table 5 shows the summary statistics for final sample of 781 unique banks. The average bank in the sample is fairly small with assets of USD 230 million, average unused commitments of USD 30 million, and average wholesale funding of USD 50 million.

I begin by estimating a dynamic specification (Equation 5) in relative time, which allows for non-parametric changes in treatment effects over time.

$$Y_{i,t} = \alpha_i + \lambda_t + \sum_{\substack{y=-16, \\ y \neq -1}}^{y=16} \beta_y \mathbb{1}(t - t_i^* = y) + \varepsilon_{i,t} \tag{3}$$

where $Y_{i,t}$ denotes the log of unused commitments (or other variables of interest) in year-quarter (t) for bank (i). Indicator variables $\mathbb{1}(t - t_i^* = y)$ measure time relative to the quarter bank i first got treated (t_i^*). α_i and λ_t denote bank and year-quarter time fixed effects, respectively. Standard errors are clustered at the bank level. However, Sun and Abraham (2021) show that treatment effects from a dynamic TWFE specification in a staggered setting can be problematic as pre or post treatment leads or lags can be contaminated with treatment effects from other relative time periods. Therefore, unbiased estimates of dynamic treatment effects necessarily assumes treatment effect homogeneity in dynamic TWFE setting.

I address the issue of violation of the treatment effect homogeneity assumption by presenting the event-time DiD estimates using the Callaway and Sant'Anna (2021) estimator[40]. I choose this estimator for two reasons discussed in Roth et al. (2023). First, this approach provides sensible estimands even under arbitrary heterogeneity of treatment effects. Second, this estimator imposes less stringent restrictions when modelling conditional parallel trends on covariates. As previously mentioned, selection on observables has the potential of throwing up biased treatment effects. The Callaway and Sant'Anna (2021) estimator efficiently combines outcome regression and inverse-probability weighted procedures using a doubly-robust method which "only requires one to correctly specify either (but not necessarily both) the outcome evolution for the comparison group or the propensity score model" (Sant'Anna and Zhao, 2020). Moreover, the Callaway and Sant'Anna (2021) estimator uses base-period covariates to perform the matching, thus, avoiding the problem of "bad controls" with covariates measured after treatment. I use the log value of real assets as a control in my baseline estimation[41].

Figure 11 shows the dynamic treatment effects using the Callaway and Sant'Anna (2021) estimator. There are two key takeaways from Figure 11. First, we do not observe significant pre-trends in unused commitments leading up to the treatment quarter irrespective of inclusion of controls. Second, we observe an increase in unused commitments following FHLB membership. The treatment effect increases gradually after treatment. We find that unused commitments increased by 8.8% and 20.0% 6 quarters and 16 quarters after treatment, respectively, in the baseline specification.

Panel 12a of Figure 12 plots the results for wholesale funding as the outcome variable. We observe an immediate and statistically significant increase in wholesale funding following FHLB membership. The treatment effect increases gradually to 21.4% after 6 quarters and 40.6% after 16 quarters in the post treatment period for the baseline specification. In contrast, the point estimates on transaction deposits are positive in the post period, but not statistically significant for the baseline specification.

The absence of significant pre-trends in the first-stage results suggests that an increase in wholesale funding follows FHLB membership, rather than the other way around. If FHLB membership is quasi-exogenous, as the results seem to suggest, rough estimates from this

[40] As pointed out in Roth (2024), the default pre-treatment plots for the Callaway and Sant'Anna (2021) estimator in Stata do not have the same interpretation as those of the traditional TWFE event-study plots. I correct for this difference by including the `long2` option in the Stata specification for the Callaway and Sant'Anna (2021) estimator.

[41] The results remain the same when the covariate is dropped – no parallel trends and significant average treatment effects. The baseline specification includes (log) real assets as a control to avoid threats to identification along the lines of earlier-treated units being structurally different from later-treated units.

exercise imply that a 1% increase in wholesale funding leads to a 0.41% increase in off-balance sheet commitments.

6.1.1 Endogeneity of banks' FHLB membership

Banks' application for membership to the FHLB system is a voluntary decision. As such, there might be many different explanations for banks' decision to apply for such membership. Given the endogenous nature of this decision, there might be concerns about the validity of a design based on the staggered membership of banks to the FHLB membership. In this section, I provide evidence to alleviate such concerns.

It is important to keep in mind that the identifying assumption of parallel trends (or conditional parallel trends) underlying the staggered DiD must hold with respect to the outcome variable in question.[42] In other words, equation 4 implies that in the absence of treatment, the average conditional outcome of the treated and the comparison groups would have evolved in parallel. The outcome variable in my setting is total unused commitments of banks. One possible story that might diminish the validity of parallel trends assumption is that individual banks facing positive loan demand shocks might endogenously apply for FHLB membership to obtain access to wholesale funds. If our outcome variable was on-balance sheet loans, this might be a plausible threat to identification. Trends in on-balance sheet loans for the treated banks, in all likelihood, may not have evolved in parallel to not-yet-treated absent FHLB membership. However, a similar argument doesn't apply to off-balance sheet commitments for two reasons. First, provisioning of commitments doesn't require actual dollar funding. Second, if the claim is that banks are procuring access to wholesale funds in response to high demand for commitments, then it further validates the message of this paper – wholesale funding and loan commitments are intrinsically linked.

To alleviate concerns about endogeneity of the FHLB membership decision, I control for state-quarter fixed effects to soak up any unobserved time-varying demand shocks at the state-level. First, I regress banks' unused commitments on state-quarter fixed effects and store the residuals. In the second step, I use the residuals as the dependent variable in the Callaway and Sant'Anna (2021) estimator for the staggered DiD design. In figure C.2a, I plot the dynamic treatment effects using residuals as the outcome variable. The dynamic coefficients are only

[42]The standard assumption of parallel trend in a two-period setting is given by: (equation 4):

$$\mathbb{E}[Y_1(0) - Y_0(0) \mid D = 1] = \mathbb{E}[Y_1(0) - Y_0(0) \mid D = 0] \quad \text{a.s} \tag{4}$$

where $\mathbb{E}[Y_1(0) \mid D = 0]$ denotes the potential outcome at $t = 1$ if the unit did not receive treatment before $t = 1$ i.e. $(D = 0)$, and $\mathbb{E}[Y_1(0) \mid D = 1]$ denotes the potential outcome if the unit did receive treatment before $t = 1$ i.e $(D = 1)$.

slightly muted compared to figure 11. The treatment effect increases gradually after treatment. We find that unused commitments increased by 6.08% and 17.69% 6 quarters and 16 quarters after treatment, respectively, in the specification controlling for state-quarter fixed effects.

6.2 Shift-Share Instrument

Due to possible endogeneity concerns related to the banks membership of the FHLB system, I employ a second identification strategy. Moreover, most of the large banks get dropped due to the exclusion of post-merger observations in the staggered DiD exercise. To obtain causal estimates which are more representative of large banks, I construct a Bartik-like instrument (shift-share design) using the different components of wholesale funding.

Formally, the structural equation we are interested in our panel setting is given by:

$$y_{it} = \beta_0 x_{it} + \beta_1 C_{it} + \varepsilon_{it} \tag{5}$$

where, i indexes a bank and t stands for (quarterly) time period. The expected endogenous variables in our setting, y_{it} and x_{it}, are unused commitments growth and wholesale funding growth, respectively. C_{it} is a vector of controls which includes time and bank fixed effects. The main parameter of interest, β_0 measures the elasticity of commitment supply to wholesale funding. The structural error term, ε_{it}, might be correlated with x_{it} and thus, I use a Bartik instrument to estimate β_0.

The construction of the Bartik instrument in this context relies on two accounting identities. The first is that growth in unused commitments is the inner product of the shares of different components of wholesale funding and their individual bank-level growth rates:

$$x_{it} = \sum_{j=1}^{5} z_{ijt} g_{ijt} \tag{6}$$

where z_{ijt} is the share of component j of wholesale funding for bank i at time t. Similarly, g_{ijt} is the growth rate of component j of wholesale funding for bank i at time t. Component shares sum up to one $\sum_{j=1}^{5} z_{ijt} = 1$. Wholesale funding is the sum of five different components: (1) Federal funds purchased and repurchase agreements sold under agreement to repurchase, (2) Foreign deposits, (3) Large time deposits (>$100,000), (4) Other borrowed money, and (5) Subordinated notes. For the second identity, the Bartik instrument exploits the fact that individual bank-level-component growth rates, g_{ijt}, can be decomposed into aggregate component-period growth rate and an idiosyncratic individual bank-component-period growth rate:

$$g_{ijt} = g_{jt} + \tilde{g}_{ijt} \tag{7}$$

where g_{jt} is the aggregate growth rate of component j of wholesale funding at time t, and $\tilde{g}_{ijt}$ is the idiosyncratic bank-level growth rate of component j. Finally, the Bartik instrument in this setting is constructed as:

$$B_{i,t} = Z_{i,t-2}G_t = \sum_{j=1}^{5} z_{i,j,t-2}g_{j,t} \tag{8}$$

where $Z_{i,t-2}$ is a row vector of shares of wholesale funding components j for bank i at lagged time period $t-2$. G_t is a column vector of aggregate growth rates of components j of wholesale funding from time period $t-1$ to t. Following the argument in Autor, Dorn and Hanson (2013), lagged values of component shares are used in the construction of the instrument to mitigate concerns of simultaneity bias. If contemporaneous component shares of wholesale funding reflect anticipated aggregate (component-level) funding shocks, lagged values of component shares will help address such endogeneity concerns. The shift-share instrument in equation 8 is thus, a weighted average of a common set of aggregate shocks to the different components of wholesale funding. The weights, calculated using (lagged) component shares, reflect heterogeneous shock exposures of individual banks.

Finally, we arrive at the standard two-stage least squares specification where the first-stage is a regression of wholesale funding (quarterly) growth rate on the Bartik instrument and bank-level controls:

$$\begin{aligned}\Delta ln(\text{Wholesale})_{i,t} =& \gamma_0 B_{i,t} + \gamma_1 ln(\text{Commitments})_{t-2} + \gamma_2 ln(\text{Wholesale})_{t-2} + \\ & \gamma_3 X_{i,t-1} + \delta_t + \rho_i + \varepsilon_{it}\end{aligned} \tag{9}$$

where $\Delta ln(\text{Wholesale})_{i,t} = ln\left(\frac{\text{Wholesale}_{i,t}}{\text{Wholesale}_{i,t-1}}\right)$, the instrument, $B_{i,t} = \sum_{j=1}^{5} z_{i,j,t-2}g_{j,t}$, and the aggregate growth rates of wholesale funding components, $g_{j,t} = ln\left(\frac{\text{Component}_{j,t}}{\text{Component}_{j,t-1}}\right)$. I include lagged values (at $t-2$) of log of unused commitments and wholesale funding as controls to mitigate base effect concerns following Acharya et al. (2023). Bank-level controls are the same as in equation 1 with the exception of component shares: (1) log of assets, (2) log of assets squared, (3) Capital ratio, and (4) Transaction deposits ratio. δ_t and ρ_i stand for quarter time and bank fixed effects, respectively.

In the second-stage, growth of unused commitments is regressed against the instrumented wholesale funding growth in the first-stage along with the excluded instruments in equation 9:

$$\begin{aligned}\Delta ln(\text{Commitments})_{i,t} =&\beta_0 \Delta ln(\text{Wholesale})^{\text{instr}}_{i,t} + \beta_1 ln(\text{Commitments})_{t-2} \\ &+\beta_2 ln(\text{Wholesale})_{t-2} + \beta_3 X_{i,t-1} + \tau_t + \alpha_i + \nu_{it}\end{aligned} \tag{10}$$

Tables 6 and 7 display the results for the second and first stage regressions, respectively. The sample of banks are large and medium banks constructed separately for each individual measure of commitments. Columns (1), (2), and (3) show the results for the second-stage regression with growth rates of (1) unused commitments (2) C&I unused commitments, and (3) OBS liquidity creation from (Berger and Bouwman, 2009) as dependant variables, respectively. The coefficient for the main variable of interest, the (instrumented) growth rate of wholesale funding, is positive and significant for all measures except for C&I unused commitments. In terms of magnitudes, the coefficient of 0.3 on the instrument, $\Delta ln(\text{Wholesale funding})^{\text{instrum}}_t$, suggests that an exogenous 1% increase in wholesale funding leads to a 0.3% increase in unused commitments. This estimate is of a similar magnitude to the estimate of 0.41% in the staggered DiD estimate from section 6.1 where the sample was mostly composed of smaller sized banks. Similarly, an exogenous 1% increase in wholesale funding leads to a 0.41% increase in C&I unused commitments (not statistically significant) and 0.44% increase in the OBS liquidity creation measure from Berger and Bouwman (2009).

The Cragg-Donald Wald F-statistic for the first-stage results comfortably meets the relevance criteria for all measures of commitments. This is true for both the traditional "rule of thumb" F-statistic value of 10 for mitigating concerns about weak instruments as well as the 10% critical values of Stock-Yogo (Stock and Yogo, 2005) for the i.i.d case.[43] However, Baum, Schaffer and Stillman (2007) suggest using the Kleibergen-Paap *rk* statistic – a more robust version of the Cragg-Donald Wald F-statistic – as they are "superior in the presence heteroskedasticity, autocorrelation, or clustering". The Kleibergen-Paap *rk* statistic satisfies the F-statistic value of 10, but fails to meet the 10% maximal IV size Stock-Yogo critical values of 16.38 for two of the three measures of commitments. The coefficients on the instrument, $B_{i,t} = \sum_{j=1}^{5} z_{i,j,t-2} g_{j,t}$, for first-stage (Table 7), are positive and statistically significant for all measures of commitments.

[43]The 10% maximal IV size Stock-Yogo critical values are 16.38 across all the 2SLS regressions.

6.2.1 Identifying assumption underlying the shift-share instrument

As outlined in Goldsmith-Pinkham, Sorkin and Swift (2020), the identification of the Bartik instrument proposed in the previous section rests on an exogeneity assumption of the wholesale funding component shares, $z_{i,j,t-2}$. In their framework, the Bartik instrument is numerically equivalent to a generalized method of moments (GMM) estimator with component shares ($z_{i,j,t-2}$) acting as instruments and aggregate (component) growth rates ($g_{i,j,t}$) acting as the weighting matrix. The exclusion restriction, thus, rests on justifying the exogeneity of component shares. Borusyak, Hull and Jaravel (2022) propose a complementary framework where the identification of the shift-share instrument follows from the exogeneity of the shocks, allowing exposure shares to be endogenous. However, the former research design is more appropriate in the current setting since the estimator in the latter design is consistent only when the number of components included in the shift-share instrument is large (Goldsmith-Pinkham, Sorkin and Swift, 2020).

Formally stated, the identifying assumption behind the proposed Bartik-like instrument is that a higher pre-existing share of one component of wholesale funding (relative to others), impacts the growth in commitments supply of a bank only through its overall growth in wholesale funding. To the best of my knowledge, there are no existing theories outlining a mechanism, let alone a testable hypothesis, that links a specific component of wholesale funding to banks' contingent commitments. On the other hand, anecdotal and aggregate evidence in section C suggests that there is a high degree of substitution and diversification across these components of wholesale funding. In other words, there is no meaningful difference between a dollar of funding raised through repo markets versus large time deposits in the manner in which it affects the commitment supply decision of banks. Thus, while bank-wide wholesale funding levels or ratios might be an equilibrium object involving a complex interplay between deposit supply, loan demand, prices, etc. the source of the wholesale funding can be considered quasi-exogenous with respect to contingent commitments.

6.3 Addressing reverse causality: Introduction of Regulation FIN 46

Reverse causality might be an alternative mechanism that could be driving the relationship between wholesale funding and banks' contingent commitments. While there are no documented theories articulating such a mechanism, a plausible channel could be through banks' liquidity commitments to asset-backed commercial paper (ABCP) conduits. These standalone entities issue commercial paper to investors, and use the proceeds to buy loan assets from corporations and commercial banks. ABCP conduits are typically sponsored by commercial banks. These conduits enable corporations and banks to carve out loan assets and sell them directly to investors via the conduit structure. Most importantly, this process does not necessitate the sponsors to own the assets, thereby avoiding additional capital issuance to meet regulatory requirements.[44] Commercial banks, as sponsors of ABCP conduits, raise funding (typically, wholesale funding) for the conduits, provide liquidity and default guarantees to investors, and carry out administrative services for the conduits. A bank engaged in ABCP securitization, thus, might systematically raise wholesale funding in response to increased securitization activities.[45] Since banks' sponsorship of ABCP conduits typically involves making off-balance sheet liquidity commitments and simultaneously raising wholesale funding for the conduits, the causality could run in the opposite direction.

In order to address concerns about reverse causality, I exploit an exogenous regulatory shock to the supply of banks' off-balance sheet commitments – the introduction of Financial Accounting Standards Board (FASB) interpretation No. 46 (FIN 46) in a standard DiD seeting.[46] In a nutshell, the FIN 46 directive mandated banks to hold 100% risk-weighted equity capital against previously exempt assets of ABCP conduit-like entities which were beneficiaries of liquidity guarantees by banks. Historically, such liquidity commitments made by banks were exempt from any equity capital requirements (Acharya, Schnabl and Suarez, 2013). Thus, the introduction of FIN 46 marked a sharp departure from the existing regulatory treatment of liquidity guarantees to ABCP conduit-like entities.[47]

As documented in Acharya, Schnabl and Suarez (2013) and Bens and Monahan (2008), FIN 46 was introduced as a measure to improve accounting transparency of banks due to increasing concerns surrounding off-balance entities after the Enron scandal in 2001. The new rules with significantly higher capital requirements were first proposed in July 2002 (Bens and Monahan, 2008). The directive was officially released by FASB in January 2003 with the effective date set as fiscal periods ending after June 15, 2003. The implementation date

[44] As mentioned in Acharya, Schnabl and Suarez (2013), "If a bank were to provide a direct corporate loan, even one secured with the same assets, it would be obligated to maintain regulatory capital for it. An ABCP program permits the sponsor to offer financing services to its customers without using the sponsor's balance sheet or holding incremental regulatory capital"

[45] In theory, investor funding raised for ABCP conduits should not appear on the balance sheets of its sponsors (commercial banks). However, ABCP sponsors are required to retain an equity stake in the loan portfolios sold to the ABCP conduits. In such a scenario, it is conceivable that some of the wholesale funding raised for the ABCP conduits could find its way on to the liabilities side of the ABCP sponsor banks' balance sheets.

[46] The directive was officially titled "Consolidation of Variable Interest Entities—an interpretation of ARB No. 51" and can be accessed at here: https://www.fasb.org/page/PageContent?pageId=/reference-library/superseded-standards/summary-of-interpretation-no-46.htmlbcpath=tff

[47] The introduction of FIN 46 has been extensively studied in Acharya, Schnabl and Suarez (2013) and Bens and Monahan (2008), and the sources cited in their research. I direct the readers to the text of their research for a more detailed background on the FIN 46 directive.

was later delayed to fiscal periods ending after December 15, 2003.[48]. Following Bens and Monahan (2008), I assume that July 2002 (Q3 2002) is when the new rules began to impact banks' liquidity commitments to ABCP conduits (treatment date). In July 2004, a consortium of regulators provided partial relief to banks by significantly reversing the original set of rules. Specifically, banks were no longer required to consolidate ABCP conduit-like entities on their balance sheets. Instead, they were required to "hold capital at a conversion factor of 10% against the amount covered by liquidity guarantees" (Acharya, Schnabl and Suarez, 2013). Figure 13 plots the evolution of the rollout of FIN 46 with key dates marked in dashed lines.

If the regulatory change was largely unanticipated, banks would be suddenly required to consolidate conduit assets on to their balance sheet. As such, the new regulation discontinuously increased the cost of providing new liquidity commitments and servicing existing ones for all banks. Since the new regulation applied uniformly to all liquidity commitments, including ones made before its introduction, it disproportionately affected banks already engaged in such activities.[49] In order to leverage the DiD design, I classify banks as "treated" if they reported non-zero liquidity commitments to ABCP conduits for any quarter between Q2 2001 and Q3 2002.[50] I use the FRY-9C data for bank holding companies to implement the DiD design. The sample of banks is restricted to large and medium-sized banks as sorted on unused commitments. Treated banks are small in number – only 20 bank holding companies reported non-zero liquidity commitments to ABCP conduits. Observations with quarterly changes in assets greater than 20% are dropped to controls for mergers and acquisitions. Formally, I estimate the following dynamic event-study specification:

$$ln(\text{Commitments})_{i,t} = \alpha_i + \lambda_t + \sum_{\substack{y=-10,\\ y\neq -1}}^{y=10} \beta_y \mathbb{1}(t - t_i^* = y) + \varepsilon_{i,t} \tag{11}$$

where $Y_{i,t}$ denotes the log of unused commitments (or other variables of interest) in year-quarter (t) for bank (i). Indicator variables $\mathbb{1}(t - t_i^* = y)$ measure time relative to the quarter bank i first got treated (t_i^*) and take on a value of zero for untreated banks. α_i and λ_t

[48]The timeline is documented here: https://www.newyorkfed.org/medialibrary/media/banking/reportingforms/fin46.pdf

[49]Regulators require banks to hold equity capital against its risk-weighted assets. In addition to such capital requirements, they have to satisfy leverage tests based on Tier 1 capital and total assets. Consolidation of exisiting ABCP conduits under the new law would, thus, require greater capital issuance by banks which is costly.

[50]Data on ABCP liquidity commitments of banks started getting reported for the first time in Q2 2001 on bank regulatory reports. Liquidity commitments to ABCP conduits is the sum of: unused commitments to provide liquidity to own conduit structures (BHCKB808) and conduits sponsored by unrelated institutions (BHCKB809)

denote bank and year-quarter time fixed effects, respectively. Standard errors are clustered at the bank level.

Panel 14a of figure 14 plots the dynamic coefficients of the event-study design for log of commitments. There are three main takeaways from this graph. First, the absence of significant pre-trends indicate that FIN 46 was largely unanticipated at least as measured by the relative growth of commitments for the treated banks. Given the shadow of the Enron crisis from which this regulation emerged, it stands to reason that FIN 46 may not have been a completely exogenous shock. However, Bens and Monahan (2008) bring a litany of anecdotal evidence that casts doubt on such a claim. The lack of pre-trends, thus, provides additional evidence that introduction of FIN 46 may have been an unexpected shock. Second, there is a sustained decline in commitments growth for the treated banks compared to the control group. Overall, commitments decreased by 19.8% over 7 quarters from the time of the introduction of FIN 46 (Q3 2002) to the date of its reversal (Q2 2004). Third, the dynamic coefficient on Q3 2004 – the first quarter after the policy reversal in July 2004 – is negative but not significant. This results fits in well with the timeline of the regulation, is in line with our expectation, and adds to the credibility of the research design. Once the treatment was turned "off", treated banks responded by increasing their commitments relative to untreated banks.

These results suggest that FIN 46 was an exogenous shock which led to a significant decline in commitments for treated banks during the treatment period. If the causality ran from commitments to wholesale funding, we would expect the latter to behave in a similar fashion. Panel 14b of figure 14 plots the dynamic coefficients of an event-study design with (log) wholesale funding as the dependant variable in Equation 11. None of the post-treatment coefficients are statistically significant. Thus, these results rule out the possibility of reverse causality

7 Mechanism

This section investigates the mechanism driving the relationship between wholesale funding and off-balance sheet commitments. As highlighted in Section 1, banks' holding of liquid assets plays a central role in explaining this relationship. As such, there are two key questions that are at the heart of the workings of this relationship: (1) Why do banks with higher wholesale funding ratios hold greater liquidity buffers? (2) What makes banks extend more off-balance sheet commitments when they accumulate a buffer of liquid assets?

7.1 Theoretical Underpinnings

Theoretical motivation for banks' greater liquid-asset holdings against wholesale funding lies in refinancing risk as articulated in Ratnovski (2013). Most sources of wholesale funding have a rollover component. Providers of wholesale funding can choose to refinance maturing debt or refuse rollover. Ratnovski (2013) builds a theoretical model where the refinancing risk is driven by uncertainty about bank's solvency. In the model, some of the short-term debt matures at an intermediate date and needs refinancing. Banks can usually refinance with new borrowings as investors have an elastic supply of funds and there is no aggregate liquidity shortage. However, with a small probability, investors receive a negative noisy signal which increases their posterior probability of insolvency for all banks when some are, in fact, solvent. Thus, a solvent bank may not be able to refinance maturing debt because it gets pooled together with other insolvent banks following the arrival of a noisy, negative signal. To hedge against such a liquidity risk, banks hold a precautionary buffer of easily tradeable liquid assets.

It is important to point out here the differences with the motivations for holding precautionary liquidity buffers in deposit-based theories of commitment lending. In KRS, banks hold liquidity buffers in anticipation of deposit withdrawals. As previously noted, deposit withdrawals are sluggish in nature, price-controlled by banks due to their monopoly power, and easily substitutable with wholesale funding as they carry little information content (Drechsler, Savov and Schnabl, 2017). A more realistic explanation for liquidity buffers, implicit in the post-GFC bank regulations (see footnote 11), lies in the fragility of wholesale funding. Additionally, KRS assume that raising external finance to meet deposit withdrawals is costly due to adverse selection. This assumption implicitly espouses a view of equally uninformed lenders in the wholesale funding markets. In contrast, investors in Ratnovski (2013) usually refinance solvent banks except when a negative, noisy signal arrives – a view more amenable to the idea that some lenders are informed in the wholesale funding markets. Pérignon, Thesmar and Vuillemey (2018) study dry-ups in wholesale funding markets and find no evidence consistent with adverse selection models.

Once the motivation for holding liquid asset stockpiles is established, banks' incentive to extend credit lines rests on two factors. First, on-balance sheet accumulation of liquid-assets is costly for banks (see footnote 10). Moreover, wholesale funding is usually more expensive as it does not earn a deposit spread like traditional deposits (Drechsler, Savov and Schnabl, 2017). Thus, off-balance sheet commitments offer banks a way to offset the higher costs of wholesale funding and liquidity buffers.[51] Second, offering contingent commitments will be viable for banks only if credit line withdrawals do not coincide with wholesale funding refinancing risk. Following the argument in Ratnovski (2013), this implies that credit line withdrawals do not take place at the same time as arrival of (negative) noisy signals about bank's solvency. There is a concern here that if wholesale funding providers also double up as beneficiaries of credit lines, arrival of a noisy negative signal could trigger double runs on credit lines and wholesale funding. The necessary ingredient, I believe, for mitigating such circumstances lies in monitoring. If firms can be dissuaded from opportunistically drawing down credit lines, the synergy between wholesale funding and credit line withdrawals goes through as they can share the cost of liquidity buffers. The monitoring role, however, might be limited if wholesale funding providers and credit line beneficiaries face correlated liquidity shocks. This reasoning points to a fundamental source of systemic risk inherent in wholesale-funding based models of commitments.[52]

7.2 Empirical Evidence

I start my empirical analysis by investigating whether banks with greater wholesale funding hold more liquid assets. The key challenge here is to identify balance sheet items that best map to the notion of liquid, easily tradeable securities. Call reports classify all securities held on banks' balance sheet into "available for sale" and "held-to-maturity" buckets. In theory, "available for sale" securities could be a candidate for banks' liquidity buffers. However, this classification ignores the duration risk of the securities portfolio. Drechsler, Savov and Schnabl (2021) note that the average duration of banks' securities portfolio is 8.4 years. This implies that a 1% change in Fed Funds rate would, on average, lead to an 8.4% decline in the securities portfolios of banks. A liquid-asset portfolio with such high duration risk doesn't fit the notion of easily tradeable, precautionary liquidity buffers. Thus, I define liquid-assets or liquidity buffers as securities with repricing maturity less than 3 years.[53] Additionally, I classify "Federal Funds sold and securities purchased" as liquid assets. Bank reserves are excluded as they are

[51] Banks usually charge a fee on the undrawn amount of revolving credit line facilities offered to firms, along with some upfront fees (Shockley and Thakor, 1997)

[52] The literature has explored possible sources of liquidity in the event of an aggregate liquidity shock. Holmström and Tirole (1998) argue that in times of aggregate uncertainty, the self-sufficiency of private markets in providing liquidity breaks down and government-provided liquidity is optimal. Gatev and Strahan (2006) document the hedging aspect of deposit inflows following declines in market liquidity. Acharya and Mora (2015), however, point out that such deposit inflows may not always occur.

[53] Call reports provide detailed maturity data for all securities starting Q2 1997. Duration is proxied by the repricing maturity of the securities. A cut-off of three years is chosen partially due to data availability. Maturity data for "other residential mortgage backed securities (RMBS)" is split into two broad buckets: (1) maturity greater than 3 years, and (2) maturity less than 3 years.

minimum regulatory requirements for banks and as such, can't be deployed to service credit line withdrawals or wholesale funding shocks (Kashyap, Rajan and Stein, 2002). In summary, liquid assets of banks are defined as the sum of all securities with maturity less than 3 years, and Federal funds sold and securities purchased with agreement to resell.[54]

If the link between wholesale funding and commitments works through banks' holdings of liquid securities, we can jointly test these relationships in an instrumental variable setting (Kashyap, Rajan and Stein, 2002).[55] I regress liquid-assets ratio against wholesale funding ratio in the first-stage. In the second-stage, various measures of commitments are regressed against fitted values of liquid-assets ratio from the first-stage. The motivation here is to capture bank commitments that can be explained by liquid securities holdings on account of wholesale funding. The dependent variables are the three measures of liquidity. The control variables are the same as in panel regressions in Section 5.4. Liquid assets ratio is defined as the ratio of liquid securities, and the sum of total loans and liquid securities $\left(\frac{\text{Liquid securities}}{\text{Total Loans + Liquid Securities}}\right)$. The sample of banks is large banks sorted on the respective measure of commitments and the time period is restricted to Q2 1997-Q4 1977 as detailed maturity data of securities begins in Q2 1997. Table 8 displays the results of the second-stage regression. The coefficient on Liquid assets ratio is positive and significant for all measures of commitments except for the Liquidity creation ratio from Berger and Bouwman (2009). Moreover, the first-stage regression results reported in 9 document a positive and significant coefficient on wholesale funding ratio for the sample of banks sorted on COMMIT and CICOMMIT (columns 2 and 3). Results from the IV regression suggest the following interpretation: banks' commitments are positively and correlated with that component of liquid securities which are driven by wholesale funding.

Next, I try to empirically test the hypothesis that wholesale funding dependence – and maintenance of liquidity buffers against it – is costly for banks. As previously mentioned, wholesale funding is costlier than traditional deposits as they do not earn a deposit spread like deposits (Drechsler, Savov and Schnabl, 2017). Moreover, the opportunity costs of holding liquid securities on-balance sheet make them relatively costly. I construct quarterly measures of net interest margin following Drechsler, Savov and Schnabl (2017), and regress it against wholesale funding ratio separately for large banks sorted on the three measures of commitments.[56] Table 10 reports the regression results. We observe a negative and statistically

[54]Detailed mapping of these items to Call reports variables is reported in Table A.2

[55]The idea here is not to rigorously argue the exclusion restriction by establishing exogeneity of the instrument. The aim of this exercise is to understand how much of the variation in commitments can be explained by the component of liquid-assets held due to variation in wholesale funding.

[56]NIM is constructed as the difference between interest income and expenses, scaled by total assets. Interest income and expenses are reported as year-to-date values in the raw data. I convert the data into quarterly values and scale them by

significant coefficient on wholesale funding ratio across all the different samples of large banks sorted on the measures of commitments. These results indicate that banks with higher wholesale funding ratios have lower net interest margins.

Do banks offset the higher cost of wholesale funding and liquid securities by extending more credit line commitments? As noted in the previous section, banks usually charge a fee on the undrawn amount of revolving credit line facilities to firms. A possible motive for banks to extend credit lines could be to offset higher costs of wholesale funding dependence. Ideally, one would like to empirically test this hypothesis by analyzing the fees earned on credit line commitments. However, fees related to credit line commitments are not separately reported on Call reports. To proxy for such fees, I use banks' "Other non-interest income", a variable that started getting reported on Call reports after 2000. "Other non-interest income" includes many different non-interest sources of income including loan commitments fees as well as credit card fees. Regressions results are reported in Table 11.[57] Except for the commitment ratio (column 2), all specifications report a positive and significant coefficient on wholesale funding ratio. These results suggest that wholesale funding banks earn less by way of interest income and more from non-interest income sources like commitment fees. Do these effects balance each other out when looking at bank's total earning? In Table 12, I regress net income against wholesale funding for large banks sorted on the different measures of commitments.[58] Across the board, the coefficient on wholesale funding is not statistically significant. In summary, banks with greater wholesale funding have lower NIMs, but higher non-interest incomes. Overall, the two effects seem to offset each other as the difference in net income is not statistically significant.

8 Evidence from domestic branches of foreign banks

Consider the following thought experiment – what if banks were not allowed to hold retail deposits in the form of transaction and savings accounts? Would they still indulge in commitment lending activities given that the synergies between deposit-taking and commitment

the average of total assets reported for the quarter following the approach in Drechsler, Savov and Schnabl (2017). For Call report variables for interest expenses and income, refer to Table A.2

[57]The dependent variable here is the ratio of "Other non-interest income" scaled by total assets. Other non-interest income in raw data is reported as year-to-date values starting Q1 2001. I convert the data into quarterly values and scale them by the average of total assets reported for the quarter following the approach in Drechsler, Savov and Schnabl (2017). For Call report mapping to "other non-interest income", refer to Table A.2.

[58]The dependent variable here is the ratio of "net income" scaled by total assets. Net income, in the raw data, is reported as year-to-date values. I convert the data into quarterly values and scale them by the average of total assets reported for the quarter following the approach in Drechsler, Savov and Schnabl (2017). For Call report mapping to "net income", refer to Table A.2.

lending no longer apply? Our understanding of the existing literature would most likely lead us to a negative prior. Domestic branches of foreign banks allow us a rare opportunity to study that thought experiment in reality as branches of foreign banks are prohibited from accepting retail deposits.

Foreign banks seeking to establish a presence in the US can legally structure themselves in various forms. The most common structure adopted by foreign banks is through the establishment of branches or agencies[59]. Two landmark legislations shaped the landscape for activities of foreign branches in the US: (1) International Banking Act (IBA) of 1978, and (2) Foreign Bank Supervision Enhancement Act (FBSEA) of 1991 (U.S. Government Accountability Office, 1996). The former legislation set a precedent of national treatment, allowing foreign banks to compete with US banks on the same basis. More importantly, the IBA allowed the US branches of foreign banks to apply for deposit insurance if it was undertaking domestic retail activities[60]. And the latter laid down reporting and supervision standards for foreign branches in line with the regulations faced by US banks. However, in 1991, the Federal Deposit Insurance Corporation Improvement Act (FDICIA) amended the IBA to disallow a de novo US branch of a foreign bank from obtaining deposit insurance if it is engaged in retail banking activity. Thus, if a foreign bank had intentions of undertaking domestic retail activities, it would have to establish an insured subsidiary bank (Federal Reserve Board, 1996).

Prohibition on accepting retail deposits meant that branches of foreign banks had a negligible share (less than 1%) of transaction (checkings) deposits in their liabilities for the sample period from 1990-2008. They are largely funded with wholesale funding, with large time deposits accounting for a bulk of that funding. A natural question to ask, then, is the extent to which these foreign branches undertake commitment lending in the US, if any. Using quarterly data from Call reports, I construct proxies of unused commitments of domestic branches of foreign banks and plot them in Figure 15.[61]. The nominal USD value of the main proxy of commitments stood at $822 billion in Q4 2007, a value which was 26.0% of the total commitments of commercial banks in the US. Meanwhile, their assets stood at 18.02% of the total assets of commercial banks in the US. Moreover, figure 15 shows that aggregate wholesale

[59] U.S. Government Accountability Office (1996) reports that 82 percent of US assets of foreign banks were held in branches and agencies in 1994.

[60] Domestic retail activity was defined as the acceptance of retail deposits under $ 100,000.

[61] Foreign banks' branches and agencies are required to file form FFIEC 002 with the regulatory authorities every quarter. The reporting variables are similar, in terms of definition, to the Call Reports filed by commercial banks, but frequently differ in their variable names. I construct time-consistent measures of the key variables from 1990-2008 for branches of foreign banks by restricting my sample to those banks with entity type "U.S. Branches of a foreign bank" (where RSSD9331 is equal to 9)

funding of foreign branches co-moved strongly with its aggregate commitments, especially during the 90's.

A natural argument against the suggestive evidence offered here is that this analysis ignores the presence of transaction deposits in the home country/countries of the foreign banks. However, under the separate entity doctrine, US branches and agencies are considered separate legal entities, distinct from their corporate headquarters and sister branches abroad (Cleary Gottlieb, 2012). Most importantly, for liquidation purposes, the New York bank insolvency law has the authority to seize all the assets of the foreign bank that are located in New York and not its assets abroad. Upon liquidation, proceeds first pay off the claims of creditors arising from the transaction of business with the New York branch (Cleary Gottlieb, 2012). As such, while the US branch undoubtedly benefits from the credit-worthiness of its foreign headquarters, the potential claims of branch debtors are ring-fenced by the assets reported by the US branch. The standalone nature of the branch and its activities, thus, allows some freedom in studying their balance sheet on a standalone basis. The fact that branches of foreign banks engage in significant quantities of commitments absent any transaction deposits, suggests that a wholesale-funding backed model of commitments might be a viable and competitive structure.

9 Conclusion

Demandable deposits, often characterized as relatively stable funding, play a central role in existing theories of banking structure efficiency and models of credit line commitments. I find little evidence in support of those claims. Instead, I find that a relatively fragile source of financing – wholesale funding – plays an important role in driving banks' supply of credit line commitments.

The centrality of wholesale funding as the key driver of contingent commitments has far-reaching consequences for our understanding of banking structures and systemic liquidity risk. First, it highlights a fundamental source of aggregate risk in the banking system – correlated drawdowns of credit lines and negative wholesale funding shocks. Given the fact that investors in wholesale funding sources of banks most likely overlap with beneficiaries of bank credit lines, events characterized by aggregate uncertainty will systematically lead to system-wide scarcity of liquidity. This reasoning will undoubtedly lead a central planner to reduce banks' dependence on wholesale funding. On the other hand, excessive curbing of wholesale funding markets – like post-GFC regulations – runs the risk of going too far and result in lower than optimal level credit line commitments. Optimal regulation, thus, has to contend with this tradeoff.

Second, the decoupling of demandable deposits from credit line commitments raises the question: are banks uniquely placed in providing credit line commitments? In theory, one could imagine numerous forms of financial intermediaries funded by short-term debt who could be up to this task.[62] However, the fact that commercial banks have emerged as the largest providers of commitments in equilibrium suggest that some other force must be at play.

Third, existing studies focus on one specific component of wholesale funding like large-time deposits or repo funding in isolation without accounting for their interaction with other components and their substitutability, if any. All these questions could be promising areas for future research.

[62] Securities dealers often provide credit lines to mortgage companies (Lewis, 2023).

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Table 1: Call Reports: Summary Statistics for Large Banks

	N	Min	p25	p50	p75	Max	Mean	SD
Panel A: Large Banks (Sorted on LC_OBS)								
Assets (USD billions)	3309	0.33	13.67	34.29	74.27	1667.30	79.86	156.61
Large Banks per quarter (N)	72	21.00	30.00	38.00	68.00	95.00	49.01	23.39
OBS Liquidity Creation Ratio	3309	0.13	0.20	0.27	0.35	0.90	0.32	0.17
Wholesale Funding Ratio	3309	0.08	0.25	0.36	0.51	0.97	0.40	0.21
Transaction Deposits Ratio	3309	0.01	0.13	0.23	0.30	0.42	0.22	0.11
Capital Ratio	3309	0.04	0.07	0.08	0.09	0.18	0.08	0.02
Fed funds/Repo ratio	3309	0.00	0.16	0.29	0.44	0.75	0.30	0.19
Foreign deposits ratio	3309	0.00	0.03	0.13	0.33	0.74	0.20	0.21
Other Borrowed money ratio	3309	0.00	0.04	0.14	0.25	0.58	0.17	0.14
Subordinated notes ratio	3309	0.00	0.01	0.03	0.05	0.14	0.04	0.03
Large Time Deposits ratio	3309	0.01	0.15	0.23	0.38	0.91	0.29	0.19
Panel B: Large Banks (Sorted on COMMIT)								
Assets (USD billions)	5539	0.28	9.23	18.69	45.38	1667.30	53.64	125.44
Large Banks per quarter (N)	72	50.00	63.00	80.50	96.00	117.00	80.88	20.78
Unused Commitments Ratio	5539	0.13	0.23	0.28	0.37	0.70	0.31	0.11
Wholesale Funding Ratio	5539	0.07	0.23	0.32	0.44	0.96	0.36	0.19
Transaction Deposits Ratio	5539	0.02	0.12	0.21	0.30	0.46	0.21	0.11
Capital Ratio	5539	0.05	0.07	0.08	0.09	0.18	0.08	0.02
Fed funds/Repo ratio	5539	0.00	0.17	0.30	0.44	0.75	0.31	0.18
Foreign deposits ratio	5539	0.00	0.00	0.06	0.22	0.73	0.15	0.19
Other Borrowed money ratio	5539	0.00	0.04	0.14	0.28	0.60	0.17	0.15
Subordinated notes ratio	5539	0.00	0.00	0.03	0.05	0.14	0.03	0.03
Large Time Deposits ratio	5539	0.01	0.18	0.29	0.45	1.00	0.33	0.20
Panel C: Large Banks (Sorted on CICOMMIT)								
Assets (USD billions)	3607	1.03	15.31	34.48	70.57	1667.30	76.49	150.46
Large Banks per quarter (N)	72	31.00	37.50	44.00	70.50	91.00	52.88	18.91
Unused C&I Commitments Ratio	3607	0.31	0.50	0.56	0.64	0.98	0.57	0.12
Wholesale Funding Ratio	3607	0.09	0.25	0.36	0.49	0.97	0.39	0.20
Transaction Deposits Ratio	3607	0.02	0.13	0.22	0.30	0.43	0.22	0.10
Capital Ratio	3607	0.05	0.07	0.08	0.09	0.18	0.08	0.02
Fed funds/Repo ratio	3607	0.00	0.17	0.30	0.44	0.74	0.31	0.18
Foreign deposits ratio	3607	0.00	0.04	0.13	0.33	0.75	0.20	0.20
Other Borrowed money ratio	3607	0.00	0.05	0.14	0.26	0.57	0.17	0.14
Subordinated notes ratio	3607	0.00	0.01	0.03	0.05	0.15	0.04	0.03
Large Time Deposits ratio	3607	0.01	0.15	0.24	0.37	0.76	0.27	0.16

This table presents the summary statistics for Commercial Banks classified as large after sorting on three measures of commitments: (1)LC_OBS, (2) COMMIT, and (3) CICOMMIT. Individual bank level variables are first aggregated at the highest holding company level using the identifier RSSD9348. Each quarter, banks are sorted (in a decreasing order) on the nominal dollar values of the respective measure of commitments. For each measure, banks cumulatively accounting for top 90% of the aggregate quantity are classified as large. All variables are winsorized at the 1% level. Observations with quarter-on-quarter growth greater than 20% or less than -20% are excluded to account for bank mergers.

Table 2: FR Y-9C Reports: Summary Statistics for Large Banks

	N	Min	p25	p50	p75	Max	Mean	SD
Panel A: Large Banks (Sorted on LC_OBS)								
Assets (USD billions)	2225	1.22	20.02	47.76	100.82	2358.27	121.56	243.94
Large Banks per quarter (N)	70	17.00	20.00	26.00	47.00	69.00	33.61	15.80
OBS Liquidity Creation Ratio	2225	0.12	0.21	0.27	0.37	0.90	0.32	0.17
Wholesale Funding Ratio	2225	0.07	0.24	0.35	0.49	0.98	0.39	0.21
Transaction Deposits Ratio	2225	0.02	0.15	0.23	0.31	0.46	0.23	0.11
Capital Ratio	2225	0.04	0.07	0.08	0.09	0.17	0.08	0.02
Fed funds/Repo ratio	2225	0.00	0.13	0.25	0.36	0.66	0.26	0.15
Foreign deposits ratio	2225	0.00	0.02	0.09	0.25	0.72	0.16	0.17
Other Borrowed money ratio	2225	0.02	0.16	0.26	0.37	0.66	0.28	0.15
Subordinated notes ratio	2225	0.00	0.03	0.06	0.09	0.24	0.07	0.05
Large Time Deposits ratio	2225	0.01	0.13	0.20	0.33	0.72	0.24	0.16
Panel B: Large Banks (Sorted on COMMIT)								
Assets (USD billions)	3548	3.19	13.93	30.79	70.56	2358.27	86.94	200.88
Large Banks per quarter (N)	70	33.00	42.00	54.50	63.00	73.00	53.01	11.62
Unused Commitments Ratio	3548	0.10	0.24	0.29	0.38	0.73	0.32	0.11
Wholesale Funding Ratio	3548	0.08	0.25	0.35	0.46	0.97	0.38	0.19
Transaction Deposits Ratio	3548	0.02	0.12	0.20	0.29	0.46	0.21	0.11
Capital Ratio	3548	0.04	0.07	0.08	0.09	0.15	0.08	0.02
Fed funds/Repo ratio	3548	0.00	0.15	0.26	0.37	0.69	0.27	0.16
Foreign deposits ratio	3548	0.00	0.00	0.05	0.17	0.69	0.12	0.16
Other Borrowed money ratio	3548	0.00	0.14	0.24	0.37	0.68	0.26	0.16
Subordinated notes ratio	3548	0.00	0.03	0.05	0.09	0.25	0.06	0.05
Large Time Deposits ratio	3548	0.01	0.15	0.24	0.38	0.83	0.28	0.18
Panel C: Large Banks (Sorted on CICOMMIT)								
Assets (USD billions)	2377	3.19	23.44	47.40	97.02	2358.27	117.54	236.43
Large Banks per quarter (N)	70	21.00	26.00	31.50	45.00	62.00	35.87	11.99
Unused C&I Commitments Ratio	2377	0.34	0.51	0.58	0.68	1.00	0.60	0.13
Wholesale Funding Ratio	2377	0.10	0.26	0.38	0.51	0.97	0.41	0.20
Transaction Deposits Ratio	2377	0.02	0.13	0.22	0.30	0.46	0.22	0.11
Capital Ratio	2377	0.04	0.07	0.08	0.09	0.16	0.08	0.02
Fed funds/Repo ratio	2377	0.00	0.14	0.25	0.36	0.64	0.26	0.15
Foreign deposits ratio	2377	0.00	0.03	0.09	0.26	0.73	0.16	0.18
Other Borrowed money ratio	2377	0.02	0.16	0.27	0.38	0.65	0.28	0.15
Subordinated notes ratio	2377	0.00	0.03	0.06	0.09	0.26	0.07	0.05
Large Time Deposits ratio	2377	0.01	0.13	0.19	0.31	0.70	0.23	0.15

This table presents the summary statistics for BHCs classified as large after sorting on three measures of commitments: (1)LC_OBS, (2) COMMIT, and (3) CICOMMIT. Each quarter, banks are sorted (in a decreasing order) on the nominal dollar values of the respective measure of commitments. For each measure, banks cumulatively accounting for top 90% of the aggregate quantity are classified as large. All variables are winsorized at the 1% level. Observations with quarter-on-quarter growth greater than 20% or less than -20% are excluded to account for bank mergers.

Table 3: The Relationship Between Commitments and Wholesale funding ratio (Call Reports): Panel Regressions for Large Banks

Large Banks (Call Reports): OBS Liquidity Creation (LC_OBS)				
	Dep. Variable = Liquidity Creation Ratio (LC_OBS)			
	(1)	(2)	(3)	(4)
Wholesale funding ratio	0.341***	0.369***	0.440***	0.182**
	(0.0702)	(0.0675)	(0.0747)	(0.0812)
N	3309	3309	3309	3302
Year-quarter FE	X	X	X	X
Size Controls		X	X	X
Other Controls			X	X
Bank FE				X
R^2	0.270	0.387	0.507	0.919

Large Banks (Call Reports): Unused Commitments (COMMIT)				
	Dep. Variable = Unused Commitments Ratio (COMMIT)			
	(1)	(2)	(3)	(4)
Wholesale funding ratio	0.265***	0.230***	0.202***	0.117**
	(0.0535)	(0.0551)	(0.0651)	(0.0541)
N	5539	5539	5539	5523
Year-quarter FE	X	X	X	X
Size Controls		X	X	X
Other Controls			X	X
Bank FE				X
R^2	0.266	0.305	0.442	0.885

Large Banks (Call Reports): C&I Unused Commitments (CICOMMIT)				
	Dep. Variable = C&I Unused Commitments Ratio			
	(1)	(2)	(3)	(4)
Wholesale funding ratio	0.213***	0.188**	0.220**	0.174**
	(0.0644)	(0.0750)	(0.0997)	(0.0733)
N	3607	3607	3607	3601
Year-quarter FE	X	X	X	X
Size Controls		X	X	X
Other Controls			X	X
Bank FE				X
R^2	0.232	0.248	0.273	0.852

This table reports the regressions of various measures of off-balance sheet commitments on wholesale funding and other control variables for **large banks using Call reports data**. Detailed explanation of sample construction and classification of banks into large, medium, and small can be found in Section A.1. The dependent variables are (1) LC_OBS ratio (2) COMMIT ratio and (3) CICOMMIT ratio in Panel A, B, and C respectively. For detailed explanation of these variables refer to section 3.2 and Table A.2. The main explanatory variable across these regressions is the wholesale funding ratio (see section 3.2). *Control* variables include log assets, log assets squared, capital ratio, transaction deposits ratio, large time deposits share of wholesale funding, other borrowed money share of wholesale funding, subordinated notes' share of wholesale funding, and foreign deposits share of wholesale funding. Year-quarter fixed effects are included to control for time trends. Standard errors are clustered at the banks holding company level and shown in parentheses. All measures are winsorized at 1% level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 4: The Relationship Between Commitments and Wholesale funding ratio (FR Y-9C Reports): Panel Regressions for Large Banks

Large Banks (FRY-9C reports): OBS Liquidity Creation (LC_OBS)				
	Dep. Variable = Liquidity Creation Ratio (LC_OBS)			
	(1)	(2)	(3)	(4)
Wholesale funding ratio	0.296***	0.433***	0.616***	0.288**
	(0.0942)	(0.104)	(0.105)	(0.126)
N	2225	2225	2225	2218
Year-quarter FE	X	X	X	X
Size Controls		X	X	X
Other Controls			X	X
Bank FE				X
R^2	0.289	0.423	0.583	0.924

Large Banks (FRY-9C Reports): Unused Commitments (COMMIT)				
	Dep. Variable = Unused Commitments Ratio (COMMIT)			
	(1)	(2)	(3)	(4)
Wholesale funding ratio	0.276***	0.267***	0.263***	0.191**
	(0.0704)	(0.0780)	(0.0783)	(0.0760)
N	3548	3548	3548	3541
Year-quarter FE	X	X	X	X
Size Controls		X	X	X
Other Controls			X	X
Bank FE				X
R^2	0.256	0.257	0.476	0.893

Large Banks (FRY-9C Reports): C&I Unused Commitments (CICOMMIT)				
	Dep. Variable = C&I Unused Commitments Ratio			
	(1)	(2)	(3)	(4)
Wholesale funding ratio	0.321***	0.343***	0.456***	0.316***
	(0.0566)	(0.0716)	(0.0919)	(0.104)
N	2377	2377	2377	2373
Year-quarter FE	X	X	X	X
Size Controls		X	X	X
Other Controls			X	X
Bank FE				X
R^2	0.337	0.355	0.435	0.871

This table reports the regressions of various measures of off-balance sheet commitments on wholesale funding and other control variables for **large banks using FR Y-9C reports**. Detailed explanation of sample construction and classification of banks into large, medium, and small can be found in Section A.1. The dependent variables are (1) LC_OBS ratio (2) COMMIT ratio and (3) CICOMMIT ratio in Panel A, B, and C respectively. For detailed explanation of these variables refer to section 3.2 and Table A.1. The main explanatory variable across these regressions is the wholesale funding ratio (see section 3.2). *Control* variables include log assets, log assets squared, capital ratio, transaction deposits ratio, large time deposits share of wholesale funding, other borrowed money share of wholesale funding, subordinated notes' share of wholesale funding, and foreign deposits share of wholesale funding. Year-quarter fixed effects are included to control for time trends. Standard errors are clustered at the banks holding company level and shown in parentheses. All measures are winsorized at 1% level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 5: Summary Statistics for the sample of banks used in Staggered FHLB membership

	N	p25	p50	p75	Max	Mean	SD
Assets (USD Billions)	46421	0.10	0.15	0.24	12.46	0.23	0.43
Unused Commitments (USD Billions)	46421	0.01	0.01	0.03	4.84	0.03	0.12
Wholesale Funding (USD Billions)	46421	0.01	0.02	0.05	7.16	0.05	0.19
Transaction Deposits (USD Billions)	46421	0.02	0.03	0.05	1.85	0.05	0.06

This table reports the summary statistics for the sample of banks used in the exercise using staggered FHLB membership in a DiD setting. For details of sample construction, refer to section 6.1.

Table 6: Effect of wholesale funding on commitments: Second-stage IV estimates

Second-stage regression (large and medium banks)			
	(1)	(2)	(3)
	$\Delta ln(\text{Commit.})_t$	$\Delta ln(\text{C\&I Commit.})_t$	$\Delta ln(\text{OBS Liq. Creation})_t$
$\Delta ln(\text{Wholesale funding})_t^{\text{instrum}}$	0.301**	0.410	0.443**
	(0.121)	(0.278)	(0.186)
$\ln(\text{assets})_{t-1}$	-0.0771***	-0.0622	-0.0775**
	(0.0289)	(0.0481)	(0.0339)
$ln(\text{assets})_{t-1}$ squared	0.00400***	0.00338**	0.00302***
	(0.000877)	(0.00136)	(0.00101)
Capital Ratio_{t-1}	-0.0757	-0.116	-0.233
	(0.122)	(0.199)	(0.249)
Transaction Deposits Ratio_{t-1}	0.0364**	0.0234	-0.00538
	(0.0159)	(0.0336)	(0.0324)
$ln(\text{Wholesale Funding})_{t-2}$	0.0192***	0.0195	0.0252***
	(0.00671)	(0.0128)	(0.00717)
$ln(\text{Commitments})_{t-2}$	-0.0800***		
	(0.00587)		
$ln(\text{C\&I Commitments})_{t-2}$		-0.0755***	
		(0.00691)	
$ln(\text{OBS Liquidity Creation})_{t-2}$			-0.0570***
			(0.00722)
N	19612	9691	7630
Cragg-Donald Wald F-stat	65.42	21.9	26.3
Kleibergen-Paap rk F-stat	39	10.3	11.4
Year-quarter FE	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes

This table reports the second-stage of 2SLS IV estimation using the shift-share instrument described in section 6.2. The sample of banks include large and medium banks as described in section A.1 using the Call reports data. The dependent variables are growth rates ($\Delta Y_t = ln(Y_t/Y_{t-1})$) of (1) unused commitments (2) C&I unused commitments, and (3) OBS liquidity creation (Berger and Bouwman, 2009) in Columns (1), (2), and (3), respectively. For detailed explanation of these variables refer to section 3.2. The main explanatory variable of interest across these regressions is the instrumented wholesale funding growth obtained from the first-stage in Table 7. In all second-stage regressions, $\Delta ln(\text{Wholesale funding})_t$ is instrumented by: Wholesale funding component shares (lagged by two quarters) x Growth in aggregage components. *Control* variables include lagged values of log assets, log assets squared, capital ratio, transaction deposits ratio, log of the respective commitment measure lagged by two quarters, and log of wholesale funding lagged by two quarters. All regressions include time and bank fixed effects. Standard errors are clustered at the banks holding company level and shown in parentheses. All measures are winsorized at 1% level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 7: Effect of wholesale funding on commitments: First-stage IV estimates

First-stage regression (large and medium banks)			
	Dep. Variable = $\Delta ln(\text{Wholesale funding})_t$		
	(1)	(2)	(3)
$b_{i,t} = (\sum_{j=1}^{5} z_{i,j,t-2} g_{j,t})$ wholesale component shares (t-2) x Component growth rate	0.408***	0.327***	0.423***
	(0.0654)	(0.102)	(0.126)
N	19612	9691	7630
Year-quarter FE	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes

This table reports the first-stage of 2SLS IV estimation using the shift-share instrument described in section 6.2. The sample of banks include large and medium banks as described in section A.1 using Call reports data. The dependent variables across all the first-stage regressions is wholesale funding growth, $\Delta ln(\text{Wholesale funding})_t = ln\left(\frac{\text{Wholesale Funding}_t}{\text{Wholesale Funding}_{t-1}}\right)$. The shift-share instrument for wholesale funding growth, $b_{i,t} = (\sum_{j=1}^{5} z_{i,j,t-2} g_{i,j,t})$, , is defined as *lagged wholesale funding component shares* × *Aggregate component growth rate*. *Control* variables (not shown here) are the same as Table 6 and include lagged values of log assets, log assets squared, capital ratio, transaction deposits ratio, log of the respective commitment measure lagged by two quarters, and log of wholesale funding lagged by two quarters. All regressions include time and bank fixed effects. Standard errors are clustered at the banks holding company level and shown in parentheses. All measures are winsorized at 1% level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 8: Effect of liquid securities on commitments: Second-stage IV estimates

	Second-stage regression (Large banks)		
	(1)	(2)	(3)
	Liquidity Creation ratio	Commit. ratio	C&I Commitments ratio
Liquid asset ratio	1.590	0.660*	0.829*
	(1.509)	(0.357)	(0.424)
ln(assets)	-0.112	0.194	-0.0210
	(0.638)	(0.202)	(0.354)
squared ln(assets)	0.00507	-0.00518	0.00204
	(0.0144)	(0.00559)	(0.00928)
Capital Ratio	1.232	0.458	-0.117
	(1.497)	(0.453)	(0.378)
Transaction Deposits Ratio	-0.308	-0.00187	-0.123
	(0.325)	(0.0737)	(0.149)
N	1313	2855	1609
Cragg-Donald Wald F-stat	17.67	64.75	49.84
Year-quarter FE	X	X	X
Size Controls	X	X	X
Other Controls	X	X	X
Bank FE	X	X	X

This table reports the second-stage of 2SLS IV estimation on commitments using fitted values of liquid assets ratio as the dependent variable in the first-stage. The first-stage regression involves a regressing liquid assets ratio on wholesale funding ratio. The second-stage regresses the various measures of commitments on the fitted values of liquid assets ratio from the first-stage. The sample of banks include large banks sorted on the respective measures of commitments as described in section A.1 using Call reports data. The dependent variables are (1) OBS liquidity creation ratio (2) unused commitments ratio (COMMIT), and (3) C&I commitments ratio (CICOMMIT) in Columns (1), (2), and (3), respectively. For detailed explanation of these variables refer to section 3.2. The main explanatory variable of interest across these regressions are the fitted values of liquid assets ratio from the first-stage in Table 9. *Control* variables include log assets, log assets squared, capital ratio, transaction deposits ratio, large time deposits share of wholesale funding, other borrowed money share of wholesale funding, subordinated notes' share of wholesale funding, and foreign deposits share of wholesale funding. All regressions include time and bank fixed effects. Standard errors are clustered at the banks holding company level and shown in parentheses. All measures are winsorized at 1% level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 9: Effect of liquid securities on commitments: First-stage IV estimates

First-stage regression (large banks)			
Second-stage dep. var	Liquidity Creation ratio	Commit. ratio	C&I Commitments ratio
	First-stage Dep. Variable = Liquid assets ratio		
	(1)	(2)	(3)
Wholesale funding ratio	0.0932	0.181*	0.207**
	(0.120)	(0.104)	(0.105)
N	1313	2855	1609
Year-quarter FE	X	X	X
Size Controls	X	X	X
Other Controls	X	X	X
Bank FE	X	X	X

This table reports the first-stage of 2SLS IV estimation on commitments using fitted values of liquid assets ratio as the dependent variable in the first-stage. The first-stage regression involves a regressing liquid assets ratio on wholesale funding ratio. The second-stage regresses the various measures of commitments on the fitted values of liquid assets ratio from the first-stage as shown in Table 8. The sample of banks include large banks sorted on the respective measures of commitments as described in section A.1 using Call reports data. The dependent variable in the first-stage is liquid-assets ratio across all regressions. The sample of banks are large banks sorted on (1) OBS liquidity creation ratio (2) unused commitments ratio (COMMIT), and (3) C&I commitments ratio (CICOMMIT) in Columns (1), (2), and (3), respectively. For detailed explanation of these variables refer to section 3.2. The main explanatory variable of interest across these regressions is wholesale funding ratio. *Control* variables include log assets, log assets squared, capital ratio, transaction deposits ratio, large time deposits share of wholesale funding, other borrowed money share of wholesale funding, subordinated notes' share of wholesale funding, and foreign deposits share of wholesale funding. All regressions include time and bank fixed effects. Standard errors are clustered at the banks holding company level and shown in parentheses. All measures are winsorized at 1% level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 10: Relationship between Net Interest Margin (NIM) and Wholesale Funding

Bank sorted on:	Liquidity Creation ratio	Commit. ratio	C&I Commitments ratio
	Dep. Variable = Net Interest Margin ratio		
	(1)	(2)	(3)
Wholesale funding ratio	-0.0144*	-0.0182***	-0.0184***
	(0.00800)	(0.00334)	(0.00419)
ln(assets)	-0.0105	0.00274	0.000287
	(0.0130)	(0.00672)	(0.00985)
squared ln(assets)	0.000309	-0.000137	-0.0000233
	(0.000357)	(0.000196)	(0.000275)
Transaction Deposits Ratio	-0.00868	-0.00553	-0.00429
	(0.00707)	(0.00404)	(0.00576)
Capital Ratio	0.00764	0.0539***	0.0630**
	(0.0435)	(0.0202)	(0.0246)
N	3302	5523	3601
Year-quarter FE	X	X	X
Size Controls	X	X	X
Other Controls	X	X	X
Bank FE	X	X	X
R^2	0.903	0.852	0.862

This table reports the regressions of Net Interest Margin (NIM) on wholesale funding ratio from Call reports data. The dependent variable across all regressions is NIM constructed as the difference between interest income and expenses, scaled by total assets. Interest income and expenses are reported as year-to-date values in the raw data. I convert the data into quarterly values and scale them by the average of total assets reported for the quarter following the approach in Drechsler, Savov and Schnabl (2017). For Call report variables for interest expenses and income, refer to Table A.2. The main explanatory variable is wholesale funding ratio. Columns 1, 2, and 3 report the regression results for large banks as sorted on (1) liquidity creation ratio (2) unused commitments ratio and (3) C&I Commitments ratio, respectively. For detailed explanation of these variables refer to section 3.2 and Table A.2. *Control* variables include log assets, log assets squared, capital ratio, transaction deposits ratio, large time deposits share of wholesale funding, other borrowed money share of wholesale funding, subordinated notes' share of wholesale funding, and foreign deposits share of wholesale funding. All regressions include time and bank fixed effects. Standard errors are clustered at the banks holding company level and shown in parentheses. All measures are winsorized at 1% level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 11: Relationship between Other Non-interest Income and Wholesale Funding

Bank sorted on:	Liquidity Creation ratio	Commit. ratio	C&I Commitments ratio
	Dep. Var. = Other non-interest income ratio		
	(1)	(2)	(3)
Wholesale funding ratio	0.0213***	0.00486	0.00777*
	(0.00641)	(0.00728)	(0.00460)
ln(assets)	-0.0115	-0.0195**	-0.0240
	(0.0304)	(0.00976)	(0.0195)
squared ln(assets)	0.000358	0.000485*	0.000524
	(0.000801)	(0.000280)	(0.000559)
Transaction Deposits Ratio	-0.00934	0.00845	0.00871
	(0.00636)	(0.00897)	(0.00956)
Capital Ratio	-0.0124	0.0197	0.0468
	(0.0477)	(0.0234)	(0.0407)
N	752	2015	1014
Year-quarter FE	X	X	X
Size Controls	X	X	X
Other Controls	X	X	X
Bank FE	X	X	X
R^2	0.870	0.580	0.775

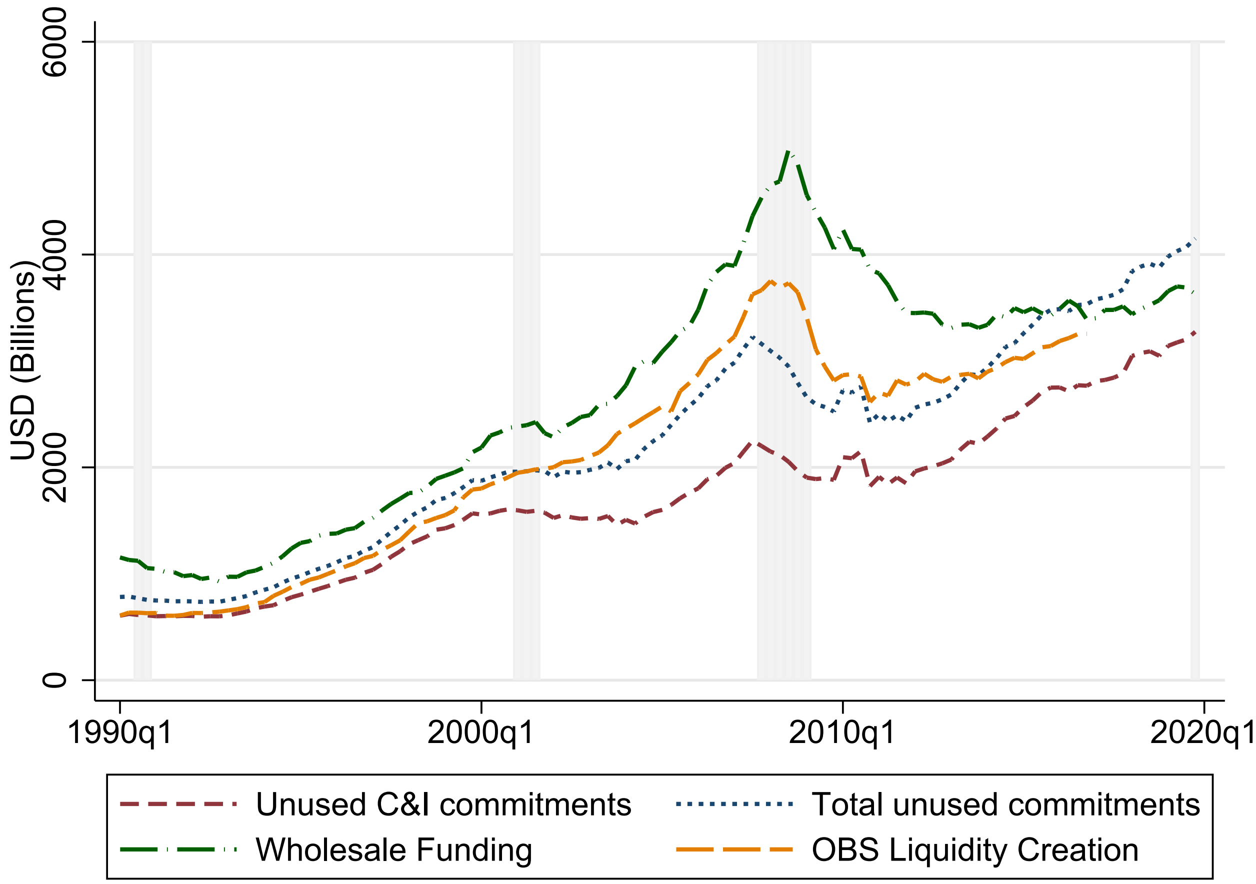
This table reports the regressions of other non-interest income (on wholesale funding ratio from Call reports data. The dependent variable here is the ratio of "Other non-interest income" scaled by total assets. Other non-interest income in raw data is reported as year-to-date values starting Q1 2001. I convert the data into quarterly values and scale them by the average of total assets reported for the quarter following the approach in Drechsler, Savov and Schnabl (2017). For Call report mapping to "other non-interest income", refer to Table A.2. The main explanatory variable is wholesale funding ratio. Columns 1, 2, and 3 report the regression results for large banks as sorted on (1) liquidity creation ratio (2) unused commitments ratio and (3) C&I Commitments ratio, respectively. For detailed explanation of these variables refer to section 3.2 and Table A.2. *Control* variables include log assets, log assets squared, capital ratio, transaction deposits ratio, large time deposits share of wholesale funding, other borrowed money share of wholesale funding, subordinated notes' share of wholesale funding, and foreign deposits share of wholesale funding. All regressions include time and bank fixed effects. Standard errors are clustered at the banks holding company level and shown in parentheses. All measures are winsorized at 1% level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 12: Relationship between Net Income and Wholesale Funding

Bank sorted on:	Liquidity Creation ratio	Commit. ratio	C&I Commitments ratio
	Dep. Var. = Net Income ratio		
	(1)	(2)	(3)
Wholesale funding ratio	0.00324	-0.00250	0.000435
	(0.00313)	(0.00294)	(0.00348)
ln(assets)	-0.00124	0.000154	-0.00241
	(0.00729)	(0.00506)	(0.00707)
squared ln(assets)	-0.0000247	-0.0000843	-0.00000948
	(0.000193)	(0.000143)	(0.000190)
Transaction Deposits Ratio	0.00137	-0.00527	-0.000505
	(0.00547)	(0.00430)	(0.00604)
Capital Ratio	0.119***	0.0926***	0.106***
	(0.0239)	(0.0184)	(0.0236)
N	3302	5523	3601
Year-quarter FE	X	X	X
Size Controls	X	X	X
Other Controls	X	X	X
Bank FE	X	X	X
R^2	0.687	0.568	0.588

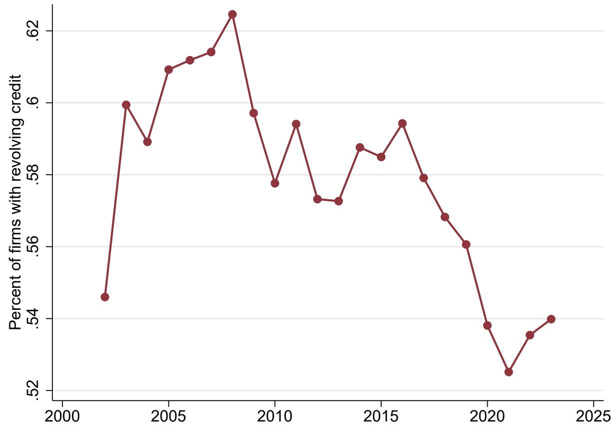
This table reports the regressions of net income on wholesale funding ratio from Call reports data. The dependent variable across all the regressions is the ratio of "net income" scaled by total assets. Net income, in the raw data, is reported as year-to-date values. I convert the data into quarterly values and scale them by the average of total assets reported for the quarter following the approach in Drechsler, Savov and Schnabl (2017). For Call report mapping to "net income", refer to Table A.2. The main explanatory variable is wholesale funding ratio. Columns 1, 2, and 3 report the regression results for large banks as sorted on (1) liquidity creation ratio (2) unused commitments ratio and (3) C&I Commitments ratio, respectively. For detailed explanation of these variables refer to section 3.2 and Table A.2. *Control* variables include log assets, log assets squared, capital ratio, transaction deposits ratio, large time deposits share of wholesale funding, other borrowed money share of wholesale funding, subordinated notes' share of wholesale funding, and foreign deposits share of wholesale funding. All regressions include time and bank fixed effects. Standard errors are clustered at the banks holding company level and shown in parentheses. All measures are winsorized at 1% level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Figure 1: Aggregate Wholesale Funding and Measures of Banks' Credit Lines (1990-2020)



This figure plots the time-series of aggregate wholesale funding along with three measures of banks' off-balance sheet commitments: (1) Off-balance sheet (OBS) liquidity creation from Berger and Bouwman (2009) (2) Unused commitments, and (3) C&I Unused Commitments. All the aggregate measures are constructed using bank call reports. Availability of Berger and Bouwman (2009) stops in 2017.

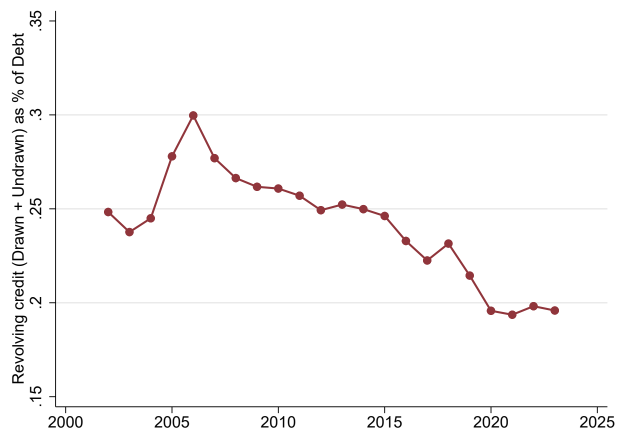
Figure 2: Revolving Credit Facilities of Non-Financial Firms (Capital IQ)



(a) Percentage of firms with revolving credit

(b) Total revolving credit (% of assets)

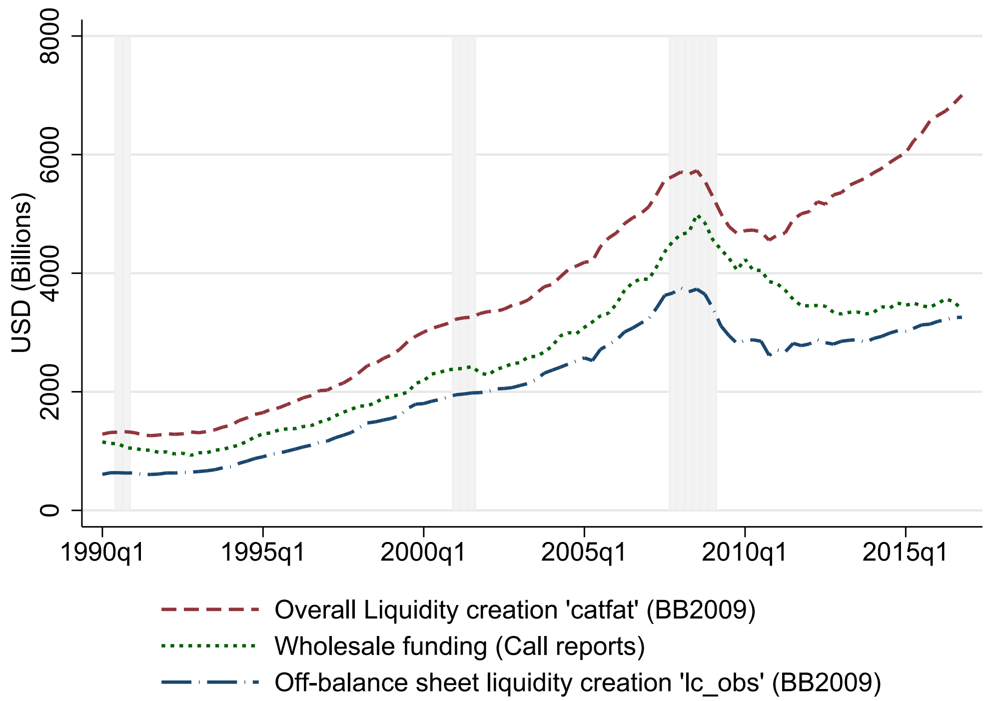
(c) Undrawn revolving credit (% of debt)



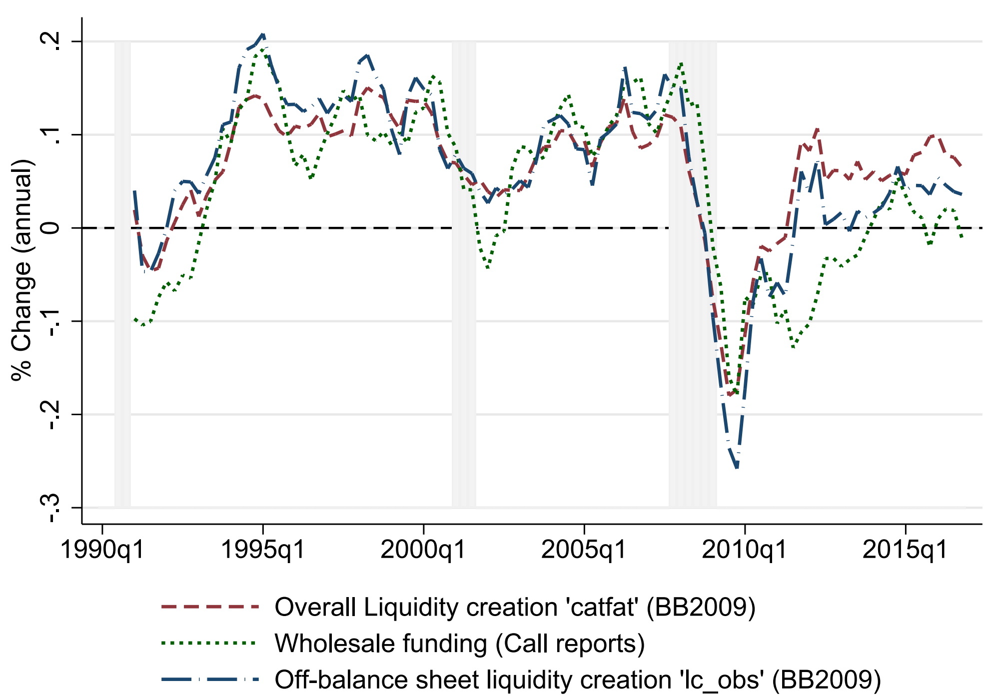
(d) Total revolving credit (% of debt)

This figure plots the time-series dynamics of revolving credit facilities available from Capital IQ. The sample of firms is restricted to non-financial firms incorporated in the US. Firm-level data on revolving credit is merged with annual firm-level data from compustat in the construction of some ratios. Total revolving credit line is calculated as the sum of drawn and undrawn revolving credit facilities following Mathers and Giacomini (2015). In panel 2a, a firm is classified as having revolving access to revolving credit if the reported numbers for total revolving credit are non-missing and greater than zero. Aggregate ratios in panel 2b,2c, and 2d are constructed by dividing the aggregate values of the numerator by the aggregate values of the denominator for each year.

Figure 3: Liquidity Creation and Wholesale Funding (Call Reports)



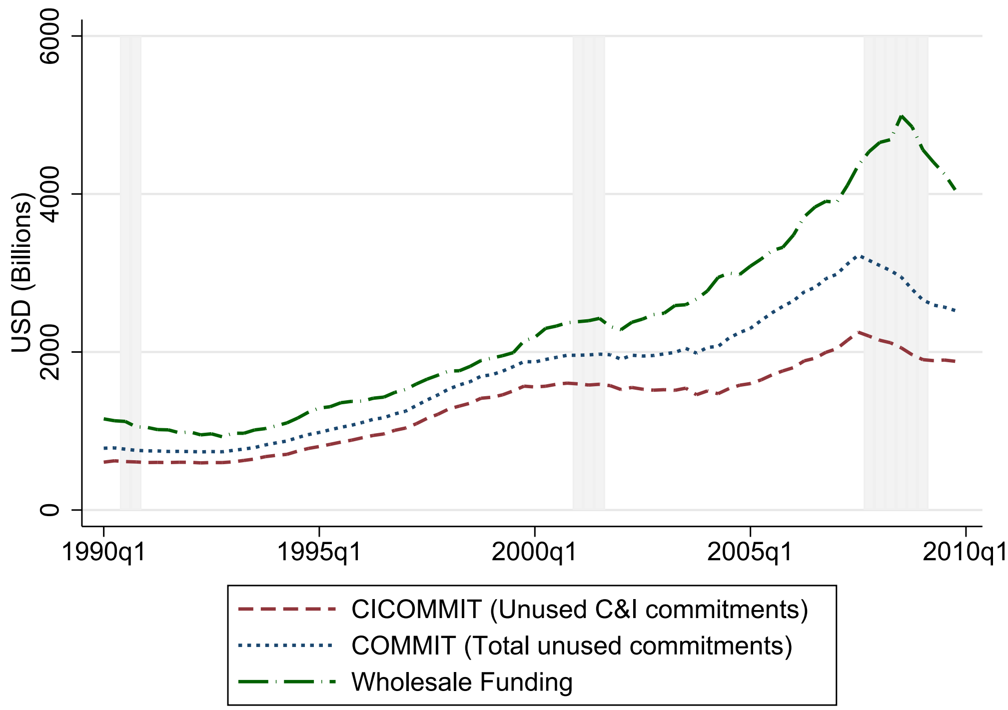
(a) Levels (USD Billions)



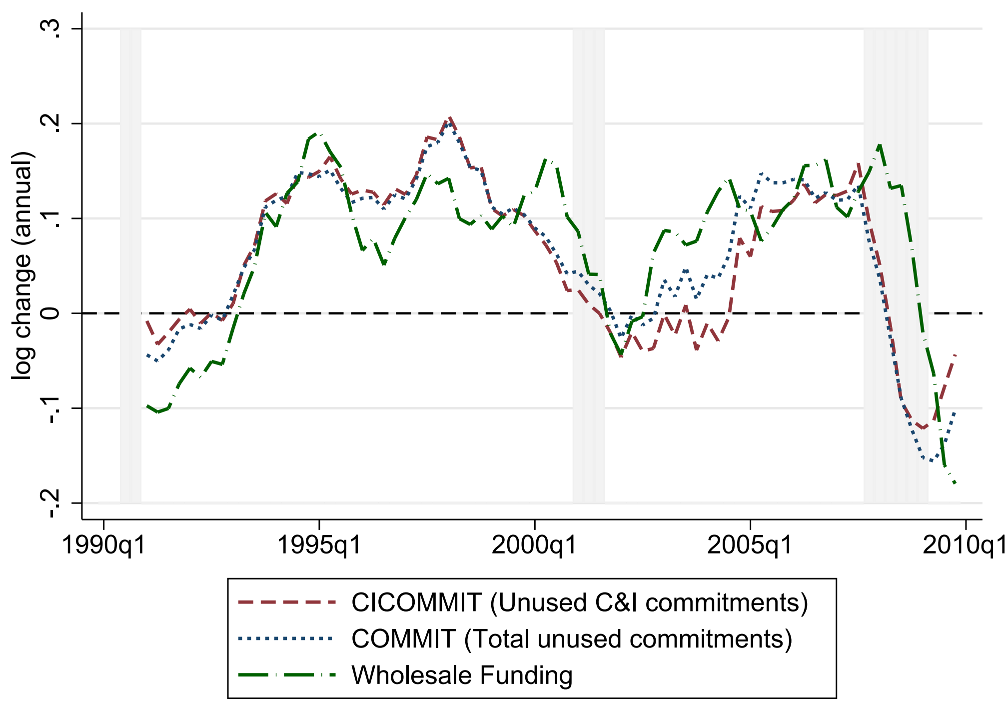
(b) Annual log change

This figure plots the time-series of aggregate liquidity creation from Berger and Bouwman (2009) along with wholesale funding from call reports. Figure 3a plots the time series in levels (USD billions) while Figure 3b plots the annual log changes in the respective aggregate series.

Figure 4: Unused Commitments and Wholesale Funding (Call Reports)



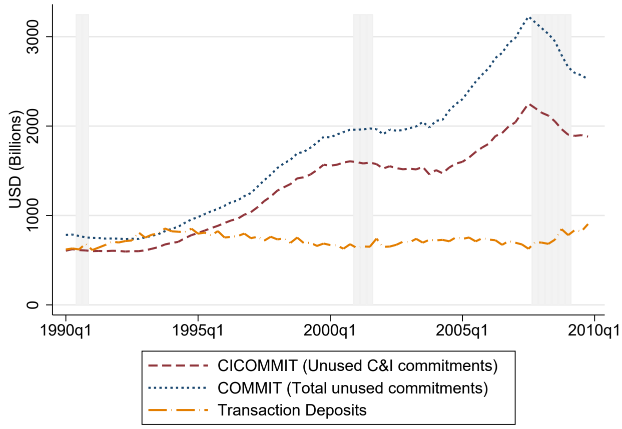
(a) Levels (USD Billions)



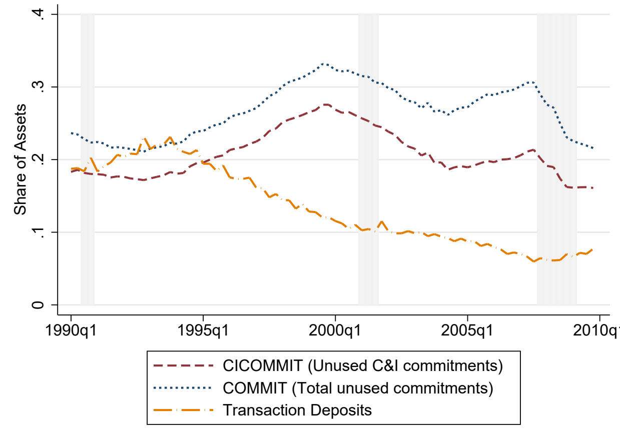
(b) Annual log change

This figure plots the time-series of aggregate unused commitment (COMMIT) along with aggregate wholesale funding for BHC data from FR Y-9C reports. Figure 4a plots the time series in levels (USD billions) while Figure 4b plots the annual log changes in the respective aggregate series.

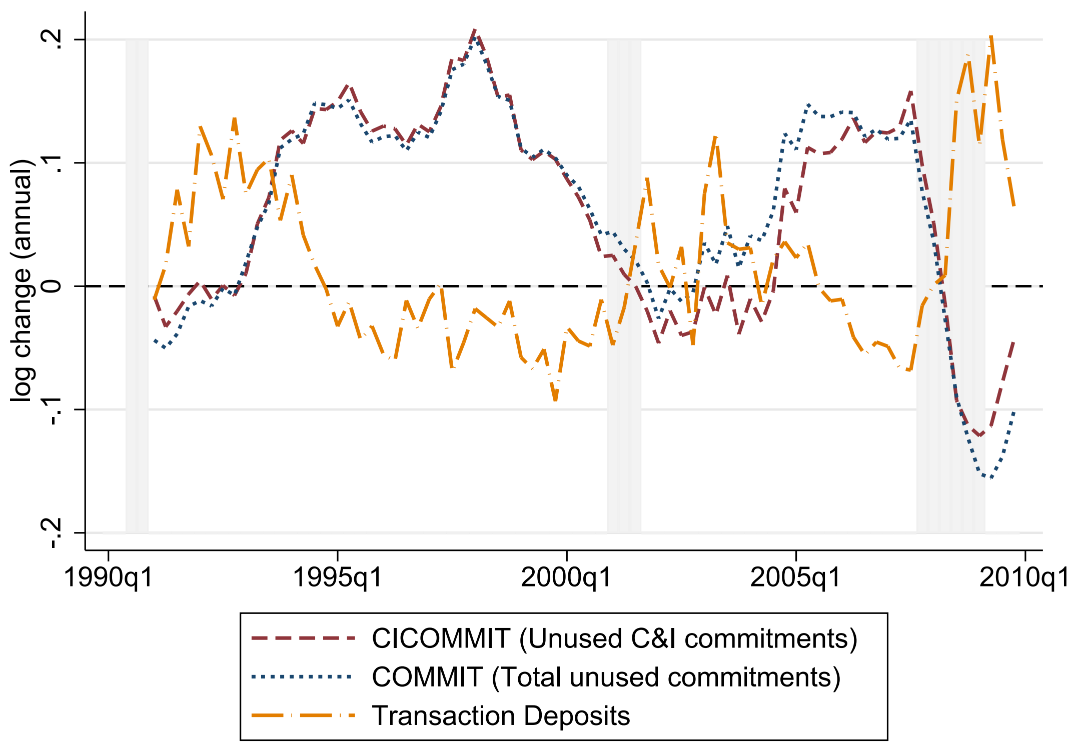
Figure 5: Unused Commitments and Transaction Deposits (Call Reports)



(a) Levels (USD Billions)



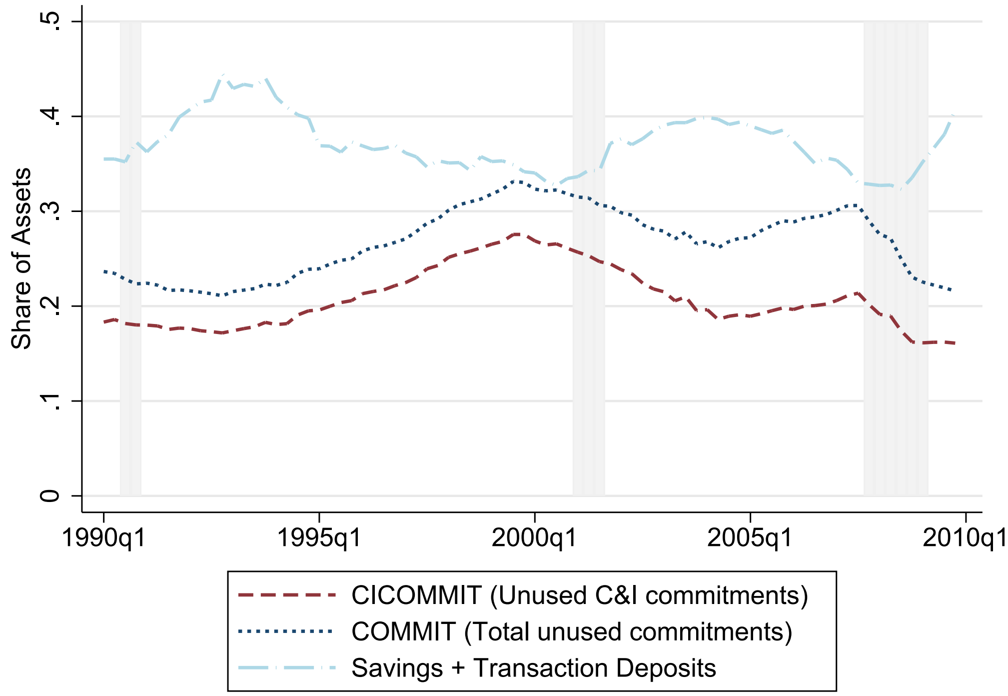
(b) Share of assets



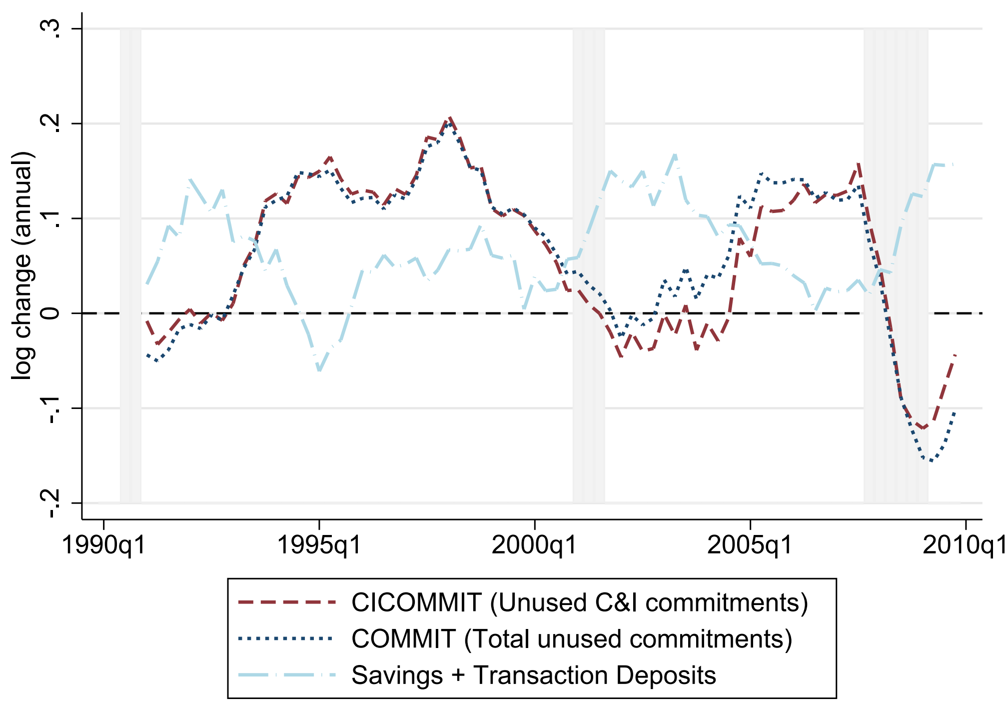
(c) Annual log change

This figure plots the time-series of aggregate unused commitment (COMMIT) along with aggregate transaction deposits for commercial banks from Call Reports. Figure 5a plots the time series in levels (USD billions), 5b plots the share of assets, and Figure 5c plots the annual log changes in the respective aggregate series.

Figure 6: Unused Commitments and Demandable Deposits (Call Reports)



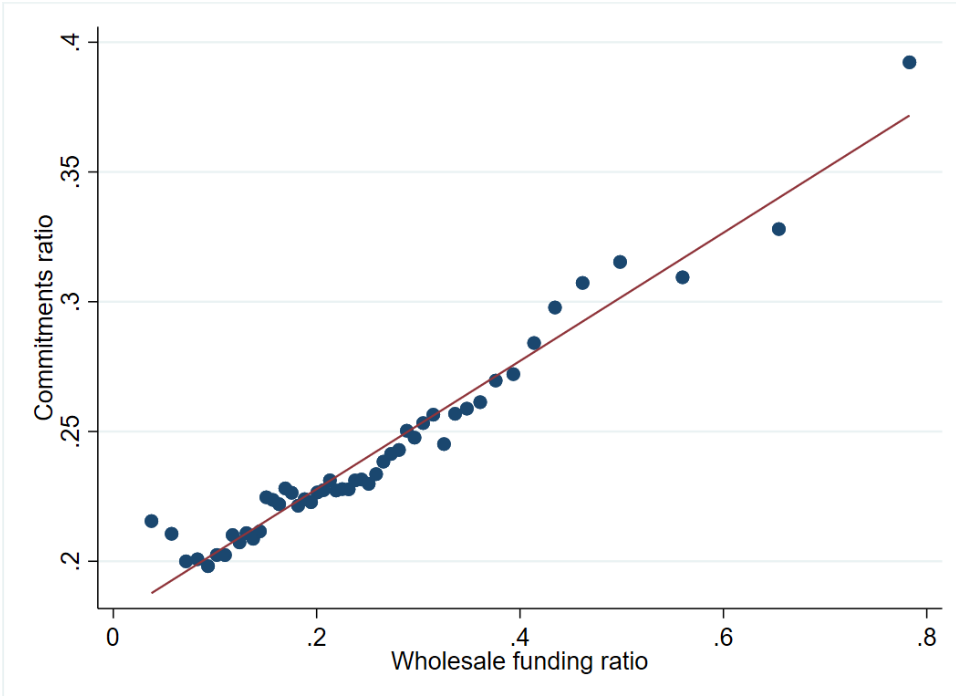
(a) Share of assets



(b) Annual log change

This figure plots the time-series of aggregate unused commitment (COMMIT) along with aggregate demandable deposits for commercial banks from Call Reports. Demandable deposits, for commercial banks, is defined as the sum of (1) transaction deposits and (2) savings deposits. Figure 6a plots the the share of assets while Figure 6b plots the annual log changes in the respective aggregate series.

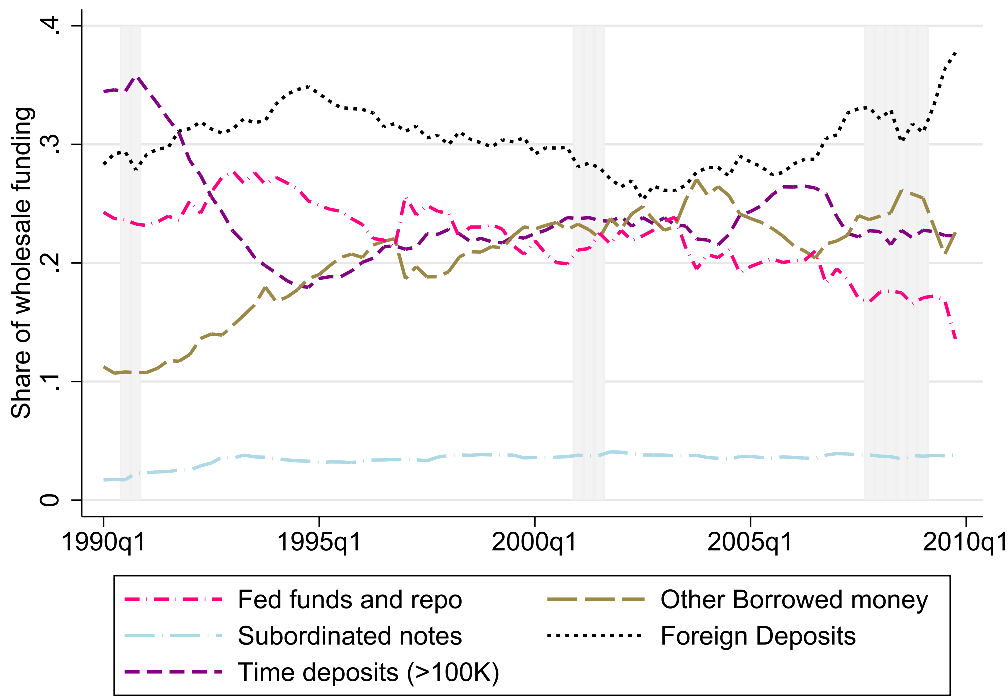
Figure 7: Binscatter plot: Unused Commitments ratio against wholesale funding ratios (large banks)



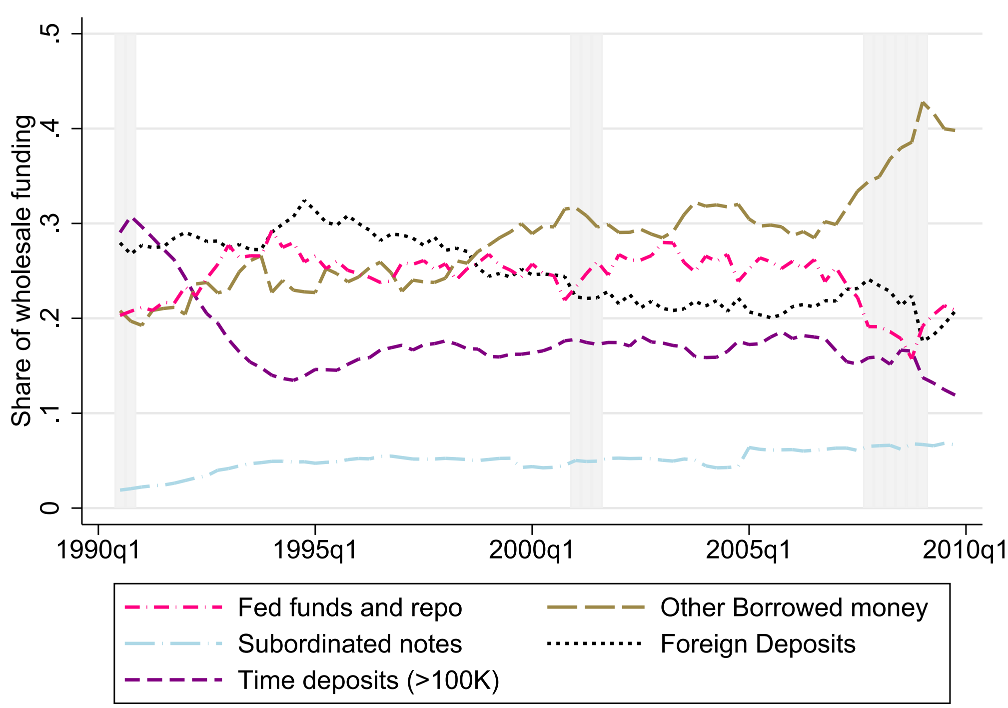
(a) Dep variable: Unused Commitments

This is a binscatter plot of unused commitments ratios against wholesale funding ratios for large banks for the time period of 1990-2008.

Figure 8: Components of Wholesale Funding (FR Y-9C and Call Reports)



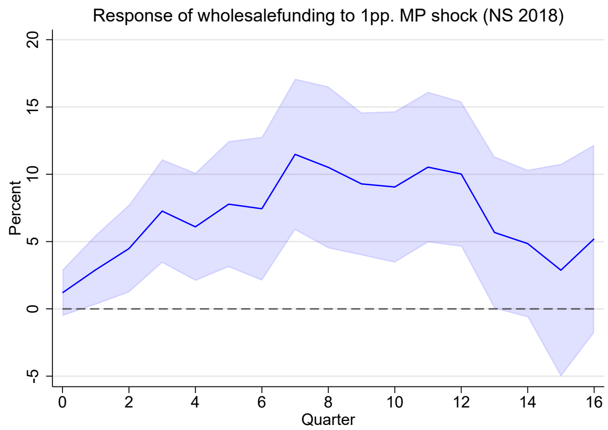
(a) Share of wholesale funding (Commercial Banks)



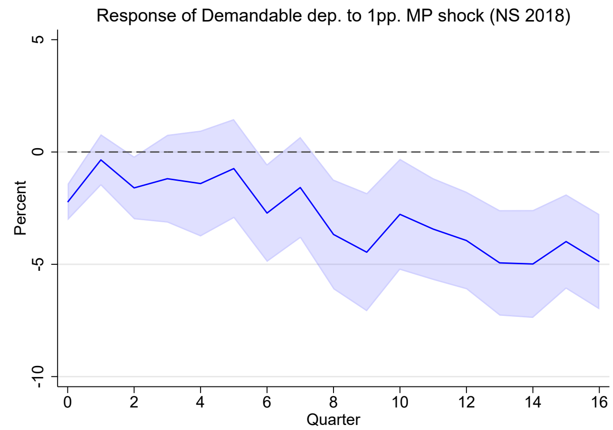
(b) Share of wholesale funding (BHCs)

This figure plots the time-series of various components of wholesale funding as a share of aggregate wholesale funding for commercial banks (8a) and BHCs (8b).

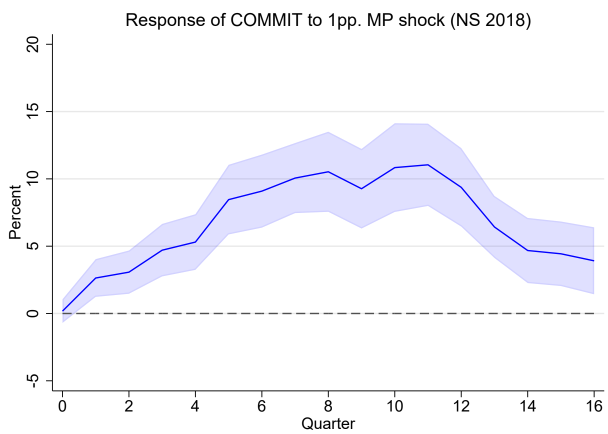
Figure 9: Monetary Policy shocks and Impulse Response Functions



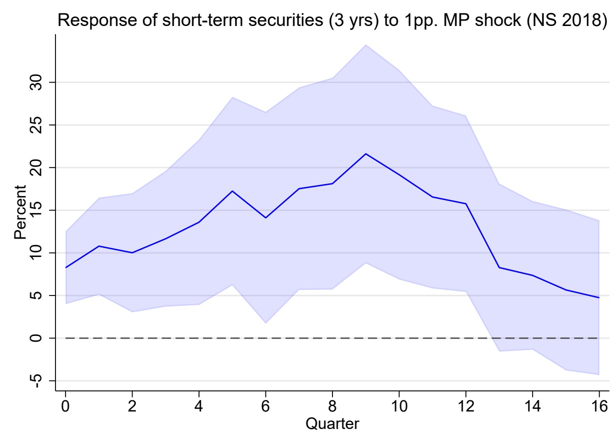
(a) Wholesale Funding



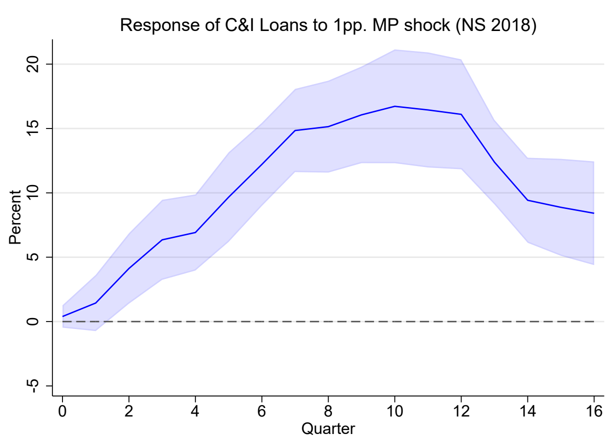
(b) Demandable Deposits



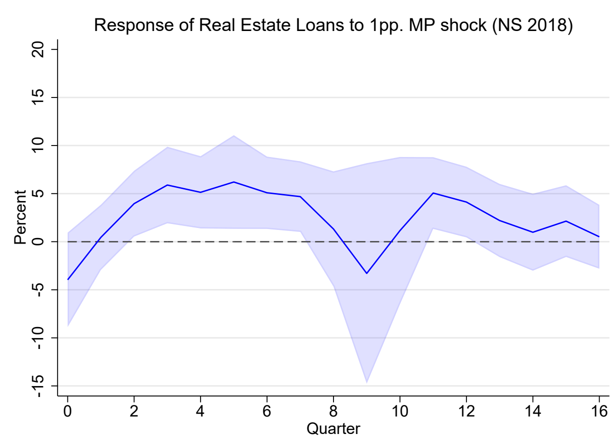
(c) Unused Commitments



(d) Short-term securities



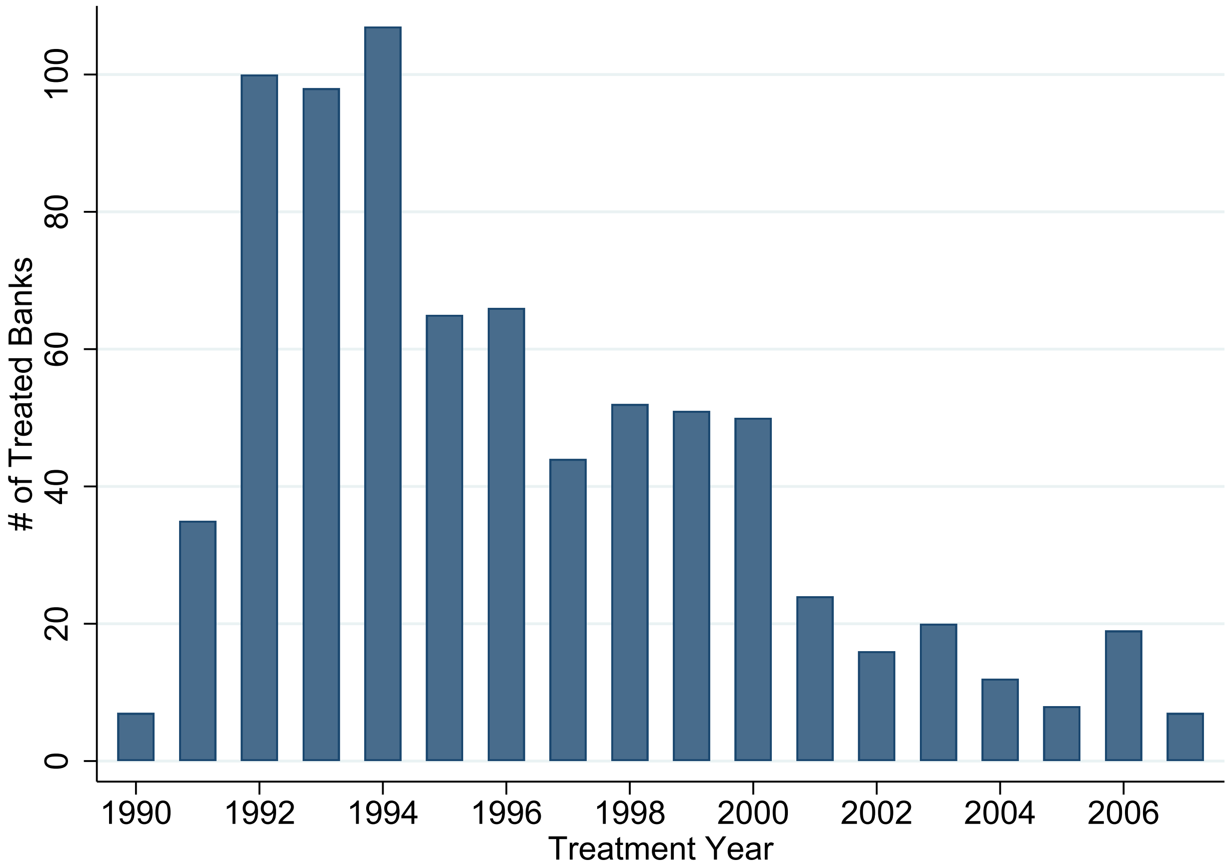
(e) C&I Loans



(f) Real Estate Loans

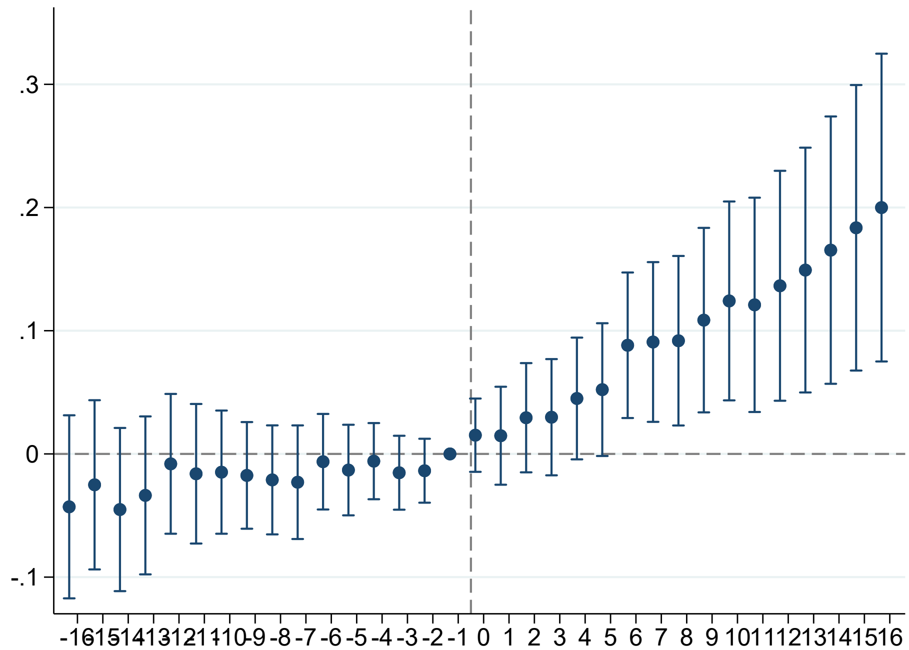
Exogenous Monetary policy shocks (Nakamura and Steinsson (2018)) and bank balance sheet items: This figure plots the impulse response functions of bank balance sheet variables to an exogenous 1 p.p. monetary policy shock in Nakamura and Steinsson (2018). For more details on the data and the specification, refer section 5.5

Figure 10: Treatment (FHLB Membership) dates for staggered DiD

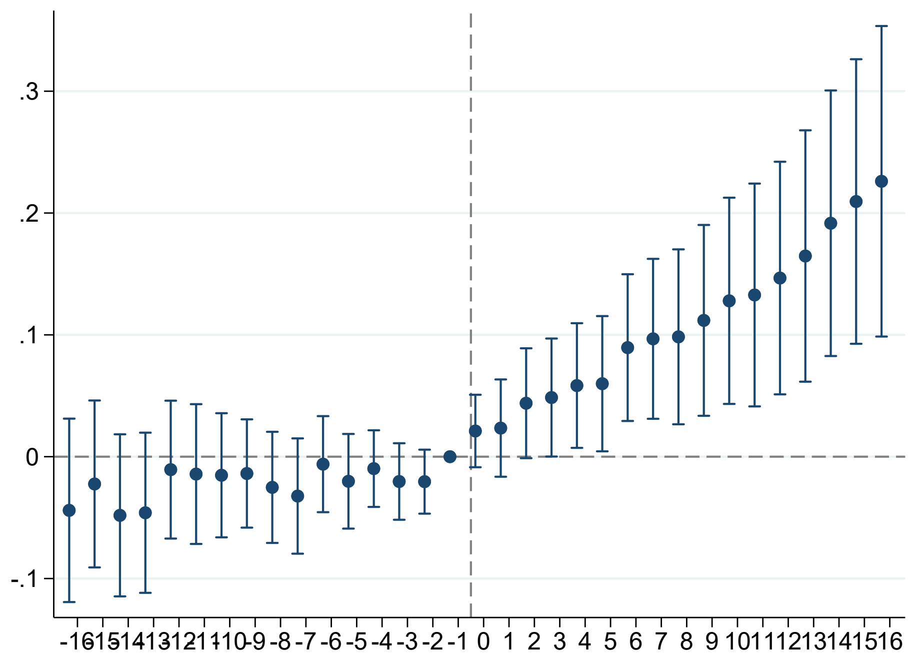


This figure plots the treatment dates (FHLB membership dates) by year of the final sample of 781 banks in the staggered DiD tests. For sample construction, refer to section 6.1

Figure 11: Impact of FHLB membership on Unused Commitments (second-stage)



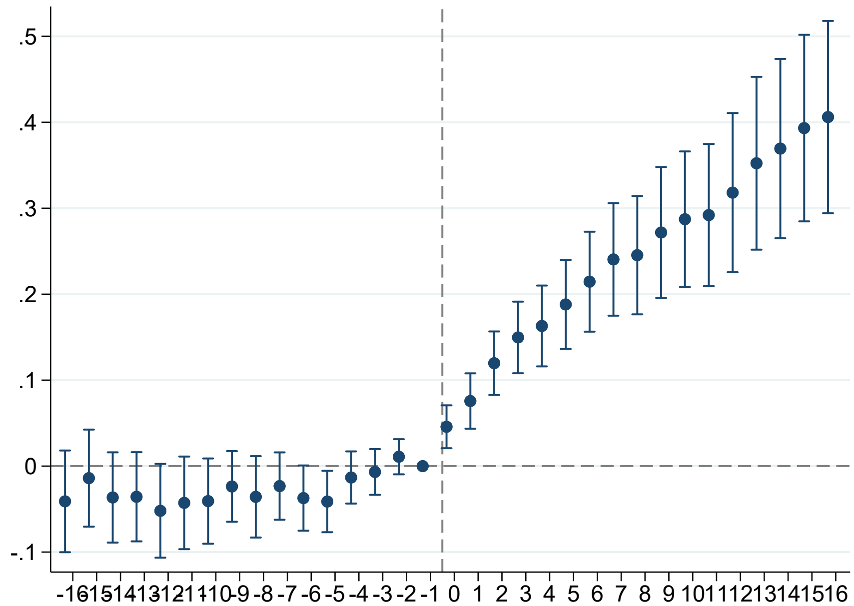
(a) Unused Commitments: Log real assets as control (Baseline specification)



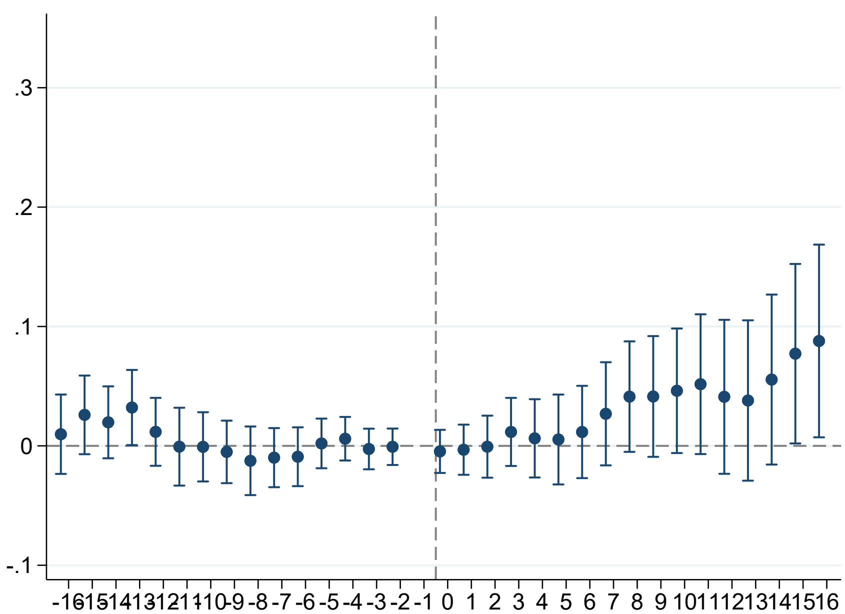
(b) Unused Commitments: No controls

DiD estimates for the impact of (staggered) FHLB membership on Unused Commitments (second-stage results for FHLB membership based identification strategy): This figure plots the event-study coefficients estimated using the Callaway and Sant'Anna (2021) estimator. The outcome variable is the log of Unused Commitments. Treatment timing is constructed using the dates of FHLB membership (Section 6.1). The sample consists of the subset of banks that became members of the FHLB system during 1990-2008 (not-yet-treated). Panel 11a reports the baseline results using real assets as a control with the doubly-robust method. Panel 11b reports the results with no controls. Standard errors are clustered at the bank level. The bars represent 95 percent confidence intervals. All treatment effects are relative to base period of the quarter before treatment ($t = -1$) and all relative time periods are in quarters.

Figure 12: Impact of FHLB membership on Wholesale Funding (first-stage) and Transaction Deposits



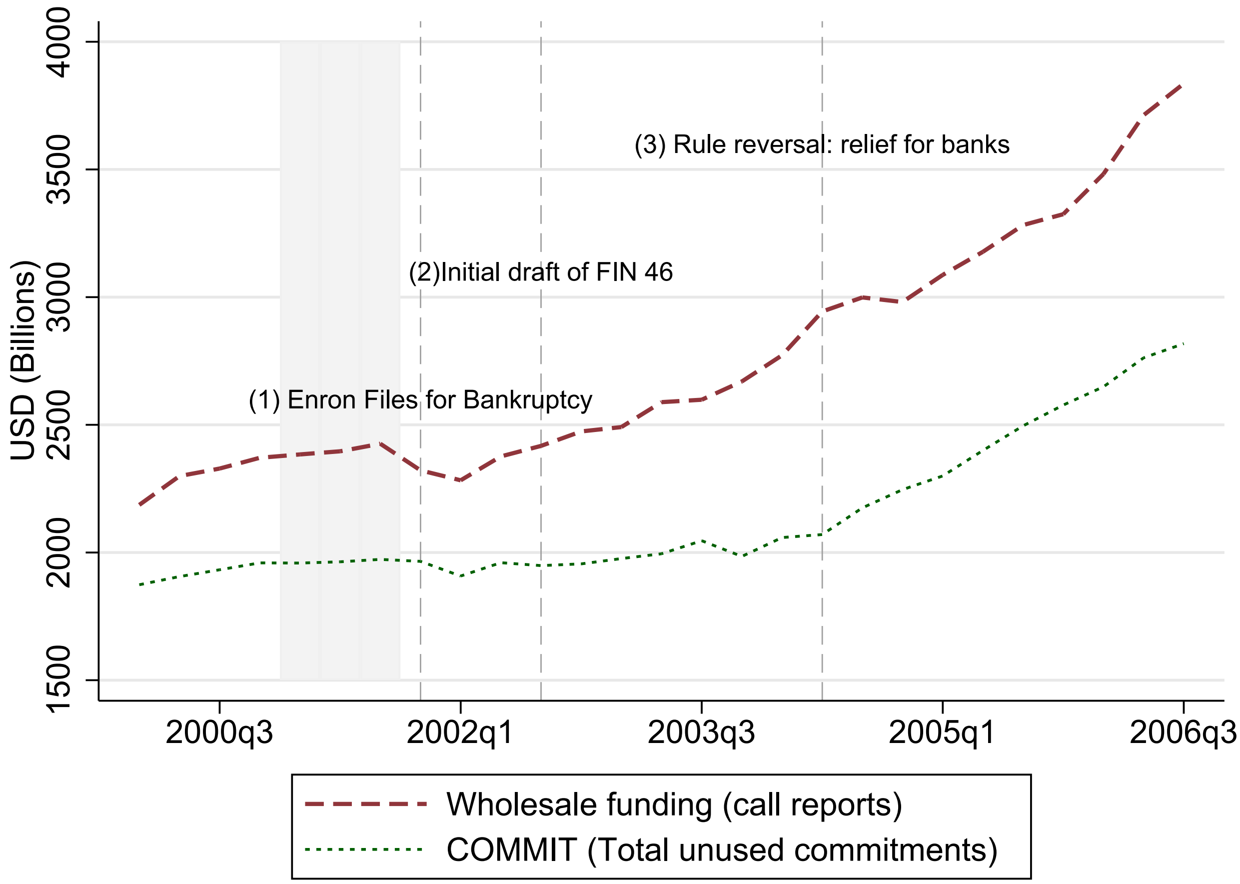
(a) Wholesale funding: Log real assets as control (Baseline specification)



(b) Transaction Deposits: Log real assets as control (Baseline specification)

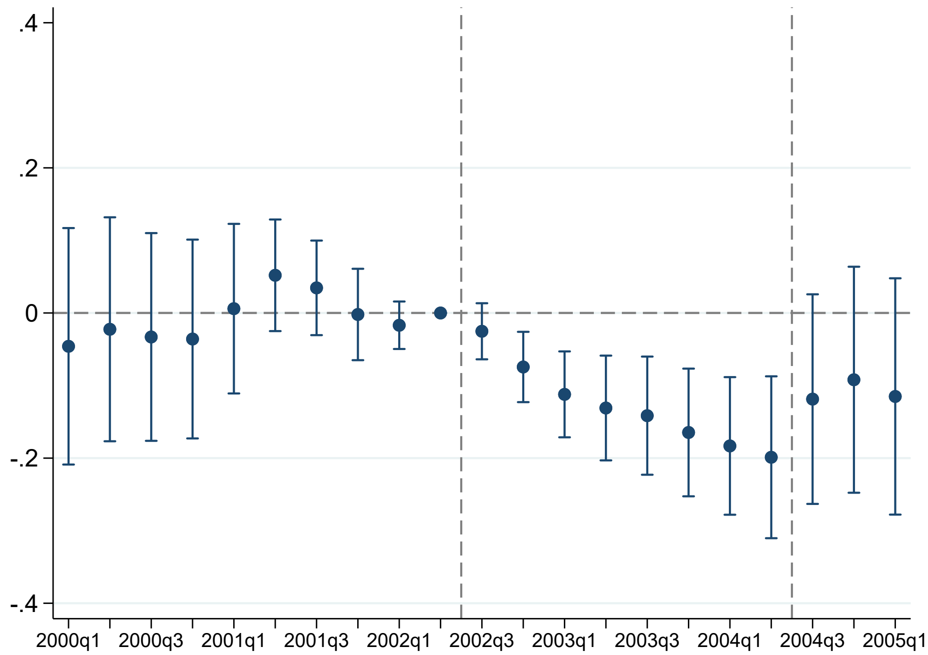
DiD estimates for the impact of (staggered) FHLB membership on wholesale funding (first-stage results for FHLB membership based identification strategy) and Transaction deposits: This figure plots the event-study coefficients estimated using the Callaway and Sant'Anna (2021) estimator. The outcome variable is the log of wholesale funding in Panel 12a, and transaction deposits in Panel 12b. Treatment timing is constructed using the dates of FHLB membership (Section 6.1). The sample consists of the subset of banks that became members of the FHLB system during 1990-2008 (not-yet-treated). Both panels report the baseline results using real assets as a control with the doubly-robust method. Standard errors are clustered at the bank level. The bars represent 95 percent confidence intervals. All treatment effects are relative to base period of the quarter before treatment ($t = -1$) and all relative time periods are in quarters.

Figure 13: Timeline For the Introduction of FIN 46

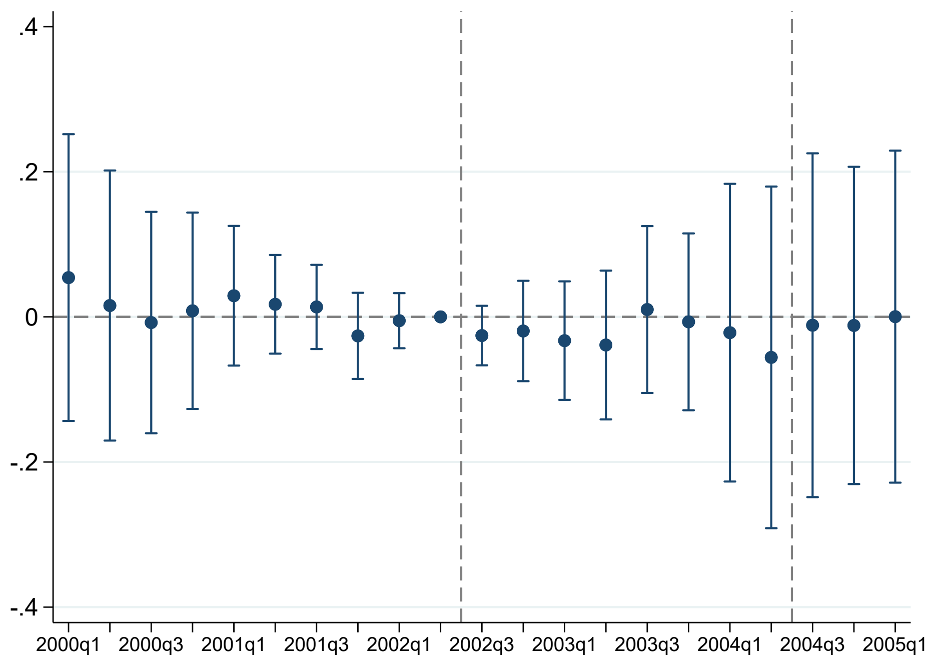


This figure plots the key dates surrounding the evolution of the FIN 46 regulation. The green and red dashed lines represent the aggregate dollar amount of wholesale funding and unused commitments at banks.

Figure 14: Impact of Introduction of FIN 46 on Unused Commitments and Wholesale Funding



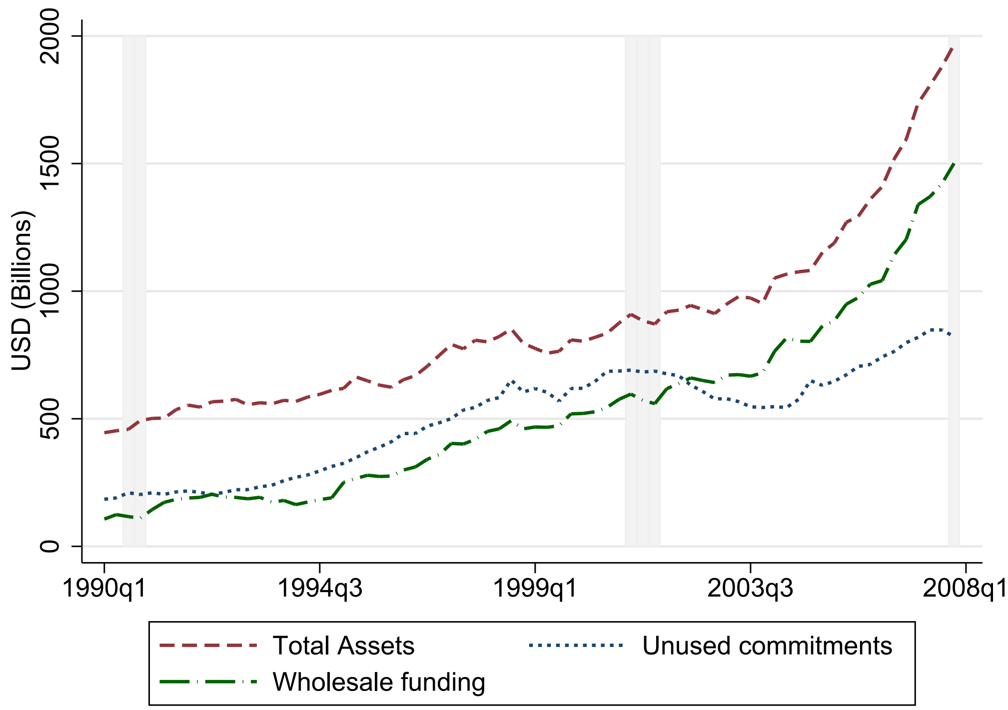
(a) Dependant variable: Log of Unused Commitments



(b) Dependant variable: Log of Wholesale Funding

DiD estimates for the impact of introduction of FIN 46 on unused commitments and wholesale funding: This figure plots the event-study coefficients estimated using the event-study DiD design specified in equation 11. The outcome variable is the log of unused commitments in Panel 14a, and wholesale funding in Panel 14b. Treatment timing is Q3 2002 – the quarter in which FIN 46 rules were first proposed (Section 6.3). The sample consists of large and medium-size bank holding companies as sorted on unused commitments. Banks are classified as "treated" if they reported non-zero ABCP liquidity commitments for any quarter between Q2 2001- Q3 2003. Standard errors are clustered at the bank level. The bars represent 95 percent confidence intervals. All treatment effects are relative to base period of the quarter before treatment ($t = -1$) and all time periods are in quarters.

Figure 15: Aggregate Measures for US Branches of Foreign Banks (1990-2008)



This figure plots the time-series of assets, unused commitments, and wholesale funding for US Branches of Foreign Banks (see section 8 for more details). Wholesale funding for US Branches of Foreign Banks is defined as the sum of large time deposits, federal funds purchased and repos sold, and other borrowed money.

Online Appendix for:

"What Drives Bank Credit Lines? Wholesale Funding and Bank Liquidity Creation"

Appendix A Data

Table A.1: Variable Definitions: FR Y-9C Reports

Variable	Definition
RSSDID	Bank's Primary Identifier (RSSD9001)
Foreign Type	Type of foreign ownership (RSSD9325)
Assets	Total Assets (BHCK2170)
Total Loans	Loans and leases held for investment and sale (BHCK2122) + Unearned income on loans (BHCK2123)
Cash	Cash and Balances due from depository institution (BHCK0010) OR
	Noninterest-bearing balances and currency and coin (BHCK0081) + Interest-bearing balances in US (BHCK0395) +
	Interest-bearing balances in foreign offices (BHCK0397)
Securities	(BHCK0390) OR
	Held-to-maturity securities (BHCK1754) + Available-for-sale debt securities (BHCK1773)
Federal funds sold and securities purchased	BHCK1350 OR
under agreements to resell	Federal Funds sold (BHDMB987) + securities purchased under agreements to resell (BHCKB989) OR
	Federal Funds sold (BHCK0276) + securities purchased under agreements to resell (BHCK0277)
Trading Assets	(BHCK2146) OR (BHCK3545)
Premises	Premises and Fixed Assets (BHCK2145)
Other Real Estate	Other real estate owned (BHCK2150)
Intangible Assets	(BHCK2143) OR
	Goodwill (BHCK3163) + Other Intangible assets (BHCK0426) OR
	Goodwill (BHCK3163) + Mortgage Servicing Assets (BHCK3164) + Credit card relationships and nonmortage assets
	(BHCK5507) + All other identifiable intangible assets (BHCK5507)
Foreign Deposits	Non-interest bearing (BHFN6631) + Interest-bearing (BHFN6636)
Investment in subsidiaries	Investments in unconsolidated subsidiaries (BHCK2130)
Federal funds purchased and securities sold	(BHCK2800) OR
under agreements to repurchase	Federal Funds Purchased (BHDMB993) + Securities Sold under agreements to repurchase (BHCKB995) OR
	Federal Funds Purchased (BHCK0278) + under agreements to repurchase (BHCK0279)
Other Borrowed Money	Other borrowed money with remaining maturity < 1 yr (BHCK2332) + remaining maturity > 1 yr (BHCK2333) OR
	(BHCK3190)
Subordinated Notes	Subordinated notes and debentures (BHCK4062) + Subordinated notes payable to trusts (BHCKC699)
Time Deposits > 100,000	(BHCB2604) + (BHOD2604)
Trading Liabilities	(BHCK3548) OR (BHCT3548)
Other Liabilities	(BHCK2750)
Bank Equity	Total Equity Capital (BHCK3210)

Continuation of Table A.1

Variable	Definition
Minority Interest	Minority interest in consolidated subsidiaries (BHCK3000)
Home Equity Lines	Revolving open-end lines secured by 1-4 family properties (BHCK3814)
Credit Card Lines	Unused credit card lines (BHCK3815)
Construction commitment - Secured	Commercial real-estate, construction, and land dev.: Commitments to funds loans secured by real estate (BHCK3816)
Construction commitment - Unsecured	Commercial real-estate, construction, and land dev.: Commitments to funds loans not secured by RE (BHCK6550)
Securities Underwriting	BHCK3817
Other Unused Commitments	Other unused commitments (BHCK3818)[63]
Financial Standby Letters of Credit	(BHCK6566)
Performance Standby Letters of Credit	(BHCK6570)
Commercial Letters of Credit	Commercial and similar letters of credit (BHCK3411)
Total Unused Commitments	Home Equity Lines + Credit Card Lines + Construction Commitments (secured) + Construction Commitments (unsecured) + Securities Underwriting + Other Unused Commitments
All Other Off-balance sheet liabilities	(BHCK3430)
Demand Deposits	Total demand deposits in CB subsidiaries (BHCB2210) + non-interest bearing balances in depository subs. (BHOD3189)
Transaction Deposits	Now, ATS and other transaction accounts in CB subs. (BHCB3187) + other depository subs. (BHOD3187)
Savings Deposits	Money market deposit accounts and other savings accounts in CB subs (BHCB2389) + other depository subs (BHOD2389)
Time Deposits less than 100,000	Time Deposits < 100,000 in CB subs. (BHCB6648) + other depository subs. (BHOD6648)
Domestic Deposits	Non-interest bearing (BHDM6631) + Interest-bearing (BHDM6636)
Total Deposits	Domestic Deposits + Foreign Deposits
CRE Loans	Construction and other land loans secured by real estate (BHDM1415) + Secured by farmland (BHDM1420) + Secured by multi-family residential properties (BHDM1460) + Secured by non-farm non-residential properties (BHDM1480) + not secured by real estate (BHCK2746)
Other Loans	BHC1635 OR BHCK1545 + BHCK1564 OR BHCK1545 + BHCKJ454 + BHCKJ451
Lease Financing Receivables	Lease Financing Receivables of U.S. addresses (BHCK2182) + non-U.S. addresses (BHCK2183)
Other Real Estate Owned	(BHCK2150)
Agricultural Loans	Loans to finance agricultural production (BHCK1590)
C&I Loans	Commercial and Industrial loans (BHCK1766) OR C&I Loans to U.S. addresses (BHCK1763) + C&I Loans to non-US addresses (BHCK1764)
Other Assets	(BHCK2160)
Berger and Bouwman (2009) Liquidity Creation Variables	
Illiquid assets	CRE Loans + Agricultural Loans + C&I Loans + Other Loans + Lease Financing Receivables + Investments in subsidiaries + Other Real Estate Owned + Intangible Assets + Premises + Other Assets
Liquid Assets	Cash + Securities + Trading assets + Federal funds sold and securities purchased

[63] Proxy for C&I Commitments

Continuation of Table A.1	
Variable	Definition
Liquid Liabilities	Transaction Deposits + Demand Deposits + Savings Deposits + Federal funds purchased and securities sold + Trading Liabilities
Illiquid Liabilities plus Equity	Subordinated Debt + Other Liabiligies + Bank Equity
Liquid Commitments	Total Unused Commitments + Financial Standby Letters of credit + Performance Standby Letters of credit + Commercial and similar letters of credit + All other off-balance sheets liabilities
Off-balance sheet liquidity creation (lc_obs)	0.5 * Liquid Commitments
Asset-side liquidity creation (lc_a)	0.5 * illiquid assets + (-0.5) * liquid assets
Liability-side liquidity creation (lc_l)	0.5 * liquid liabilities + (-0.5) * illiquid liabilities
catfat	0.5 * illiquid assets + (-0.5) * liquid assets + 0.5 * liquid liabilities + (-0.5) * illiquid liabilities + 0.5 * Liquid Commitments
Regression Variables	
Wholesale Funding	Foreign Deposits + Other Borrowed Money + Subordinated Notes + Time Deposits > 100,000 + Federal funds purchased and securities sold (Following Acharya and Mora (2015))
Demandable deposits	Demand deposits + Transaction deposits + Savings deposits
Total Funding	Wholesale funding + Demandable deposits + Time deposits < 100,000
Commitments (commit)	Home Equity Lines + Securities Underwriting + Commercial and similar letters of credit + Construction Commitments (secured) + Construction Commitments (unsecured) + Other Unused Commitments (following Kashyap, Rajan and Stein (2002))
C&I Commitments (cicommit)	Other Unused Commitments (following Kashyap, Rajan and Stein (2002))
Off-balance sheet (OBS) liquidity creation ratio (LC_OBS)	LC_OBS = (lc_obs)/(lc_obs + Total loans)
Commitment Ratio (COMMIT)	COMMIT = commit/(commit + Total Loans)
C&I Commitment ratio (CICOMMIT)	CICOMMIT = cicommit/(cicommit + C&I Loans) (following Kashyap, Rajan and Stein (2002))
Wholesale funding ratio	Wholesalefunding / Total funding
Capital Ratio	Bank Equity / Assets
Transaction Deposits Ratio (DEPRAT)	DEPRAT = (Demand Deposits + Transaction Deposits)/(Total Deposits) following Kashyap, Rajan and Stein (2002)
Subordinated Notes Ratio	Subordinated Notes/Wholesale funding
Other Borrowed Money Ratio	Other Borrowed Money /Wholesale funding

Continuation of Table A.1	
Variable	Definition
Large Time Deposits Ratio	Time Deposits > 100,000 / Wholesale funding
Federal funds and Repo Ratio	Federal Funds Sold and Repo purchased / Wholesale funding
Foreign Deposits Ratio	Foreign Deposits / Wholesale funding

Table A.2: Variable Definitions: Call Reports

Variable	Definition
RSSDID	Bank's Primary Identifier (RSSD9001)
Charter Type	(RSSD9048)
Highest Regulatory Holding Company	Highest holding company to which a bank belongs (RSSD9348)
Assets	Total Assets (RCFD2170)
Total Loans	(RCFD1400) OR
	Loans and leases held for investment and sale (RCFD2122) + Unearned income on loans (RCFD2123)
Cash	Cash and Balances due from depository institution (RCFD0010) OR
	Noninterest-bearing balances and currency and coin (RCFD0081) + Interest-bearing balances in US (RCFD00) +
Securities	(RCFD0390) OR
	Held-to-maturity securities (RCFD1754) + Available-for-sale debt securities (RCFD1773)
Federal funds sold and securities purchased	RCFD1350 OR
under agreements to resell	Federal Funds sold (RCFDB987) + securities purchased under agreements to resell (RCFDB989)
Trading Assets	(RCFD2146) OR (RCFD3545)
Premises	Premises and Fixed Assets (RCFD2145)
Intangible Assets	(RCFD2143) OR
	Goodwill (RCFD3163) + Other Intangible assets (RCFD0426)
Foreign Deposits	(RCFN2200)
Investment in subsidiaries	Investments in unconsolidated subsidiaries (RCFD2130)
Federal funds purchased and securities sold	(RCFD2800) OR
under agreements to repurchase	Federal Funds Purchased (RCFDB993) + Securities Sold under agreements to repurchase (RCFDB995)
Other Borrowed Money	(RCFD2850) OR (RCFD3190)
Subordinated Notes	Subordinated notes and debentures (RCFD3200)
Time Deposits > 100,000	(RCON2604)
Trading Liabilities	(RCFD3548)
Other Liabilities	(RCFD2930)
Bank Equity	Total Equity Capital (RCFD3210)
Minority Interest	Minority interest in consolidated subsidiaries (RCFD3000)
Home Equity Lines	Revolving open-end lines secured by 1-4 family properties (RCFD3814)
Credit Card Lines	Unused credit card lines (RCFD3815)
Construction commitment - Secured	Commercial real-estate, construction, and land dev.: Commitments to funds loans secured by real estate (RCFD3816)
Construction commitment - Unsecured	Commercial real-estate, construction, and land dev.: Commitments to funds loans not secured by RE (RCFD6550)
Securities Underwriting	(RCFD3817)

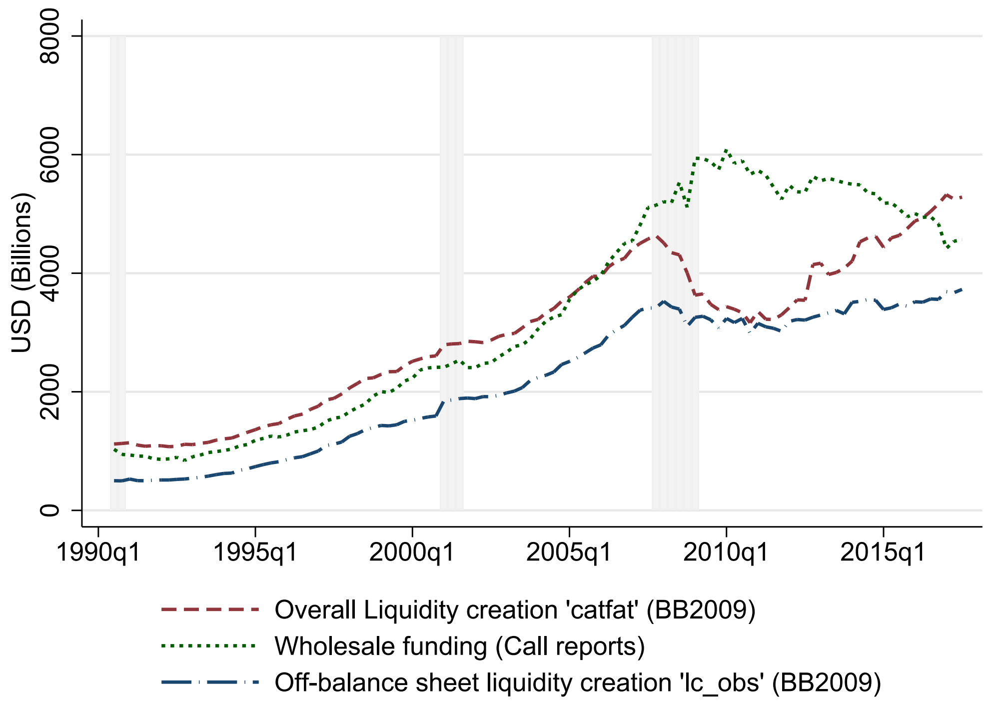
Continuation of Table A.2

Variable	Definition
Other Unused Commitments	Other unused commitments (RCFD3818)[64]
Financial Standby Letters of Credit	(RCFD3819)
Performance Standby Letters of Credit	(RCFD3821)
Commercial Letters of Credit	Commercial and similar letters of credit (RCFD3411)
Total Unused Commitments	Home Equity Lines + Credit Card Lines + Construction Commitments (secured) +
	Construction Commitments (unsecured) + Securities Underwriting + Other Unused Commitments
All Other Off-balance sheet liabilities	(RCFD3430)
Demand Deposits	(RCON2210)
Transaction Deposits	(RCON2215)
Savings Deposits	(RCON2389) OR
	Money Market Deposit accounts (MMDA) (RCON6810) + Other non-transaction savings deposits exluding MMDAs (RCON0352)
Time Deposits less than 100,000	Time Deposits < 100,000 (RCON6648)
Domestic Deposits	(RCON2200) OR
	Non-interest bearing (RCON6631) + Interest-bearing (RCON6636)
Total Deposits	Domestic Deposits + Foreign Deposits
CRE Loans	Construction and other land loans secured by real estate (RCFD1415) + Secured by farmland (RCFD1420) +
	Secured by multi-family residential properties (RCFD1460) + Secured by non-farm non-residential properties (RCFD1480) + not secured by real estate (RCFD2746)
Other Loans	(RCFD1563)
Lease Financing Receivables	Lease Financing Receivables of U.S. addresses (RCFD2182) + non-U.S. addresses (RCFD2183)
Other Real Estate Owned	(RCFD2150)
Agricultural Loans	Loans to finance agricultural production (RCFD1590)
C&I Loans	Commercial and Industrial loans (RCFD1766) OR
	C&I Loans to U.S. addresses (RCFD1763) + C&I Loans to non-US addresses (RCFD1764)
Other Assets	(RCFD2160)
Liquid Securities	Federal funds purchased and securities sold + Residential Mortage backed Securities with remaining maturity less than 3 years (RCFDA555 + RCFDA556 + RCFDA557) + Securities issued by U.S. Treasury with remaining maturity less than 3 years (RCFDA555 + RCFDA556 + RCFDA557) + Other Mortgage backed securities with remaining maturity less than 3 years (RCFDA561)
Net Interest Margin (NIM)	Interest Income (RIAD4107) - Interest expenses (RIAD4073)
Other non-interest income	Other non-interst income (RIADB497)
Net income	Net income (RIAD4340)

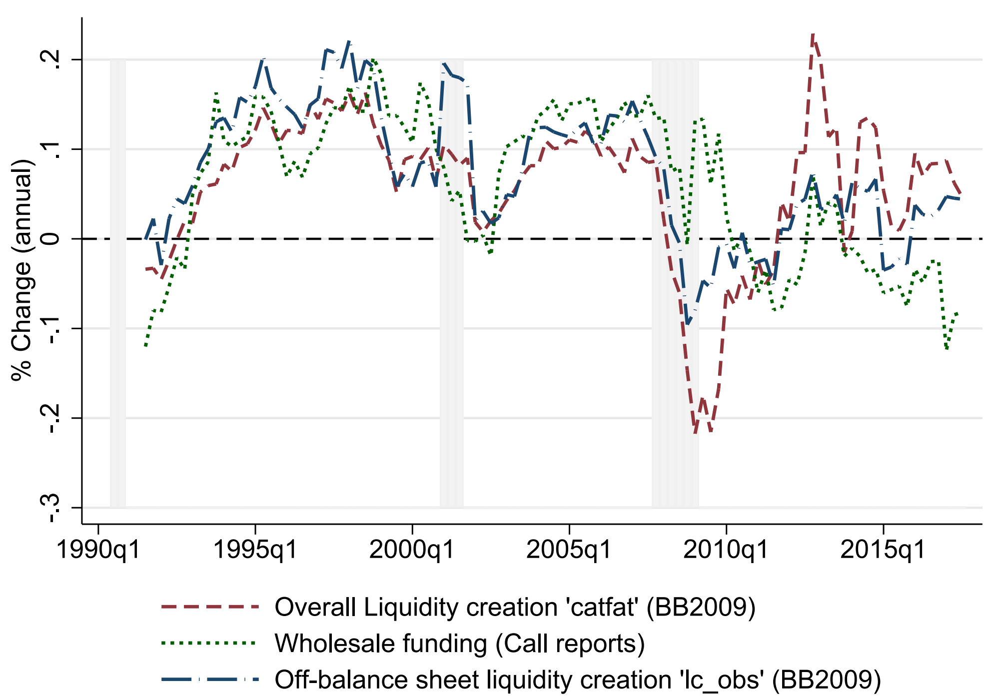
[64] Proxy for C&I Commitments

Continuation of Table A.2	
Variable	Definition
Average Total Assets	Quarterly average of total assets (RCFD3368)
Regression Variables	
Wholesale Funding	Foreign Deposits + Other Borrowed Money + Subordinated Notes + Time Deposits > 100,000 + Federal funds purchased and securities sold (Following Acharya and Mora (2015))
Demandable deposits	Transaction deposits + Savings deposits
Total Funding	Wholesale funding + Demandable deposits + Time deposits < 100,000
Commitments (commit)	Home Equity Lines + Securities Underwriting + Commercial and similar letters of credit + Construction Commitments (secured) + Construction Commitments (unsecured) + Other Unused Commitments (following Kashyap, Rajan and Stein (2002))
C&I Commitments (cicommit)	Other Unused Commitments (following Kashyap, Rajan and Stein (2002))
Off-balance sheet (OBS) liquidity creation ratio (LC_OBS)	LC_OBS = (lc_obs)/(lc_obs + Total loans)
Commitment Ratio (COMMIT)	COMMIT = commit/(commit + Total Loans)
C&I Commitment ratio (CICOMMIT)	CICOMMIT = cicommit/(cicommit + C&I Loans) (following Kashyap, Rajan and Stein (2002))
Wholesale funding ratio	Wholesalefunding / Total funding
Capital Ratio	Bank Equity / Assets
Transaction Deposits Ratio (DEPRAT)	DEPRAT = (Demand Deposits + Transaction Deposits)/(Total Deposits) following Kashyap, Rajan and Stein (2002)
Subordinated Notes Ratio	Subordinated Notes/Wholesale funding
Other Borrowed Money Ratio	Other Borrowed Money /Wholesale funding
Large Time Deposits Ratio	Time Deposits > 100,000/Wholesale funding
Federal funds and Repo Ratio	Federal Funds Sold and Repo purchased /Wholesale funding
Foreign Deposits Ratio	Foreign Deposits /Wholesale funding
Liquid Assets ratio	Liquid securities/(Liquid securities + Total Loans)
NIM ratio	NIM/(Average Total Assets)
Other non-interest income ratio	Other non-interest income/Average Total Assets
Net income ratio	Net income/Average Total Assets

Figure A.1: Liquidity Creation and Wholesale Funding (FR Y-9C Reports)



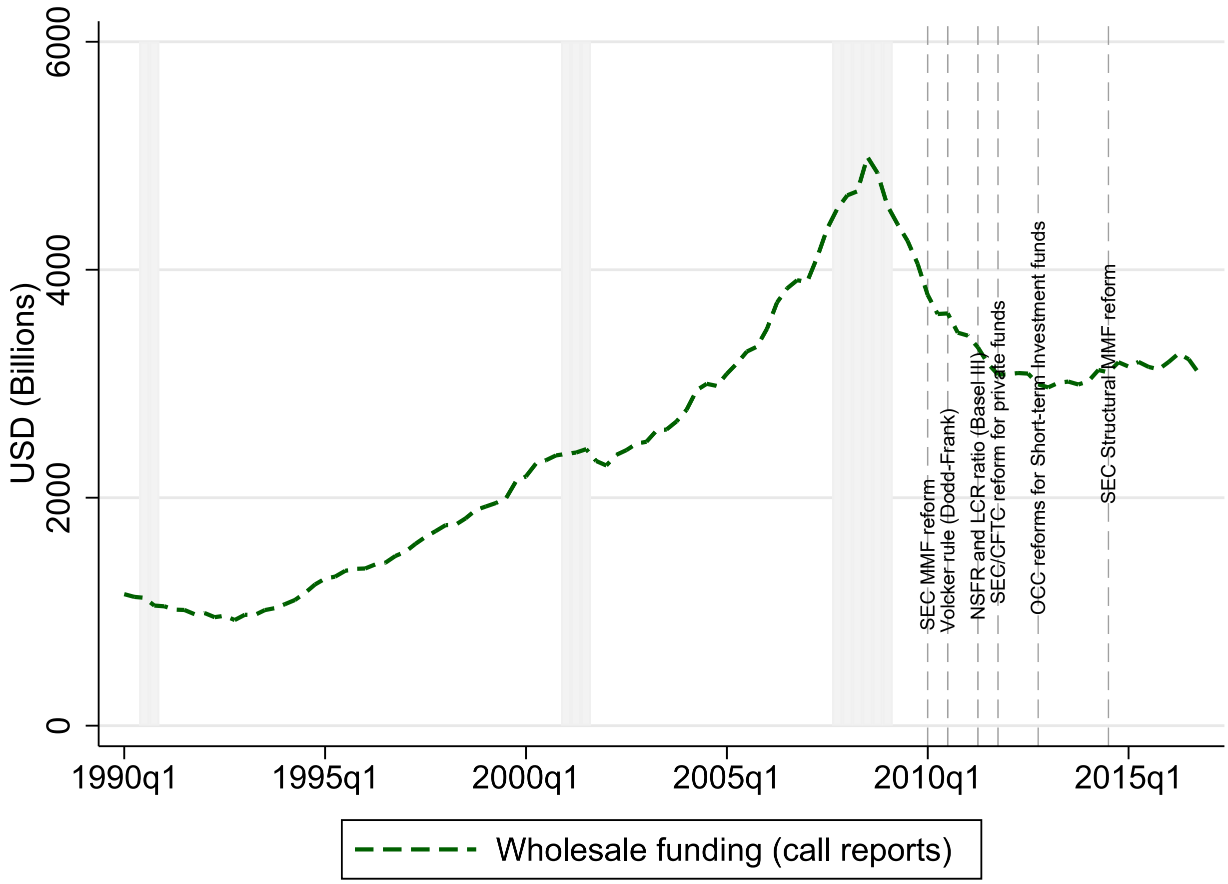
(a) Levels (USD Billions)



(b) Annual log change

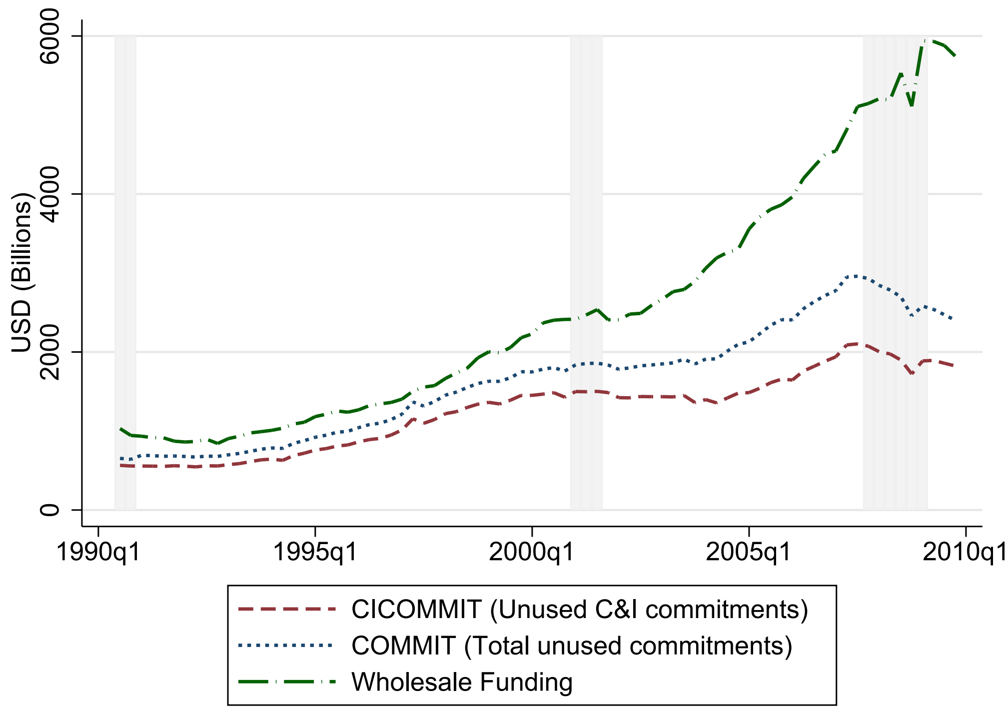
This figure plots the time-series of aggregate liquidity creation constructed for BHC data from FR Y-9C using the methodology outlined in Berger and Bouwman (2009) data along with wholesale funding. Figure A.1a plots the time series in levels (USD billions) while Figure A.1b plots the annual log changes in the respective aggregate series.

Figure A.2: Post-GFC regulations affecting banks' wholesale funding markets

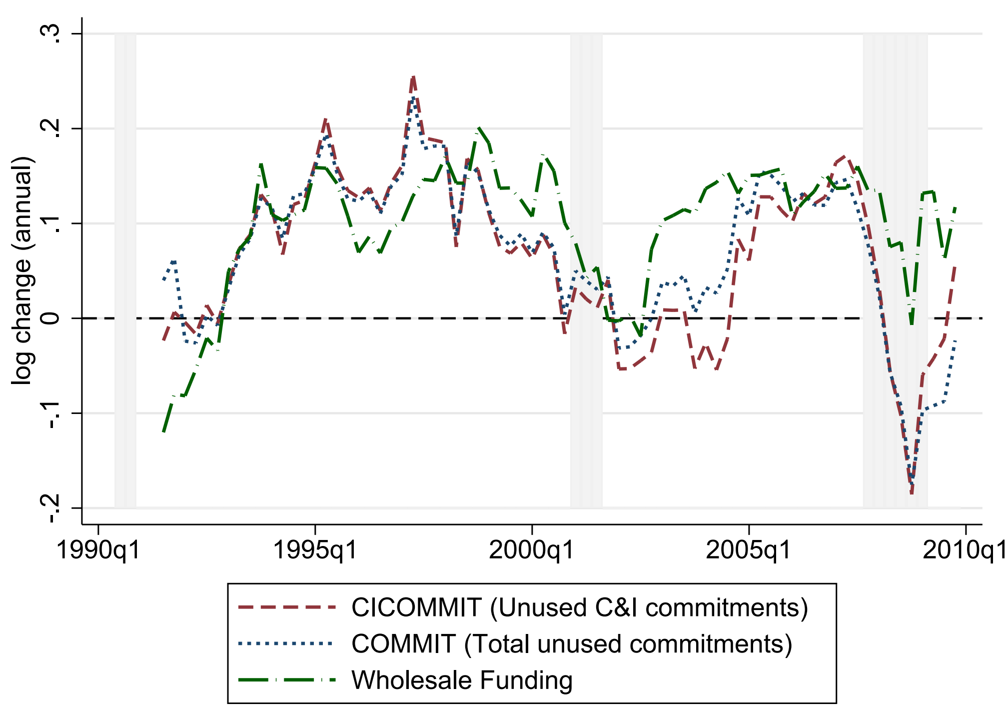


This figure plots the dates of introduction of regulations affecting wholesale funding markets of banks along with the aggregate dollar volume of banks' wholesale funding measured from Call Reports.

Figure A.3: Unused Commitments and Wholesale Funding (FR Y-9C Reports)



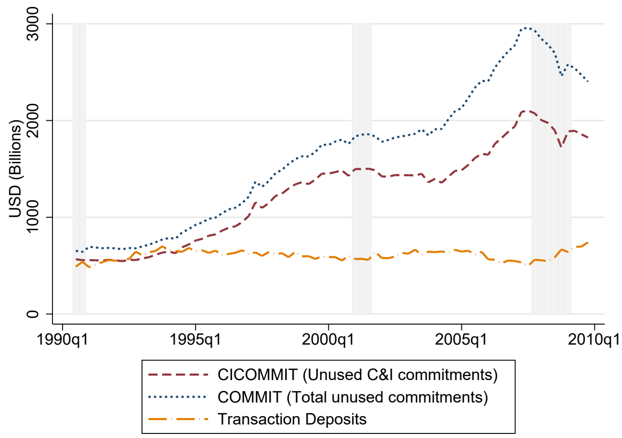
(a) Levels (USD Billions)



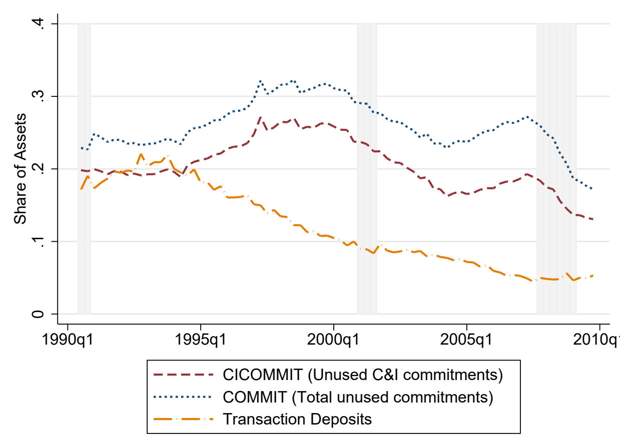
(b) Annual log change

This figure plots the time-series of aggregate unused commitment (COMMIT) along with aggregate wholesale funding for BHC data from FR Y-9C reports. Figure A.3a plots the time series in levels (USD billions) while Figure A.3b plots the annual log changes in the respective aggregate series.

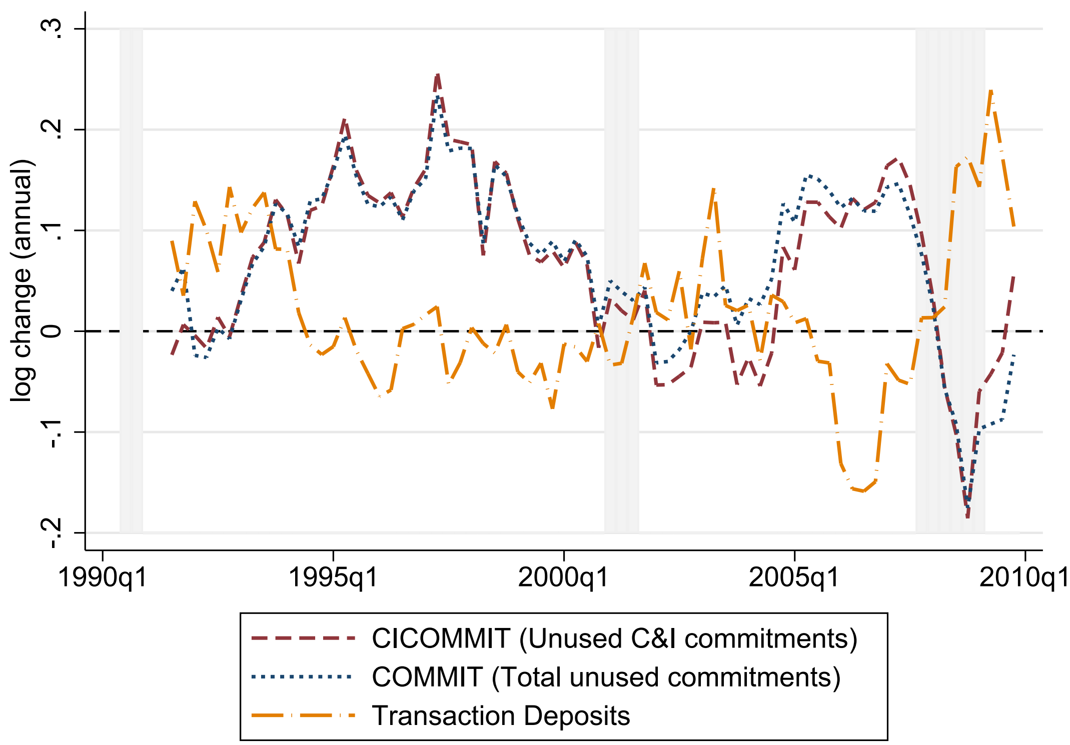
Figure A.4: Unused Commitments and Transaction Deposits (FR Y-9C Reports)



(a) Levels (USD Billions)



(b) Share of assets



(c) Annual log change

This figure plots the time-series of aggregate unused commitment (COMMIT) along with aggregate transaction deposits for BHCs from FR Y-9C reports. Figure A.4a plots the time series in levels (USD billions), A.4b plots the share of assets, and Figure A.4c plots the annual log changes in the respective aggregate series.

Table A.3: Call Reports: Summary Statistics for Medium Banks

	N	Min	p25	p50	p75	Max	Mean	SD
Panel A: Medium Banks (Sorted on LC_OBS)								
Assets (USD billions)	4585	0.03	2.81	5.84	11.03	93.28	9.32	10.57
Medium Banks per quarter (N)	72	37.00	47.50	58.00	82.50	117.00	67.44	25.94
OBS Liquidity Creation Ratio	4585	0.07	0.13	0.16	0.20	0.57	0.18	0.09
Wholesale Funding Ratio	4585	0.04	0.16	0.25	0.35	0.96	0.28	0.17
Transaction Deposits Ratio	4585	0.02	0.14	0.23	0.30	0.55	0.23	0.11
Capital Ratio	4585	0.05	0.07	0.08	0.09	0.21	0.09	0.03
Fed funds/Repo ratio	4584	0.00	0.17	0.31	0.45	0.78	0.31	0.19
Foreign deposits ratio	4584	0.00	0.00	0.00	0.02	0.60	0.04	0.11
Other Borrowed money ratio	4584	0.00	0.00	0.07	0.24	0.67	0.14	0.16
Subordinated notes ratio	4584	0.00	0.00	0.00	0.02	0.14	0.02	0.03
Large Time Deposits ratio	4584	0.02	0.31	0.46	0.64	1.00	0.48	0.23
Panel B: Medium Banks (Sorted on COMMIT)								
Assets (USD billions)	14501	0.06	1.01	1.70	2.97	24.86	2.40	2.20
Medium Banks per quarter (N)	72	130.00	167.50	197.00	251.00	315.00	210.74	55.25
Unused Commitments Ratio	14501	0.08	0.16	0.20	0.25	0.56	0.21	0.08
Wholesale Funding Ratio	14501	0.04	0.15	0.23	0.33	0.87	0.26	0.16
Transaction Deposits Ratio	14501	0.03	0.13	0.21	0.29	0.56	0.22	0.11
Capital Ratio	14501	0.05	0.07	0.08	0.10	0.20	0.09	0.02
Fed funds/Repo ratio	14501	0.00	0.06	0.19	0.37	0.82	0.24	0.21
Foreign deposits ratio	14501	0.00	0.00	0.00	0.00	0.58	0.02	0.08
Other Borrowed money ratio	14501	0.00	0.00	0.10	0.27	0.75	0.16	0.18
Subordinated notes ratio	14501	0.00	0.00	0.00	0.00	0.10	0.01	0.02
Large Time Deposits ratio	14501	0.04	0.39	0.57	0.76	1.00	0.58	0.24
Panel C: Medium Banks (Sorted on CICOMMIT)								
Assets (USD billions)	6312	0.07	2.47	4.26	7.70	50.30	6.01	5.72
Medium Banks per quarter (N)	68	49.00	68.50	91.00	116.50	141.00	91.93	26.79
Unused C&I Commitments Ratio	6312	0.21	0.40	0.46	0.53	0.97	0.47	0.13
Wholesale Funding Ratio	6312	0.05	0.17	0.25	0.34	0.93	0.28	0.16
Transaction Deposits Ratio	6312	0.03	0.13	0.22	0.30	0.61	0.22	0.12
Capital Ratio	6312	0.05	0.07	0.08	0.10	0.21	0.09	0.02
Fed funds/Repo ratio	6312	0.00	0.15	0.29	0.45	0.85	0.31	0.20
Foreign deposits ratio	6312	0.00	0.00	0.00	0.00	0.58	0.03	0.09
Other Borrowed money ratio	6312	0.00	0.01	0.10	0.27	0.73	0.16	0.17
Subordinated notes ratio	6312	0.00	0.00	0.00	0.00	0.12	0.01	0.02
Large Time Deposits ratio	6312	0.01	0.33	0.47	0.64	1.00	0.49	0.22

This table presents the summary statistics for Commercial Banks classified as medium after sorting on three measures of commitments: (1)LC_OBS, (2) COMMIT, and (3) CICOMMIT. Individual bank level variables are first aggregated at the highest holding company level using the identifier RSSD9348. Each quarter, banks are sorted (in a decreasing order) on the nominal dollar values of the respective measure of commitments. For each measure, banks cumulatively accounting for 90% - 95% (excluding the top 90%) of the aggregate quantity are classified as medium. All variables are winsorized at the 1% level. Observations with quarter-on-quarter growth greater than 20% or less than -20% are excluded to account for bank mergers.

Table A.4: FR Y-9C Reports: Summary Statistics for Medium Banks

	N	Min	p25	p50	p75	Max	Mean	SD
Panel A: Medium Banks (Sorted on LC_OBS)								
Assets (USD billions)	2288	0.13	6.11	10.69	20.30	563.08	19.16	40.75
Medium Banks per quarter (N)	70	12.00	28.00	32.50	41.00	55.00	34.04	9.84
OBS Liquidity Creation Ratio	2288	0.06	0.13	0.17	0.21	0.47	0.19	0.08
Wholesale Funding Ratio	2288	0.06	0.19	0.27	0.36	0.88	0.29	0.15
Transaction Deposits Ratio	2288	0.02	0.14	0.23	0.30	0.49	0.23	0.10
Capital Ratio	2288	0.04	0.07	0.08	0.09	0.14	0.08	0.02
Fed funds/Repo ratio	2288	0.00	0.18	0.30	0.42	0.74	0.31	0.17
Foreign deposits ratio	2288	0.00	0.00	0.00	0.04	0.60	0.04	0.10
Other Borrowed money ratio	2288	0.00	0.09	0.19	0.32	0.73	0.22	0.16
Subordinated notes ratio	2288	0.00	0.00	0.02	0.06	0.24	0.04	0.05
med Time Deposits ratio	2288	0.01	0.24	0.36	0.50	1.00	0.39	0.20
Panel B: Medium Banks (Sorted on COMMIT)								
Assets (USD billions)	5582	0.13	2.50	4.16	6.59	286.86	5.52	10.14
Medium Banks per quarter (N)	70	50.00	58.00	66.00	81.00	192.00	82.44	40.37
Unused Commitments Ratio	5582	0.08	0.17	0.21	0.26	0.64	0.23	0.08
Wholesale Funding Ratio	5582	0.05	0.18	0.26	0.34	0.84	0.28	0.14
Transaction Deposits Ratio	5582	0.02	0.12	0.20	0.29	0.55	0.21	0.11
Capital Ratio	5582	0.04	0.07	0.08	0.09	0.16	0.08	0.02
Fed funds/Repo ratio	5582	0.00	0.09	0.22	0.38	0.80	0.25	0.19
Foreign deposits ratio	5582	0.00	0.00	0.00	0.00	0.30	0.01	0.04
Other Borrowed money ratio	5582	0.00	0.08	0.21	0.36	0.75	0.24	0.19
Subordinated notes ratio	5582	0.00	0.00	0.00	0.05	0.21	0.03	0.04
med Time Deposits ratio	5582	0.04	0.32	0.44	0.61	1.00	0.47	0.21
Panel C: Medium Banks (Sorted on CICOMMIT)								
Assets (USD billions)	2786	0.20	5.37	8.55	13.65	563.08	14.59	38.04
Medium Banks per quarter (N)	70	24.00	30.00	37.00	46.00	77.00	41.23	14.28
Unused C&I Commitments Ratio	2786	0.28	0.43	0.50	0.57	0.99	0.51	0.13
Wholesale Funding Ratio	2786	0.06	0.19	0.26	0.35	0.86	0.28	0.13
Transaction Deposits Ratio	2786	0.02	0.12	0.22	0.30	0.55	0.22	0.12
Capital Ratio	2786	0.05	0.07	0.08	0.09	0.14	0.08	0.02
Fed funds/Repo ratio	2786	0.00	0.16	0.30	0.43	0.85	0.31	0.19
Foreign deposits ratio	2786	0.00	0.00	0.00	0.01	0.34	0.02	0.06
Other Borrowed money ratio	2786	0.00	0.08	0.18	0.31	0.74	0.21	0.16
Subordinated notes ratio	2786	0.00	0.00	0.02	0.06	0.20	0.04	0.04
med Time Deposits ratio	2786	0.01	0.27	0.40	0.54	1.00	0.42	0.20

This table presents the summary statistics for BHCs classified as medium after sorting on three measures of commitments: (1)LC_OBS, (2) COMMIT, and (3) CICOMMIT. Each quarter, banks are sorted (in a decreasing order) on the nominal dollar values of the respective measure of commitments. For each measure, banks cumulatively accounting for 90% - 95% (excluding the top 90%) of the aggregate quantity are classified as medium. All variables are winsorized at the 1% level. Observations with quarter-on-quarter growth greater than 20% or less than -20% are excluded to account for bank mergers.

Table A.5: Call Reports: Summary Statistics for Small Banks

	N	Min	p25	p50	p75	Max	Mean	SD
Panel A: Small Banks (Sorted on LC_OBS)								
Assets (USD billions)	448361	0.015	0.041	0.078	0.16	19.3	0.19	0.50
Small Banks/quarter (N)	72	5772	6006	6210.5	7105.5	7943	6550.2	703.5
OBS Liq. Creation Ratio	448361	0	0.032	0.057	0.090	0.21	0.065	0.044
Wholesale Funding Ratio	448361	0.013	0.087	0.14	0.22	0.52	0.16	0.10
Transaction Dep. Ratio	448361	0.061	0.21	0.27	0.34	0.57	0.28	0.099
Capital Ratio	448361	0.051	0.080	0.093	0.11	0.22	0.10	0.031
Fed funds+Repo ratio	447446	0	0	0	0.074	0.67	0.070	0.14
Foreign deposits ratio	447446	0	0	0	0	0	0	0
Other borrowed ratio	447446	0	0	0	0.14	0.70	0.097	0.17
Subordinated notes ratio	447446	0	0	0	0	0.041	0.00058	0.0045
Large Time Dep. ratio	447446	0.18	0.69	0.95	1	1	0.83	0.22
Panel B: Small Banks (Sorted on COMMIT)								
Assets (USD billions)	436215	0.015	0.040	0.075	0.15	30.7	0.14	0.30
Small Banks/quarter (N)	72	5533	5772	6102	6929	7870	6375.1	744.5
Unused Commit. Ratio	436215	0	0.051	0.094	0.15	0.31	0.10	0.070
Wholesale Funding Ratio	436215	0.013	0.086	0.14	0.22	0.51	0.16	0.10
Transaction Dep. Ratio	436215	0.065	0.21	0.27	0.34	0.57	0.28	0.098
Capital Ratio	436215	0.051	0.080	0.093	0.11	0.22	0.10	0.031
Fed funds+Repo ratio	435299	0	0	0	0.064	0.65	0.065	0.13
Foreign deposits ratio	435299	0	0	0	0	0	0	0
Other borrowed ratio	435299	0	0	0	0.14	0.69	0.095	0.17
Subordinated notes ratio	435299	0	0	0	0	0.034	0.00044	0.0037
Large Time Dep. ratio	435299	0.19	0.71	0.96	1	1	0.84	0.22
Panel C: Small Banks (Sorted on CICOMMIT)								
Assets (USD billions)	446336	0.015	0.041	0.077	0.16	30.7	0.18	0.46
Small Banks/quarter (N)	72	5717	5952.5	6202	7080.5	7989	6521.9	727.7
Unused C&I Commit. Ratio	445752	0	0.16	0.29	0.43	0.83	0.30	0.20
Wholesale Funding Ratio	446336	0.013	0.087	0.14	0.22	0.52	0.16	0.10
Transaction Dep. Ratio	446336	0.061	0.21	0.27	0.34	0.57	0.28	0.099
Capital Ratio	446336	0.051	0.080	0.093	0.11	0.22	0.10	0.031
Fed funds+Repo ratio	445420	0	0	0	0.072	0.66	0.069	0.14
Foreign deposits ratio	445420	0	0	0	0	0	0	0
Other borrowed ratio	445420	0	0	0	0.14	0.70	0.096	0.17
Subordinated notes ratio	445420	0	0	0	0	0.040	0.00056	0.0044
Large Time Dep. ratio	445420	0.18	0.70	0.96	1	1	0.83	0.22

This table presents the summary statistics for Commercial Banks classified as small after sorting on three measures of commitments: (1)LC_OBS, (2) COMMIT, and (3) CICOMMIT. Individual bank level variables are first aggregated at the highest holding company level using the identifier RSSD9348. Each quarter, banks are sorted (in a decreasing order) on the nominal dollar values of the respective measure of commitments. For each measure, banks cumulatively accounting for 95% - 100% (excluding the top 95%) of the aggregate quantity are classified as small. All variables are winsorized at the 1% level. Observations with quarter-on-quarter growth greater than 20% or less than -20% are excluded to account for bank mergers.

Table A.6: FR Y-9C Reports: Summary Statistics for Small Banks

	N	Min	p25	p50	p75	Max	Mean	SD
Panel A: Small Banks (Sorted on LC_OBS)								
Assets (USD billions)	96580	0.018	0.20	0.31	0.62	356.81	0.74	3.25
Small Banks/quarter (N)	70	894	1187	1366.5	1729	2167.00	1457.23	370.21
OBS Liq. Creation Ratio	96580	0.0042	0.052	0.079	0.11	0.23	0.08	0.04
Wholesale Funding Ratio	96580	0.031	0.12	0.19	0.27	0.59	0.21	0.11
Transaction Deposits Ratio	96567	0.040	0.18	0.25	0.32	0.53	0.25	0.10
Capital Ratio	96580	0.035	0.071	0.085	0.10	0.19	0.09	0.03
Fed funds+Repo ratio	96576	0	0	0.050	0.18	0.67	0.12	0.16
Foreign deposits ratio	96576	0	0	0	0	0.00	0.00	0.00
Other Borrowed ratio	96576	0	0.035	0.16	0.33	0.79	0.21	0.20
Subordinated notes ratio	96576	0	0	0	0	0.20	0.01	0.03
small Time Dep. ratio	96576	0.11	0.48	0.67	0.86	1.00	0.66	0.24
Panel B: Small Banks (Sorted on COMMIT)								
Assets (USD billions)	91963	0.018	0.20	0.30	0.55	272.41	0.51	1.51
Small Banks/quarter (N)	70	811	1151	1338.5	1665	1972.00	1389.43	337.83
Unused Commit. Ratio	90603	0.0034	0.087	0.13	0.18	0.32	0.14	0.07
Wholesale Funding Ratio	91963	0.030	0.12	0.19	0.27	0.57	0.20	0.11
Transaction Deposits Ratio	91950	0.042	0.19	0.26	0.32	0.53	0.26	0.10
Capital Ratio	91963	0.034	0.071	0.085	0.10	0.19	0.09	0.03
Fed funds+Repo ratio	91959	0	0	0.044	0.17	0.66	0.11	0.15
Foreign deposits ratio	91959	0	0	0	0	0.00	0.00	0.00
Other Borrowed ratio	91959	0	0.032	0.16	0.33	0.80	0.21	0.20
Subordinated notes ratio	91959	0	0	0	0	0.20	0.01	0.03
small Time Dep. ratio	91959	0.11	0.49	0.68	0.86	1.00	0.66	0.24
Panel C: Small Banks (Sorted on CICOMMIT)								
Assets (USD billions)	95930	0.018	0.20	0.31	0.61	256.90	0.69	2.51
Small Banks/quarter (N)	70	875	1187	1372.5	1717	2120.00	1447.79	359.96
Unused C&I Commit. Ratio	95830	0	0.24	0.35	0.46	0.90	0.35	0.18
Wholesale Funding Ratio	95930	0.031	0.12	0.19	0.27	0.59	0.21	0.11
Transaction Deposits Ratio	95917	0.040	0.19	0.26	0.32	0.53	0.25	0.10
Capital Ratio	95930	0.035	0.071	0.085	0.10	0.19	0.09	0.03
Fed funds+Repo ratio	95926	0	0	0.049	0.18	0.67	0.12	0.16
Foreign deposits ratio	95926	0	0	0	0	0.00	0.00	0.00
Other Borrowed ratio	95926	0	0.035	0.16	0.33	0.79	0.21	0.20
Subordinated notes ratio	95926	0	0	0	0	0.20	0.01	0.03
small Time Dep. ratio	95926	0.11	0.48	0.67	0.86	1.00	0.66	0.24

This table presents the summary statistics for BHCs classified as small after sorting on three measures of commitments: (1)LC_OBS, (2) COMMIT, and (3) CICOMMIT. Each quarter, banks are sorted (in a decreasing order) on the nominal dollar values of the respective measure of commitments. For each measure, banks cumulatively accounting for 95% - 100% (excluding the top 95%) of the aggregate quantity are classified as small. All variables are winsorized at the 1% level. Observations with quarter-on-quarter growth greater than 20% or less than -20% are excluded to account for bank mergers.

A.1 Sample Construction

Off-balance sheet commitments are classified in different ways and those components will be given different weights depending on the definition of commitments (LC_OBS vs. COMMIT vs. CICOMMIT). Some banks may specialize in providing credit lines to C&I firms while some may specialize in credit card lines to households. Moreover, if wholesale funding is linked to off-balance sheet commitments, bank size might play an important role since large banks can easily access wholesale funding compared to smaller banks. Due to these factors, I construct my sample in the following manner: every quarter, for each measure of commitments (LC_OBS vs. COMMIT vs. CICOMMIT), I sort banks in a decreasing order based on their nominal dollar values of commitments (separately for each measure). Banks that cumulatively account for top 90% of the aggregate commitment are classified as large banks in that quarter. Banks that account for the subsequent 90% to 95% are classified as medium banks and the rest as small banks. Constructing my sample in this manner accounts for (1) the growing consolidation in the banking industry during the two decades before the 2008 crisis (2) banks specializing in certain type of commitments.

For instance, a total of 77 banks accounted for the top 90% of unused commitments (as measured using COMMIT) whereas only 36 banks accounted for the top 90% C&I Commitments in 2007 Q1. Constructing my sample in the manner described above allows me to condition on banks' choice of commitment specialization. Conditional on being in the top 90% of C&I commitments in nominal dollar terms, what is the relationship between C&I commitments and wholesale funding? Sorting on other variables like assets could lead to spurious correlations. A large bank (by assets) that doesn't specialize in C&I commitments (not in top 90% of C&I Commitments) and has a low (high) wholesale funding share of liabilities will lead me to conclude wholesale funding is positively (negatively) correlated with C&I commitments. However, the positive (negative) correlation, in this case, might be purely due to the bank's lack of specialization in lending to C&I firms. The same bank might specialize in credit card sales (included in LC_OBS but not in COMMIT or CICOMMIT) and lead me to conclude that wholesale funding is negatively (positively) correlated with liquidity creation as measured by LC_OBS.

The sample period for my analysis is restricted to the period 1990 Q1 - 2007 Q4. Data from call reports and FR Y-9C data is available for earlier periods as well. However, I start my analysis in 1990 Q1 because the relevant variables for constructing off-balance sheet measures first started being reported at that time. BHC data is reported in a consolidated form and the description of all variables can be found in Table A.1. Liquidity creation measures for LC_OBS in Berger and Bouwman (2009) are not available for BHCs. I construct this measure using the methodology outlined in Berger and Bouwman (2009) for the BHC data (see Section 3.2). Each quarter, I first sort banks (in a decreasing order) on the nominal dollar values of the respective measure of commitments. For each measure, I classify the banks that account for the top 90%, 90%-95%, and the rest of the aggregate quantity into large, medium, and small banks, respectively.[65].

Appendix B Datasets

B.0.1 FR Y-9C Data for Bank Holding Companies

The FR Y-9C data contains ". . . basic financial data from a domestic bank holding company (BHC). . . on a consolidated basis in the form of a balance sheet, an income statement, and detailed supporting schedules, including a schedule of off balance-sheet items." (**?**). The data on relevant off-balance sheet items for the purposes of this paper are reported starting 1990Q3. Thus, for BHC data, I restrict the start of the time period of my analysis to the year 1990Q3. The FR Y-9C contains data on thousands of variables. BHCs are required to file the relevant data in a standardized form every quarter to bank regulatory agencies.[66] The definitions of variables may change over time as per the demands of the regulatory agencies and thus, it becomes important to keep track of the changes in order to construct variables that are consistent over time.[67]

B.0.2 Call Reports Data for Commercial Banks

The data on financial statements of Commercial Banks are sourced from Call Reports data available on the website of Federal Reserve Bank of Chicago. Similar to BHC data from the FR Y-9C reports, Call Reports contain quarterly financial data for Commercial Banks on a consolidated basis in the form of balance sheet, income statement and supporting schedules with details of asset, liabilities, and off-balance sheet components of Commercial Banks. The

[65] The asset-size cutoffs for BHCs required to file FR Y-9C reports are revised over time. In March 2006, the asset-size cutoff was raised from $150 million to $500 million. To avoid a large drop-off in the number of "large" banks, I keep the large bank classification in 2005 Q4 for the subsequent period. Thus, a bank classified as a large bank in 2005 Q4 will be classified as large for the period 2006 Q1 - 2007 Q4.

[66] More details on the reporting forms are available at https://www.federalreserve.gov/apps/ReportingForms/

[67] A useful tool for keeping track of variable definitions is the Micro Data Reference Manual available at https://www.federalreserve.gov/apps/mdrm/data-dictionary

relevant off-balance sheet items started being reported from 1990Q1, and thus, the start of the sample period for the analysis using Call Reports data is the year 1990.

B.0.3 Capital IQ data on firm-level credit lines

I use data from Capital IQ on drawn and undrawn credit lines of non-financial firms incorporated in the US. The data is available starting 2002 and ends in 2023. Capital IQ compiles detailed data on firm's capital structure, including drawn and undrawn amounts of revolving credit lines. Capital IQ does not report the total value of the size of credit lines. To estimate the total amount, I sum the drawn and undrawn portions of revolving credit following Mathers and Giacomini (2015).

B.0.4 Liquidity Creation data from Berger and Bouwman (2009)

The data on liquidity creation comes from Berger and Bouwman (2009).[68] The panel dataset includes bank-level liquidity creation measures from 1984Q1 to 2016Q4. Apart from quarterly measures of liquidity created at the bank level ("catfat" and "cat nonfat"), the dataset includes dollar amounts of (1) asset-side liquidity creation, (2) liability-side liquidity creation, (3) Off-balance sheet liquidity creation. The dataset includes each bank's identifier (RSSD9001) which allows us to merge the liquidity creation data with bank-level financial information from call reports data. In order to construct the liquidity creation measures at the Bank Holding Company level, we apply the methodology outlined in Berger and Bouwman (2009) to the Bank Holding Company data from FR Y-9C reports. The definition of variables and their mapping to the variables in FR Y-9C reports is outlined in detail in Table A.1.

Appendix C Components of Wholesale funding

As mentioned in Section 3.2, various different sources of funding are clubbed together under the umbrella of wholesale funding. While they might share common features, especially in contrast to demandable deposits, a natural question arises in the form of their degree of substitution. Do banks specialize in raising one form of funding over the other? Do they substitute one form of funding for another? Anecdotal evidence from Bank of England (2015) report on failure of HBOS Bank provides some suggestive answers. On the bank's approach towards wholesale funding *"HBOS senior management..took steps from 2004 to 2005 to reduce its*

[68] The dataset is available on Christa Bouwman's website on https://sites.google.com/a/tamu.edu/bouwman/data-forms-and-links-to-websites-for-u-s-banking-research

reliance on short-term funding and to extend the maturity profile of its wholesale liabilities...Senior management took measures to diversify the sources of wholesale funding, taking advantage of the expanding funding sources made available as markets deepened and new ones emerged...There was a high proportion of unsecured borrowings from the money markets (deposits, CDs and commercial paper (CP))".

The report paints a narrative of high degree of substitution and diversification across various sources of wholesale funding as well as currencies. *"According to HBOS policy, currency limits were set, and funding was diversified across three main currencies (sterling, euro and US dollar).. HBOS used US dollar funding extensively (accounting for 30-40% of total wholesale funding) although it did not have any substantial business activity in that currency.* One can conjecture whether similar narratives hold for large US banks, but the case of HBOS gives us a glimpse into the internal workings of wholesale funding markets for large global banks like HBOS.

Figure 8 plots the time series of different components of wholesale funding as a share of aggregate wholesale funding for US commercial banks and BHCs, respectively. The aggregate plots underscore the diversification of wholesale funding across its different components. With the exception of subordinated notes, all components of wholesale funding contribute roughly equally to overall wholesale funding. This is consistent with the anecdotal evidence in Bank of England (2015).

Table C.1: Replication of main results in Kashyap, Rajan and Stein (2002)

Panel 1: Replication of Table III in Kashyap, Rajan and Stein (2002)

	All Banks	Large Banks	Medium Banks	Small Banks
No. of Obs.	9333	100	500	8733
Panel A: Dependent Variable = LIQRAT: $\frac{\text{(Cash + Securities)}}{\text{Assets}}$				
DEPRAT coef.	0.237	0.308	0.116	0.239
(t-statistic)	(17.46)	(2.89)	(2.14)	(17.14)
Explanatory power of DEPRAT	0.181	0.303	0.093	0.182
Dependent Variable = SECRAT: $\frac{\text{Securities}}{\text{Assets}}$				
DEPRAT coef.	0.163	0.255	0.071	0.162
(t-statistic)	(11.67)	(2.65)	(1.29)	(11.28)
Explanatory power of DEPRAT	0.123	0.279	0.058	0.122

Panel 2: Replication of Table IV in Kashyap, Rajan and Stein (2002)

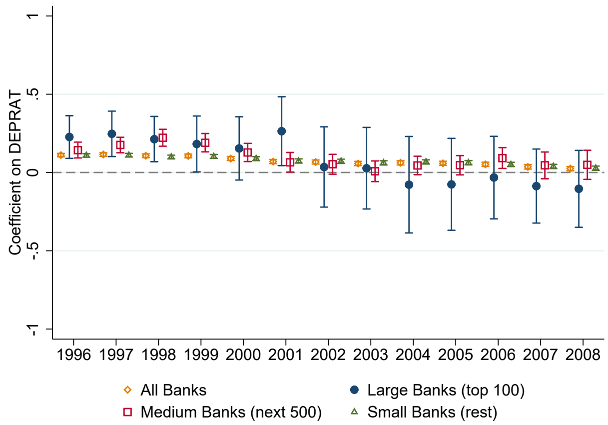
	All Banks	Large Banks	Medium Banks	Small Banks
No. of Obs.	9333	100	500	8733
Dependent Variable = COMRAT: $\frac{\text{Unused Commitments}}{\text{(Unused Commitments + Total Loans)}}$				
DEPRAT coef.	0.111	0.227	0.143	0.109
(t-statistic)	(19.88)	(3.29)	(5.59)	(19.11)
Explanatory power of DEPRAT	0.178	0.203	0.221	0.186

Panel 3: Replication of Table VI in Kashyap, Rajan and Stein (2002)

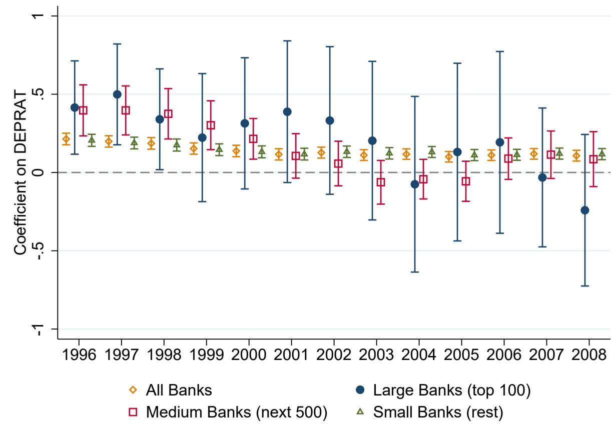
	All Banks	Large Banks	Medium Banks	Small Banks
No. of Obs.	6189	84	311	5794
Dependent Variable = CICOMRAT: $\frac{\text{Unused C\&I Commitments}}{\text{(Unused C\&I Commitments + Total C\&I Loans)}}$				
DEPRAT coef.	0.214	0.415	0.397	0.205
(t-statistic)	(11.31)	(2.77)	(4.80)	(10.49)
Explanatory power of DEPRAT	0.126	0.295	0.254	0.124

This table presents the results from replicating the main results from Kashyap, Rajan and Stein (2002). The main dependent variables are (1) COMRAT (unused commitment ratio as in A.2 and A.1), (2) CICOMRAT (unused C&I commitments as in A.2, (3) SECRAT (securities/assets), and (4) LIQRAT (cash + securities/assets). The main explanatory variable is DEPRAT (Transactions deposit ratio as in A.2 and A.1).

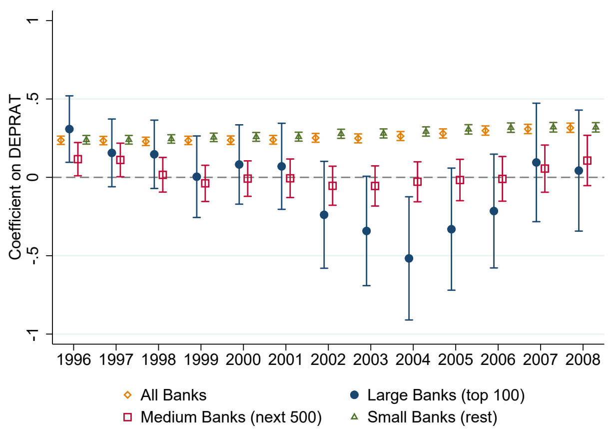
Figure C.1: Extending Kashyap, Rajan and Stein (2002) Sample Period beyond 1992-96



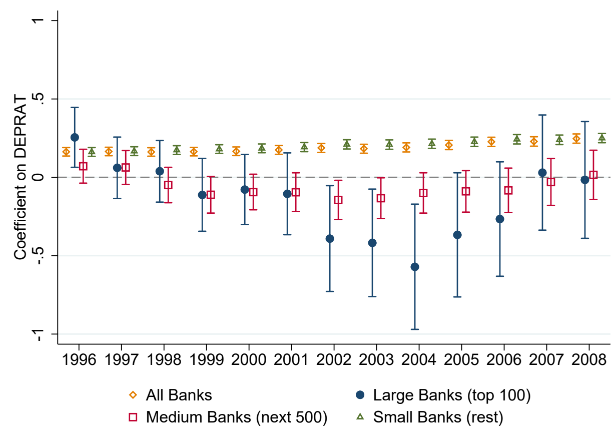
(a) Dependant Variable: COMRAT



(b) Dependant Variable: COMRAT



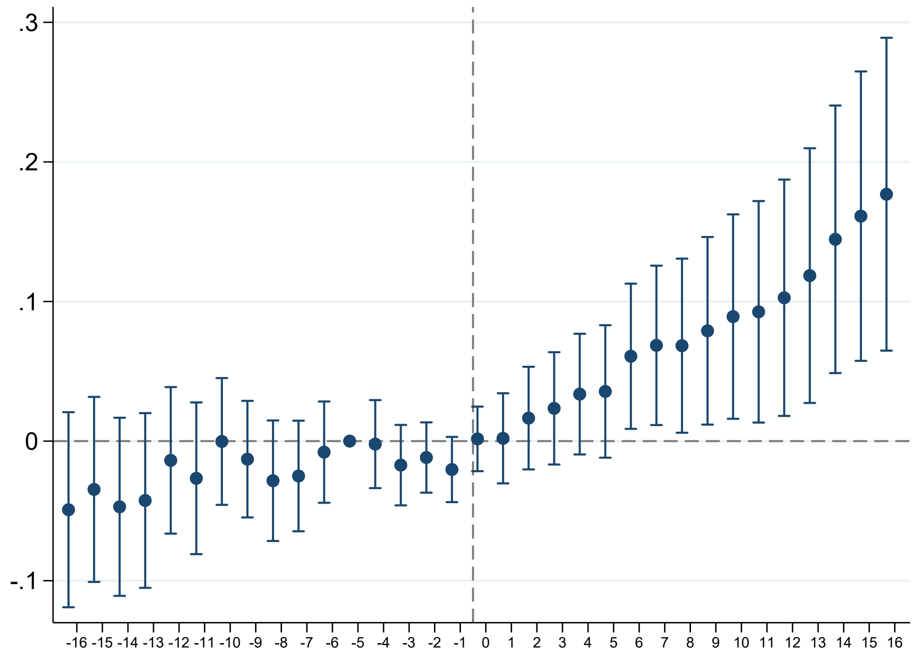
(c) Dependant Variable: LIQRAT



(d) Dependant Variable: SECRAT

These figures plot the results from extending the sample period in Kashyap, Rajan and Stein (2002). The original sample period of 1992-96 is extended till 2008 one year at a time using the original specification in Kashyap, Rajan and Stein (2002). Each year, I time-average the regression variables for the previous five years and run cross-sectional regressions separately for large, medium, and small banks. The dots represent the point estimates of the coefficient on the main explanatory variable in Kashyap, Rajan and Stein (2002) – DEPRAT (transaction deposits ratio). The lines represent the 95% confidence interval for the estimate. The main dependent variables are (1) COMRAT (unused commitment ratio as in A.2 and A.1), (2) CICOMRAT (unused C&I commitments as in A.2), (3) SECRAT (securities/assets), and (4) LIQRAT (cash + securities/assets).

Figure C.2: Impact of FHLB membership on Unused Commitments with state-quarter fixed effects



(a) Dep variable: Unused Commitments

DiD estimates for the impact of (staggered) FHLB membership on Unused Commitments controlling for state-quarter fixed effects: This figure plots the event-study coefficients estimated using the Callaway and Sant'Anna (2021) estimator. The outcome variable is the residuals from the regression of log of Unused Commitments on state-quarter fixed effects. Treatment timing is constructed using the dates of FHLB membership (Section 6.1). The sample consists of the subset of banks that became members of the FHLB system during 1990-2008 (not-yet-treated). Standard errors are clustered at the bank level. The bars represent 95 percent confidence intervals. All treatment effects are relative to base period of the quarter before treatment ($t = -1$) and all relative time periods are in quarters.