Monetary Policy Transmission and the Role of High- and Low-Quality Liquid Assets

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Abstract

Traditionally, when monetary policy tightens, it reduces banks' lending activities, which is more pronounced for banks with less liquid balance sheets. In such a scenario, liquid assets have been considered stabilizing mechanisms for banks throughout monetary policy cycles. This paper revisits the role of liquid assets in the transmission of monetary policy to the banking system by focusing on the interaction between high-frequency identified monetary shocks and four key liquidity ratios: high-quality, low-quality, total liquidity, and liquidity coverage ratios. By considering these ratios, this paper uses local projections to estimate banks' heterogeneous responses to monetary policy shocks regarding deposit flows, lending activities, liquidity creation, and profit margins. The findings suggest that the interactions between monetary tightening shocks and high-quality liquidity ratios stabilize banks' activities. In contrast, the interaction between shocks and low-quality liquidity ratios tends to amplify monetary policy transmission. This paper highlights the importance of differentiating between the qualities of liquidity and suggests that only certain qualities of liquid assets work as stabilizers during monetary cycles.

Key words: Banks, Monetary Policy, High-quality liquid assets, Low-quality liquid assets, liquidity coverage ratios

JEL Codes: E43, E44, E52, E58, G21

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1 Introduction

Numerous empirical studies have investigated whether the ability of banks to respond effectively to various monetary policy measures is associated with specific attributes. Among these attributes, the composition of liquid assets on banks' balance sheets has garnered particular attention. For instance, previous research has shown that liquid assets can serve to stabilize lending supply when banks are confronted with changes in monetary policy (e.g., Kashyap and Stein, 2000). This paper undertakes an empirical analysis of the role of liquid assets in the transmission of monetary policy, offering new insights into how the qualities of liquid assets affect the performance of banks throughout monetary policy cycles.

The continuous evolution of the banking industry, coupled with other factors, highlights the need to reexamine the role of liquid assets in the transmission of monetary policy. Specifically, there has been a change in how banks manage their liquid portfolios and the legal framework that regulates financial institutions. Recent banking events have also highlighted that the role of liquid assets during monetary cycles might destabilize the performance of banking institutions. The following paragraphs describe in detail this new landscape.

First, as depicted in Figure 1, following the global financial crisis, US banking institutions significantly increased their liquid asset holdings and transformed their liquid asset portfolios. Between 2001 and 2013, banks of all sizes boosted their liquid assets, ranging in factors between 2 and 4. Moreover, banks with total assets exceeding \$50 billion (LCR banks) expanded their allocation of high-quality liquid assets from 5% to nearly 20% of their balance sheets, concurrently reducing their holdings of low-quality liquid assets. Conversely, banks with total assets below the \$50 billion threshold (non-LCR banks) witnessed a rise in both low and high-quality liquid assets, with the latter gaining prominence on their balance sheets.

Note also that Figure 1 depicts a dynamic change in the composition of liquid asset portfolios. In particular, the implementation of new macroprudential regulations marked a divergence in the management practices of LCR banks and non-LCR banks. While LCR banks continued to augment the presence of high-quality liquid assets in their balance sheets, non-LCR banks reduced the ratios of high-quality and low-quality assets[1]. The interplay between the new macroprudential liquidity regulations and various other factors has continued to influence how banks manage their portfolios of liquid assets.

Second, the banking failures of March 2023 suggest that, under certain scenarios, an excessive accumulation of liquid assets might signify inefficient banking management, potentially increasing a bank's vulnerability to monetary tightening shocks. A review of this most recent banking crisis has revealed a significant influx of deposits, which were promptly invested in long-term securities. The rapid interest rate increase by the Federal Reserve, resulting in substantial price declines in long-term securities, incentivized uninsured depositors to withdraw their funds, ultimately leading to the collapse of regional banks (e.g., Drechsler, Savov, Schnabl, and Wang, 2023; Krainer and Paul, 2023). This chain of events thus underscores certain limitations in the new macroprudential regulation. Indeed, such a regulation endorses using high-quality liquid assets to enhance financial system stability by mitigating risks linked to maturity mismatches and potential disruptions in short-term liquidity markets (BIS, 2019). However, long-term high-quality liquid assets might also expose banks to analogous risks, as experienced in the aforementioned crisis.

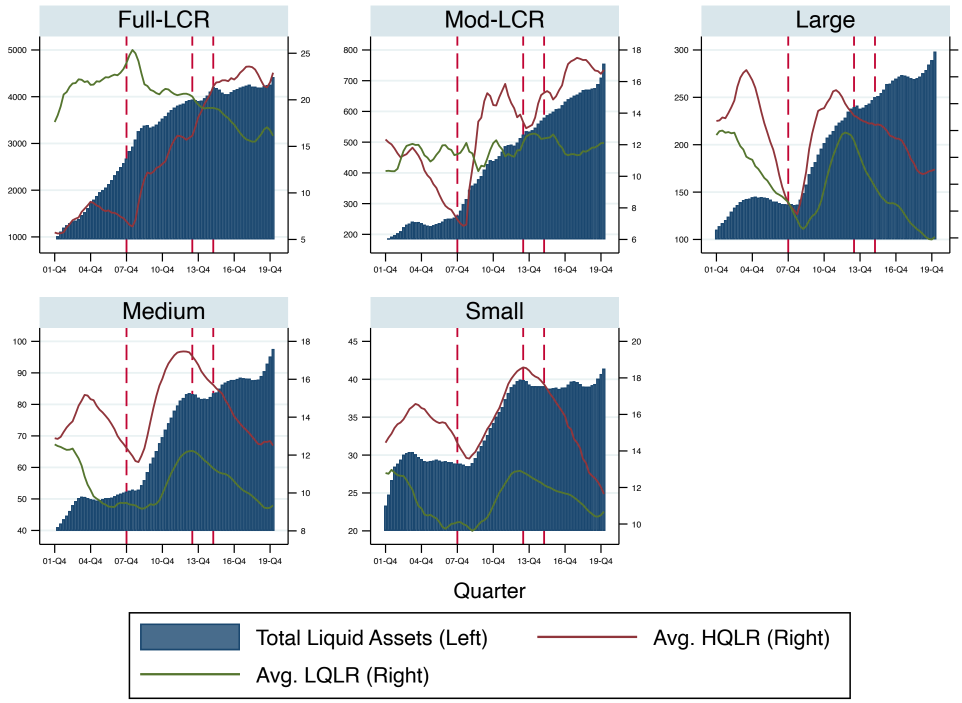
Recent banking events emphasize that relying on liquid assets during monetary cycles may not always guarantee banking stability, putting the role of liquid assets throughout monetary policy cycles in the spotlight. The complexity of this relationship arises from the intricacies inherent in the banking business model and the versatile uses that banks assign to liquid assets. This can be examined through different perspectives.

Before describing these perspectives, it is worth mentioning some key characteristics of the banking business model. In general, banks operate based on three fundamental functions: maturity transformation, risk transformation, and liquidity transformation[2]. These activities allow banks to generate profits through deposit spreads, i.e., lending at rates higher than

[1] For evidence on the management of the composition of high-quality liquid assets by LCR banks, see Ihrig et al. (2017). They highlight differences in the management practices of high-quality liquid assets among these banks.

[2] Maturity transformation consists of issuing short-term liabilities to finance long-term assets, risk transformation of issuing riskless liabilities to finance risky assets, and liquidity transformation of issuing liquid liabilities to fund illiquid assets. The alignment or divergence of these functions depends on the specific assets and liabilities involved.

Figure 1: Evolution of Liquid Assets by Quality in the US Banking System



Notes: The left-axis is measured in billions (2015 constant prices). The right-axis represents unweighted averages and is a percentage of gross total assets. Dashed vertical lines correspond to the dates of introducing new liquidity regulations (2013q2-2015q1) and the beginning of the GFC (2007q4). Series have been smoothed using a four-lag backward-looking moving average. Full-LCR banks hold assets over \$250 billion, while Mod-LCR banks have assets between \$50 billion and \$250 billion. These banks are subject to liquidity coverage ratios. Banks with assets ranging from \$300 million to \$3 billion are small-sized, those with \$3 billion to \$10 billion are medium-sized, and those with assets between \$10 billion and \$50 billion are considered large banks. These graphs are based on data from the Call Reports for all U.S. commercial banks. The data sample covers the period from 2001q4 until 2018q1.

the funding rates. For example, banks can benefit from term premiums through maturity transformation, risk premiums through risk transformation, or liquidity premiums through liquidity transformation[3].

The typical view found in textbooks argues that maximizing these sources of profits exposes banks to interest rate, default, and liquidity risks. From a risk management perspective, liquid assets play a crucial role in balancing these various sources of risk. The literature has focused on the twofold role of liquid assets as instruments for hedging liquidity and interest

[3]Term premiums refers to the difference between long-term and short-term interest rates. Risk premiums signify the differential between the interest rates on risky and safe assets. Liquidity premiums represent the distinction in interest rates between illiquid and liquid assets.

rate risks.

As instruments for liquidity risk management, liquid assets allow banks to accommodate both expected and unexpected cash withdrawals from customers (Poole, 1968). Closely related, liquid assets play a crucial role in reducing the likelihood of bank runs (Diamond and Dybvig, 1983) or might act as a buffer, protecting depositors from potential loan losses. Other strands of the literature indicate that liquid assets, as a liquidity risk management tool, might play a role in the information-revealing process between banks and clients, but the evidence is ambiguous in this regard. For some cases, liquid assets can substitute other liquidity risk instruments (e.g., public disclosure), reducing banks' transparency (Raz, McGowan, and Zhao, 2022), while in other cases, it can signal a solid and well-diversified portfolio (Stulz, Taboada, and Dijk, 2022).

As instruments for interest rate risk management, Drechsler, Savov, and Schnabl (2021) have identified that banks employ a strategic approach to mitigate interest rate risks. This strategy involves investing in liquid assets with long durations, allowing them to capitalize on the advantages offered by their deposit franchises. The primary feature of this hedging strategy is the banks' ability to exert substantial market power over retail deposits. When short-term interest rates rise, the value of long-term liquid assets declines. In contrast, the value of deposit franchises increases as soon as banks exert monopolistic power in local deposit markets.

These risk management strategies suggest a possible interaction between liquid assets and monetary policies. However, the impact of this interaction has primarily been explored through attempts to pinpoint the specific attributes of liquid assets that can influence the effectiveness of transmission channels[4]. For instance, the classic view is that liquid assets, unlike loans or other illiquid assets, can be easily drawn down, monetized, or used as collateral in Repo transactions. These attributes enable banks to access additional funds when alternative funding sources like deposits become more costly, a situation often instigated by monetary policy tightenings. Under this perspective, the literature on the bank lending channel for monetary policy suggests that liquid assets shield lending growth during periods

[4] A revision of the banking channel of monetary policies is left in Section A.

of tight monetary policy (e.g., Kashyap and Stein, 2000).

Nevertheless, alternative explanations suggest that liquid assets are not perfect stabilizing mechanisms, and under some circumstances, they can weaken the resilience of banks when confronted with fluctuations in monetary policy.

The first alternative is related to the direct influence of monetary policies on the pricing of liquid assets, known as the valuation effect mechanism. As mentioned above, since long-term liquid securities are exposed to interest rates, banks can be highly exposed to profit losses on securities when their prices decline. If these losses are unhedged, lower profits expose banks to capital losses and consequently, to lower performance. In the context of the bank lending channel, the evidence suggests that capital losses resulting from the decline in security prices lead to a stronger contraction in lending supply for banks with higher security ratios (see Bluedorn, Bowdler, and Koch, 2017; Krainer and Paul, 2023).

A second alternative is associated with the impact of monetary policies on the characteristics of liquid assets, particularly focusing on their ease of convertibility. This perspective argues that the easy convertibility of liquid assets into available funds is limited due to operational constraints associated with handling large asset volumes. For example, Afonso et al. (2020) highlights that when dealing with exceptionally large quantities of assets sold in a single day, finding willing counterparties for purchases or Repo transactions can be challenging. This situation can lead to tough negotiations if counterparties perceive that the bank is under pressure to sell, which may result in banks accepting lower asset prices. Similar to the valuation effect mechanism, this can constrain the ability of liquid assets to generate funds during monetary cycles, thereby restricting a bank's capacity to respond effectively to monetary shocks.

A third alternative underscores how monetary policies can destabilize banks' hedging strategies. Drechsler, Savov, Schnabl, and Wang (2023) show that liquid assets can serve banks as hedges to either interest rate risks or liquidity risks, but not to both. In particular, when banks choose securities with long-term duration in order to hedge interest rate risk, banks become exposed to a run if interest rates rise. In contrast, when securities with shorter duration are used to hedge liquidity risks, banks become exposed to insolvency if the rate falls. This is called the dilemma of liquid assets.

The dilemma occurs because using the duration of securities and the deposit franchise as a hedging strategy is inherently unstable to monetary policy. As presented above, banks earn a deposit spread because they invest in fixed operating costs that entitle them to monopoly power in deposit markets. The deposit franchise has a negative duration, meaning its value positively correlates with interest rates. To hedge fluctuations in the deposit franchise, banks invest in assets with positive duration, that is, assets such that their value is negatively correlated with policy rates, e.g., long-term loans and securities. Nevertheless, this hedging strategy can break down when deposits that contribute highly to the value of the deposit franchise (i.e., with low deposit-spread-betas) are withdrawn from the banking system[5].

These perspectives suggest that there is no consensus about the stabilizing or destabilizing effects of liquid assets through monetary cycles. This paper aims to provide new evidence of this interaction by focusing on the following aspects.

First, my emphasis is on the classification of liquid assets, distinguishing them based on quality criteria. The key liquidity measurements I concentrate on encompass High-quality (HQ), Low-quality (LQ), total liquidity, and liquidity coverage ratios (LCR). These categories are defined based on the criteria established by the Basel Committee on Banking Supervision (BIS, 2019). This categorization represents a departure from the conventional definition of liquidity, which primarily emphasizes the swift convertibility of assets into cash[6]. Instead, the new Basel definition is structured around three dimensions: fundamental characteristics, market-related characteristics, and operational requirements, highlighting additional aspects such as low-risk exposure, the ability to command high fire sale prices, and widespread acceptance as collateral.

Under the comprehensive Basel definition, an asset is classified as fundamentally liquid

[5]Drechsler, Savov, Schnabl, and Wang (2023) present this as a multiple equilibria result: "When interest rates are low, the value of the deposit franchise is small, and the valuation of assets is high. A run does not occur because the value of the bank would be unaffected if it did occur. But when interest rates rise, and the deposit franchise comes to dominate the value of the bank, a run equilibrium arises. This is true even if the bank is fully hedged to interest rates in the sense that its value is insensitive to interest rate shocks outside the run equilibrium."

[6]For instance, according to Berger and Bouwman (2009) an asset is deemed liquid if its holder can readily and cost-effectively convert it into cash to meet immediate liquidity requirements.

when it shows minimal exposure to various risk sources, has a structure that allows for transparent valuation with a high level of certainty about its true value, and displays a low correlation with other high-risk assets. Given the variability in assets' capacity to consistently demonstrate these properties, the differentiation between high and low-quality liquid assets highlights the inherent diversity in an asset's liquidity. In this context, high-quality liquid assets are generally expected to more consistently demonstrate these characteristics, regardless of the prevailing economic conditions. In contrast, low-quality liquid assets, even if they meet risk-weighting and credit-rating criteria, tend to lose these properties during specific economic scenarios. This differentiation serves the purpose of identifying assets that maintain their liquidity attributes more reliably and those that are susceptible to changes in particular economic contexts.

Second, I study the interaction from a dynamic perspective. For this purpose, I undertake a series of empirical analyses using the local projection methodology established by Jordà (2005). In particular, I project growth rates and ratios of banks' performance metrics, such as liquidity creation, profitability, loan growth, and deposit flows, at various time horizons onto monetary policy shocks that interact with liquidity ratios at the moment of the shock.

Finally, to take into account possible biases emerging from endogenous monetary policy. I focus on monetary shocks obtained from Jarociński and Karadi (2020). In this respect, the empirical exercise assumes that high-frequency financial market data offers accurate measurements of structural monetary policy shocks[7].

Empirical evidence is obtained using panel data spanning U.S. depository institutions from 2001 to 2018. The findings are derived from a sample of banks that are not subject to the latest macro-prudential liquidity regulations. These banks, by design, occupy the left tail of the bank size distribution. The analysis conveys the following results.

First, a set of equilibrium conditions regarding banks' deposit flows is revealed. In response to monetary tightening shocks, banks with larger HQ liquidity ratios (and LCRs) experienced higher deposit growth rates in the short term. In contrast, those with larger LQ liquidity

[7]Some authors, however, relax this assumption and only assume that these shocks serve as valid instruments for the Fed funds rate (e.g., Jeenas, 2018).

led banks to permanently lower deposit growth rates. A monetary shock inducing a 25bp increase in the federal funds rate leads banks with higher HQ liquidity ratios to expand their total deposits by 0.35% more relative to banks with less HQ-liquid asset holdings during the first eight quarters after the shock. The same shock leads banks with higher LQ liquidity ratios to contract their total deposits by 1.43% more relative to banks with less LQ-liquid assets four years after the shock. This evidence suggests that HQ liquidity stabilizes banks' funding in the short term after monetary shocks, while LQ liquidity destabilizes banks' funding permanently.

The second set of results reveals equilibrium conditions related to banks' lending behavior during tightening cycles. Initially, banks with higher HQ liquidity ratios (as well as LCRs) tend to experience reduced loan growth, according to the baseline findings. Nevertheless, after controlling for relevant confounding factors such as income and duration gaps, the influence of HQ liquidity on loan growth becomes positive but statistically insignificant. Meanwhile, the effect of LCR turns positive and significant. On the other hand, when exploring LQ liquidity-related heterogeneity, the evidence suggests that banks with larger LQ liquidity ratios experience lower growth rates in response to monetary shocks. This pattern persists even after controlling for income and valuation shocks induced by monetary policy. Regarding the quantitative effect, a monetary shock inducing a 25bp increase in the federal funds rate leads banks with higher liquidity coverage ratios to expand permanently their total loans by 0.35% more relative to banks with lower LCRs four years after the shock. The same shock leads banks with higher LQ liquidity ratios to contract their total loans by 0.89% more relative to banks with less LQ-liquid assets four years after the shock.

The third set of results reveals the effect related to banks' liquidity transformation activities during tightening cycles. Initially, according to the baseline findings, after a 25bp increase in the Fed's funds rate, banks with higher HQ liquidity ratios (as well as LCRs) tend to reduce liquidity creation by 0.14pp (and 0.18pp) relative to the total size of their balance sheet. This effect is statistically significant between quarters 4 and 13 after the shock. Nevertheless, after controlling for relevant confounding factors, the influence of both liquidity ratios on liquidity transformation becomes statistically insignificant. Furthermore, no heterogeneous effect is implied by LQ liquidity ratios on the transmission of monetary shocks toward banks' liquidity transformation activities.

Fourth, when examining profit dynamics. In response to a monetary tightening shock, banks with higher HQ liquidity ratios are associated with lower net interest margins. In response to a 25bp surprise increase in the Fed's fund rate, the net interest margins of banks standing 1sd above the HQ liquidity distribution are about 0.014pp lower at their peak, occurring in quarter ten. These patterns remain consistent after including controls, albeit with slightly smaller response differences. In response to the same shock, the net interest margins of banks standing 1sd above the LQ liquidity distribution are about 0.007pp lower at their peak, occurring in quarter six. These patterns persist even after controlling for other factors, although the differences in responses become slightly smaller once controls are incorporated.

Related Literature

This research builds on different strands of the literature estimating the heterogeneous effects of monetary policy on the US banking system.

First, it closely relates to the empirical literature on the role of liquid assets[8]. The seminal work of Kashyap and Stein (2000) provides a first empirical attempt to quantify whether the effect of monetary policy on lending supply is amplified (or diminished) due to securities holdings. Bluedorn, Bowdler, and Koch (2017) present renewed evidence on this subject by highlighting the sensitivity of estimations to the nature of the monetary policy shock. Like Kashyap and Stein (2000), when monetary policy is measured as the change in the effective federal funds rate, securities mitigate lending contractions. On the contrary, when monetary policy is measured as surprise shocks, securities amplify the lending contraction[9]. I build on these papers and differentiate from them in the following ways: First, I focus on

[8] Other studies focus on different banks' characteristics that shape the effect of monetary policies on credit supply. For instance, recent attention has been given to the role of competition and market power in the banking industry (e.g., Drechsler, Savov, and Schnabl, 2017; Gödl-Hanisch, 2022), banks' capital and leverage (e.g., Kishan and Opiela, 2000; Paz, 2022; Van den Heuvel, 2002), income shocks and maturity gaps (e.g., English, Van Den Heuvel, and Zakrajšek, 2018; Gomez et al., 2021), securitization (e.g., Di Maggio et al., 2017).

[9] An evolving literature is emerging trying to estimate the effects of monetary policy-driven changes in market value on securities on lending (e.g., Krainer and Paul, 2023, for the 2023 tightening monetary cycle)

the cross-sectional heterogeneity in high and low-quality liquidity and definitions of liquidity that align with the regulation-based categories of the newly implemented liquidity coverage ratio. Second, there is a difference in the methodology used. While I applied a dynamic framework using local projections, they used a static two-step regression approach. Finally, the set of monetary policy shocks is obtained with more recent high-frequency identification strategies, cleaning out the new effect of monetary policy announcements.

Second, it closely relates to the empirical literature on the factors (de)stabilizing banks' funding, profits, and equity during monetary cycles. Recent studies highlight the importance of the role of banks' market power on the stabilization of funding sources (e.g., Drechsler, Savov, and Schnabl, 2017, for monetary cycles) while (Li, Loutskina, and Strahan, 2023, for business cycles). Other studies study directly[10] the interest rate risk exposure of banks to monetary cycles (Begenau, Piazzesi, and Schneider, 2015; Di Tella and Kurlat, 2021; Drechsler, Savov, and Schnabl, 2021; English, Van Den Heuvel, and Zakrajšek, 2018; Paul, 2023). To my knowledge, in this regard, no other research has studied the role of liquidity in stabilizing banks' funding and profits during monetary cycles.

Third, regarding the literature on banks' liquidity creation. Since the seminal work of Berger and Bouwman (2009), the literature has explored the relationship between banks' capacity and willingness to create liquidity and other balance sheet characteristics like equity Berger and Bouwman (2009) and Evans and Haq (2021). Since I focus on the interaction between liquidity and monetary policies, the closest paper is Berger and Bouwman (2017), which estimates the impact of conventional monetary policy on U.S. banks' liquidity creation from 1984q1 until 2008q4. They find that the impact of monetary policy mainly occurs for small banks during non-crisis times, while the effects are weak and mixed for medium and large-sized banks. On the other hand, Kapoor and Peia (2021) estimate the effects of the large-scale asset purchase programs on bank liquidity creation and find that banks with a higher share of assets in mortgage-backed securities before the start of the third round of QE program have increased liquidity creation more.[11]. My research indicates that high-quality and low-

[10] In a more indirect way, other studies explore banks' characteristics that explain imperfect pass-through (e.g., Bellifemine, Jamilov, and Monacelli, 2022; Gödl-Hanisch, 2022; Polo, 2021)

[11] Another strand of the literature on bank liquidity creation focuses on the effects of macro and micro-prudential policies. For instance, Roberts, Sarkar, and Shachar (2021) estimate the effects of the liquidity

quality liquidity do not have varying effects in the transmission of either conventional or unconventional monetary shocks toward liquidity creation activities.

Finally, this paper contributes to the literature that analyses the consequences of newly implemented liquidity regulations. Banerjee and Mio (2018) find that UK banks adjusted the composition of assets and liabilities after introducing liquidity regulations. Specifically, banks increased the share of high-quality liquid assets and non-financial deposits while decreasing intra-financial loans and short-term wholesale funding. Gete and Reher (2021) studies the unintended consequences of LCR regulation. They observe that LCR regulation has led to an increase in the market share of lenders operating with a precarious funding model. Furthermore, it has amplified the credit risk shouldered by U.S. taxpayers who provide insurance for Federal Housing Administration loans. Roberts, Sarkar, and Shachar (2021) study the changes in US banks' balance sheets after introducing liquidity coverage ratios. They find that since the announcement of the LCR policy, banks subject to this constraint have created less on-balance-sheet liquidity than unconstrained banks. They highlight that the primary adjustment in liquidity creation happens on the assets side as LCR banks significantly increase their shares of liquid assets (including HQ-liquid assets) while reducing illiquid and semi-liquid assets. In contrast, the policy does not seem to induce differences in liabilities significantly. My research indicates that larger high-quality and low-quality liquidity ratios do not shield banks' profits after contractionary monetary shocks. This documented evidence captures the secondary effects of liquidity regulations on the transmission of monetary policies for the sample of unregulated banks.

Overview. The rest of the paper is organized as follows. Section 2 introduces some theoretical underpinnings related to the use of liquid assets by banks and their role in the transmission channels of monetary policy. Section 3 presents the data used, discusses the construction of the variables of interest, and highlights some stylized facts regarding the

coverage ratios, Berger, Bouwman, et al. (2016) study the effects of regulatory interventions and bailouts, Danisewicz et al. (2018) focus on the effects of bank supervisors' enforcement actions, and Nguyen et al. (2020) study the effect of stress tests. Finally, regarding other types of shocks, Berger, Guedhami, et al. (2022) study the effect of economic policy uncertainty on banks' liquidity hoarding. Beladi et al. (2020) examine the impact of the disruption of the interbank market on banks' liquidity creation and funding ability.

heterogeneity in the US banking system. Section 4 presents the benchmark empirical specification employed and discusses some challenges in the estimations. Sections 5 to 8 presents the estimation results based on the benchmark specification. Section 9 presents results based on the benchmark specifications for monetary shocks of an unconventional nature. Section 10 presents, discusses, and tackles additional methodological challenges. Finally, Section 11 concludes.

2 Review on Monetary Policy Channels and the Role(s) of Liquidity

The reasons prompting banks to maintain holdings of liquid assets are diverse[12]. Furthermore, the roles of liquid assets in monetary transmission are multifaceted. In this section, I first summarize the main determinants of banks' holdings of liquid assets. Subsequently, I discuss the potential role liquid assets might play in the transmission of monetary shocks.

Beginning with the determinants of liquid assets holdings, the literature has highlighted the following reasons:

1. Risk Management Perspective

   Liquid assets play a twofold role in banks' risk management. Banks use them as instruments for hedging liquidity risk and interest rate risks.

   (a) Liquidity Risk Management: The primary purpose of holding liquid assets is to ensure the ability to accommodate both expected and unexpected cash withdrawals from customers (Poole, 1968)[13]. Closely related, liquid assets play a crucial role in reducing the likelihood of bank runs (Diamond and Dybvig, 1983) and might

[12] Compared to non-financial firms, the reasons are also different from those governing non-financial firms (See Stulz, Taboada, and Dijk, 2022)

[13] Liquidity management entails optimizing the allocation of resources between high-yield illiquid loans and low-yield liquid assets. This fundamental trade-off has been founded on the seminal work of Poole (1968), where liquidity management is embedded in a banking portfolio choice problem in which banks choose the optimal amount of liquid assets based on their exposure to liquidity shortfalls and the easiness of getting funds from interbank markets. Banks exploit intermediation margins to maximize profits by investing in high-yield investment opportunities (e.g., loans). Nevertheless, banks' exposure to liquidity risks creates incentives for banks to hold low-yield liquid assets.

act as a buffer, protecting depositors from potential loan losses.

Other strands of the literature indicate that liquid assets, as a liquidity risk management tool, might play a role in the information-revealing process between banks and clients. Evidence is ambiguous in this regard. For some cases, liquid assets might substitute other liquidity risk instruments (e.g., public disclosure), hence reducing banks' transparency (Raz, McGowan, and Zhao, 2022), while in other cases, it can signal a solid and well-diversified portfolio (Stulz, Taboada, and Dijk, 2022).

(b) Interest Rate Risk Management:

The main attraction of a liquid asset for risk management considerations is its capacity to be readily converted into cash. However, recent evidence suggests that banks also benefit from the duration of liquid assets to hedge interest rate risks (Drechsler, Savov, and Schnabl, 2021)[14].

2. Portfolio Investment Perspective

(a) Banks might have investment motives to hold liquid assets. Liquid assets might offer attractive risk returns when considering diversification benefits and low monitoring costs, among other factors (Stulz, Taboada, and Dijk, 2022). Hence, banks might choose them to improve the risk-adjusted expected performance of banks' portfolios

For instance, MBS are held since a) they are profitable and almost credit-free. b) good alternative when loan demand is relatively low or during housing booms (usually when households take out new mortgages or refinance old ones) (See Drechsler, Savov, and Schnabl, 2023).

(b) Provides flexibility in the reallocation of resources: Since liquid assets are easily convertible, banks can make use of them to reallocate their portfolio in response to more profitable opportunities. (See Stulz, Taboada, and Dijk, 2022).

[14] The value of long-term liquid assets falls in response to increases in short-term rates while the value of deposit franchise increases. This is explained in detail in Section A.6.

(c) Self-insurance: The gains from acquiring assets at fire-sale prices make it attractive for banks to hold liquid assets. (See Acharya, Shin, and Yorulmazer, 2011)

(d) Balance sheet synergeis: The banking business is characterized by lending via commitments, which like deposits, clients can unexpectedly takedown. This adds an extra motive to hold a provision of liquid assets to satisfy their potential needs. For instance, Kashyap, Rajan, and Stein (2002) highlights that when deposit withdrawals and commitment takedowns are imperfectly correlated, the two activities can share the costs of the liquid-asset stockpile.

3. Regulatory Requirements

   Liquid assets are used to comply with regulatory mandates. Traditionally, cash is used to comply with reserve requirements, and more recently, other types of securities are used to fulfill newly implemented requirements. Recent evidence suggests that liquidity-requirement policies encourage banks to increase their holdings of liquid assets (See Sundaresan and Xiao, 2023, for the case of high-quality liquidity).

2.1 The Role(s) in Monetary Policy Trnasmission

One compelling argument underscores the significance of the interplay between monetary policies and liquidity. While monetary policies can potentially disrupt banks' performance, liquid assets can serve as stabilizing agents, bolstering banks' resilience in the face of monetary policy fluctuations. Furthermore, the beneficial property of liquid assets can either be amplified or hindered by monetary policy measures. In this section, I discuss whether, through the lenses of the banking channels (discussed in Section A), monetary policies might have a differential impact on characteristic-$Y_{i,t}$ due to holdings of liquid assets (and their types) and what would be the sign of this relationship.

Fund of Last Resort: The classic interpretation of the role of liquidity in the bank lending channel suggests that liquid assets act as a last resort fund when external financing for banks becomes costly. With their capacity to generate immediate cash flows, banks can draw down liquid assets to protect their loan portfolios in response to a tightening monetary policy that reduces retail deposits. This interpretation has been tested empirically by Kashyap and Stein (2000), who found that banks with higher ratios of securities to assets can internally refinance in response to monetary shocks, reducing the contraction in lending supply.

However, recent evidence, such as the study by Bluedorn, Bowdler, and Koch (2017), suggests that this classic view might not always hold true. Various factors can influence this interaction. One significant factor to consider is the potential impact of policy-induced pricing effects, which will be discussed further in the following sections. Another crucial factor is the size of funding withdrawals; banks may discover that their liquid assets are inadequate to cover all deposit withdrawals, especially when facing substantial shocks. The dynamic estimation approach using local projections aims to delve into these complexities comprehensively. Furthermore, examining liquidity coverage ratios to measure actual bank liquidity might provide deeper insights into these dynamics.

Unhedged Interest Rate Risk: As mentioned before, a mechanism through which monetary policy and liquid assets interact is through the valuation effect of monetary policy on securities prices. Specifically, since long-term liquid securities are exposed to interest rates, banks can be highly exposed to capital losses on securities. In line with the prediction in the balance sheet channel, banks are expected to contract lending more aggressively in response to monetary tightening shocks. Motivated by the banking events of March 2023, recent evidence in Krainer and Paul (2023) suggests that fluctuations in asset valuations of bank security holdings induced by the strong monetary tightening cycle of 2022 have a negative spillover effect on credit supply.

Risk Management Dilemma: In contrast to the previous point, when banks are fully hedged against policy-driven fluctuations in securities' prices, changes in policy rates should not impact their net worth. Recent empirical studies support this notion, indicating that banks employ their deposit franchise as a hedge against interest rate risk associated with their assets (Drechsler, Savov, and Schnabl, 2021). Nevertheless, recent occurrences suggest that tightening monetary cycles can still disrupt banks even with full mitigation against asset valuation fluctuations.

Drechsler, Savov, Schnabl, and Wang (2023) propose a model that reconciles these contrasting ideas. Since securities might play a dual role in risk management, there are situations in which they can serve banks to either hedge themselves to interest rates or liquidity risk but not both. In particular, when banks choose securities with long-term duration to hedge interest rate risk, banks become exposed to a run if interest rates rise. On the contrary, when securities with shorter duration are used to hedge liquidity risks, banks become exposed to insolvency if the rate falls.

The dilemma occurs because the deposit franchise hedging strategy is inherently unstable. As presented above, banks earn a deposit spread because they invest in fixed operating costs that entitle them to monopoly power in deposit markets. The deposit franchise has a negative duration, meaning its value positively correlates with interest rates. To hedge fluctuations in the deposit franchise, banks invest in assets with positive duration, that is, assets such that their value is negatively correlated with policy rates, e.g., long-term loans and securities. Nevertheless, this hedging strategy can break down when deposits that highly contribute to the value of the deposit franchise (i.e., with low deposit-spread-betas) are withdrawn from the banking system[15].

Finally, Drechsler, Savov, Schnabl, and Wang (2023) suggest that the dilemma is resolved when uninsured deposits have high-deposit spread-betas because banks find it optimal to allocate these types of deposits into short-term assets[16]. Under these conditions, the bank's goals for managing interest rates and liquidity are in harmony.

Cash-flow Effects Liquid assets are also subject to repricing and maturity, hence changes in policy rates generate income flows due to the repricing or maturity of securities. Therefore, they play a role in the lines of the cash-flow channel (Gomez et al., 2021), in the sense that income shocks can help to alleviate constraints on lending.

[15] Drechsler, Savov, Schnabl, and Wang (2023) present this as a multiple equilibria result: "When interest rates are low, the value of the deposit franchise is small, and the valuation of assets is high. A run does not occur because the value of the bank would be unaffected if it did occur. But when interest rates rise, and the deposit franchise comes to dominate the value of the bank, a run equilibrium arises. This is true even if the bank is fully hedged to interest rates in the sense that its value is insensitive to interest rate shocks outside the run equilibrium."

[16] Allocating uninsured deposits with low-deposit spread-betas into short-term assets increases exposure to interest rate risk since the deposit franchise and short-term assets have negative duration.

Demand-side Roles Banks usually are in the obligation to refinance a fraction of their liabilities. Through this process, banks' creditors make a choice based on banks' solvency and market interest rates. However, under information asymmetries, creditors cannot correctly observe banks' solvency status. Liquidity assets might influence the despositors' choice, to shift their deposits from one bank to another or to change the deposit product used.

Analogous to Disyata (2011) interpretation on capital, banks with higher liquidity ratios should face lower external finance premiums because the cash-generating capacity of liquid assets can insure depositors. This might transfer confidence to depositors, increasing deposit flow stability.

Nevertheless, liquidity is not necessarily a clean signal of a safe balance sheet structure or the bank's capacity to respond against shocks. In contrast to the idea that liquid assets unconditionally reduce banks' liquidity risks, a strand of the literature considers that accumulating liquidity buffers increases funding liquidity risk. This is due to the complementarities with other liquidity management instruments, specifically, banks' public communication. Raz, McGowan, and Zhao (2022) provides evidence supporting that the accumulation of liquid assets triggers an increase in liabilities' liquidity risks.

High-quality and low-quality liquidity can serve as important indicators in the capital channel, signaling to the public whether a bank is facing a dearth of lending opportunities. These signals are observed by investors who use them to anticipate a bank's ability to generate profits in the future. If these signals suggest that a bank is likely to struggle in terms of profitability, it can have several implications. One significant outcome is a reduction in the bank's equity. Investors may become less attracted to the bank's profile, which, in turn, impacts the bank's equity levels.

Asymmetric Pricing Behavior Excess Liquidity may play a role in determining lending and deposit rates. For instance, Agénor and Aynaoui (2010) show that excess reserves create asymmetries in the pass-through of policy rates towards deposits and lending rates. Specifically, deposit rates are less responsive to increases in the refinance rate (or to reductions in the required reserve ratio) because banks internalize the fact that raising the deposit rate will induce households to shift more of their assets into bank deposits – thereby increasing eventually the actual stock of reserves and compounding (all else equal) the initial problem of excess liquidity. If true, liquidity may play a role in determining deposit spreads.

Similarly, the greater the degree of excess reserves, the more banks may be willing to weaken the procedures they normally use to check the creditworthiness of potential borrowers, credit exposure limits, and other standard contract terms or loan covenants. This might suggest that banks with higher levels of liquidity become more risk-averse following an expansionary monetary shock.

Possible differentiated roles of liquidity categories Why differentiation in liquidity qualities might be relevant for the transmission channel? Differences in the response to the interaction between monetary policy shocks and liquidity ratios are expected because of inherent differences in fundamental characteristics like (a) low risk, (b) ease and certainty of valuation, (c) low correlation with risky assets, (d) listed on a recognized exchange, (e) active and sizable market, (f) low volatility, (g) flight to quality or h) limited cash convertibility.

First, consider differentiation in collateral function. Boissay and Cooper (2020) distinguishes collateral types according to the private information available about the value of the pledgeable portion of the asset. Certain assets can serve as outside collateral because their *market value* can be pledged, such as using treasuries in a Repo arrangement. In contrast, other assets can function as inside collateral, with only their *cash flows* available for pledging, like cash flows in the asset-backed commercial paper market. Since the cash flow generated by the assets supporting inside collateral is considered private information, the pledgeability of these assets is endogenous and hinges on the degree of informational asymmetry and the quality of banks' assets.

Therefore, banks whose balance sheets consist more of inside collateral than outside collateral are at a higher risk of facing self-fulfilling liquidity dry-ups, a phenomenon often referred to as the "collateral trap". This distinction becomes particularly relevant when comparing LQ-liquid assets (such as asset-backed securities) to HQ-liquid assets (like treasuries). It also ties into the concept that banks' lenders might hold pessimistic views about a bank's quality based on its liquid asset portfolio composition.

Secondly, consider the potential limitations on the convertibility or monetization capacity of assets. Operational constraints can come into play here, potentially restricting the ease with which securities can be converted into cash. For instance, Afonso et al. (2020) highlights that when dealing with unusually large quantities of assets being sold on the same day, finding willing counterparties to purchase or engage in Repo transactions for these assets can be challenging. This could be due to a perception that such a large-scale attempt to convert assets into cash might signal financial stress. Consequently, counterparties might opt to hold onto their cash reserves, anticipating potential future needs. This aspect is particularly significant when it's assumed that securities classified as HQ liquid assets can be readily and swiftly converted into cash. However, the operational constraints associated with handling very large quantities of assets, even those as seemingly liquid as HQ securities, are often overlooked.

Alternatively, the same operability constraint might translate into differentiability in fire sale prices. Afonso et al. (2020) highlights that unusually large sales might drive a hard bargain if counterparties believe that the bank is under pressure to sell, resulting in the bank accepting significantly lower prices for its assets.

Finally, consider differences in signaling. Differences between HQ and LQ liquidity might arise from the signal liquidity sent to clients. For instance, clients can perceive that HQ liquidity is less opaque than complexly structured LQ assets like (CMOs). From the depositors' perspective, less opaque assets have lower exposure to asymmetric information problems concerning the value of the bank's assets.

3 Descriptive Evidence

3.1 Data and Sample

Balance sheets data. I focus on banks' balance sheets at the bank level at the quarterly frequency. Items at the bank level are from the quarterly Call Reports Reported by the

FDIC[17]. Quarterly balance sheets items at the bank-holding level are obtained from the FR Y-9C Reports[18].

Call Reports contain statistics on all depository institutions in the U.S. which are FDIC-insured (insured subsidiaries). This universe of institutions comprises commercial, credit card, and savings banks, and the information Reported is related to the main categories of banks' balance sheets. I deflate all balance sheet items using the seasonally adjusted GDP Implicit Price deflator in the United States (base 2015=100).

Monetary policy shocks High-frequency structural monetary policy shocks are obtained from the publicly available time series constructed by Jarociński and Karadi (2020)[19].

Sample Selection First, I removed all savings banks (thrift banks). Second, to have a more consistent computation of the level of high-quality liquid assets at the bank-quarter level, I remove commercial banks with total assets lower than $300 million since this set of banks do not have to Report their holdings of reserve balances due from Federal Reserve Banks. Reporting requirements and limitations are detailed in Appendix B.2. Finally, banks included are all depository institutions that do not face post-crisis liquidity requirements beyond standard reserve requirements. This sub-sample is hereafter named the Non-LCR sample since it follows the criteria established in the liquidity coverage ratio. The description of the categorization is presented in Appendix C.

To alleviate issues in the estimations, I remove all bank-quarter observations such that 1) do not have commercial real estate or commercial and industrial loans outstanding; 2) have zero deposits; and 3) have an equity capital to GTA ratio lower than 1% (following Berger and Bouwman (2017)). Moreover, I winsorize bank-quarter observations below the 1st and above the 99th percentile of the main dependent variable to control for outliers (See Jeenas (2018)). I balance the sample by excluding any bank entering or exiting during each sample period.

[17] Available at https://www7.fdic.gov/sdi/download_large_list_outside.asp

[18] Available at https://www.ffiec.gov/npw/ and https://www.chicagofed.org/banking/financial-institution-Reports/bhc-data.

[19] Available at https://marekjarocinski.github.io

3.2 Descriptive Statistics

In this section, I provide descriptive statistics for the sub-sample of non-LCR depository institutions. After excluding LCR banks, the fully balanced sample consists of 29,106 bank-quarter observations and includes 441 unique banks over 66 quarters. Based on size, there are 180 small, 171 medium, and 93 large banks.

3.2.1 Banks' Portfolio of Liquid Assets

First, the holdings of liquid assets (cash + securities portfolio) are extensive, accounting for around 29 percent of gross total assets on average. Table 1 column 1 summarizes the composition of banks' liquidity by asset class. The average bank allocates around 15% in HQ liquidity and around 11% in LQ liquidity. Most banks' HQ-liquid assets are mainly comprised of Level 2a assets, which account for around 10.4 percent of the total balance sheet. From this category, GSEs debt and GSEs residential-MBS are the most significant asset classes, accounting for around 4.1 and 5.8 percent, respectively. The remaining component of HQ assets, Level 1 assets, account for only 3.1 percent, and it is mainly composed of reserves (2.2%) and some GNMA residential-MBS (1.0%). Regarding LQ-liquid assets, the most significant asset classes are debt issued by states and political subdivisions (5.0%), collateralized mortgage obligations (3.3%), and Fed funds and reverse Repos (1.1%). Relative to expected cash flows, the average bank operates with a liquidity coverage ratio of 0.58, indicating that its HQ liquidity does not fully cover the expected deposit outflows within a quarter.

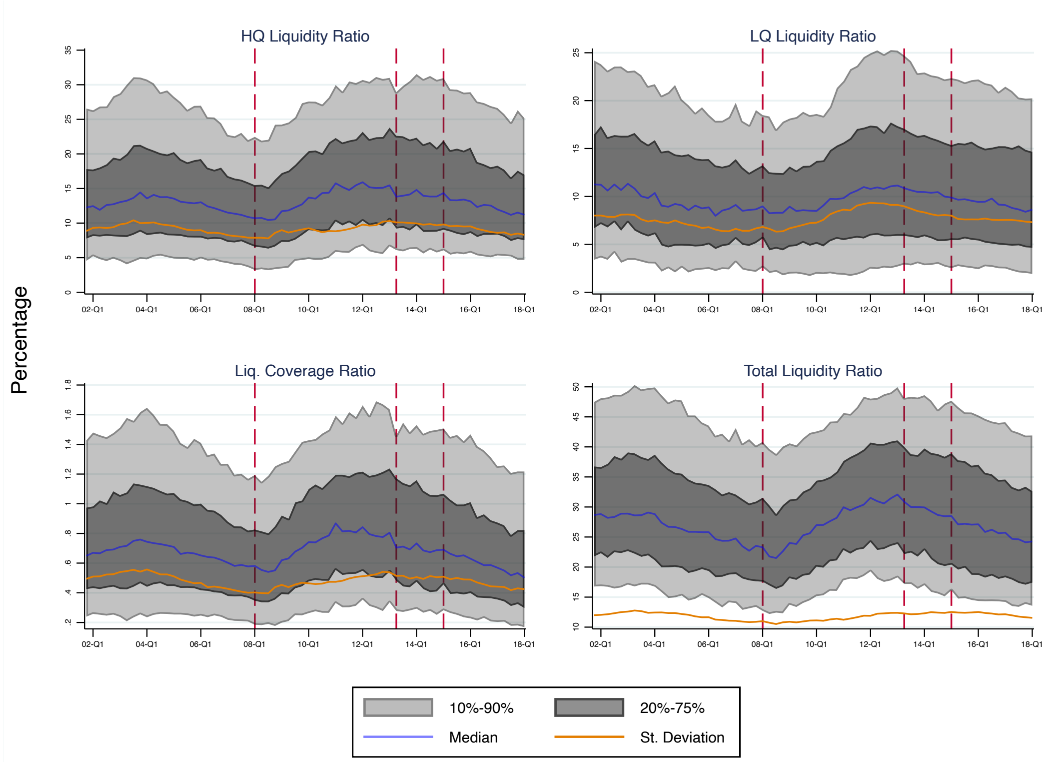
Table 1: Statistics on Liquidity Ratios

	Mean	SD	Min	Max	10th percentile	25th percentile	50th percentile	75th percentile	90th percentile
Total Liquid Assets Ratio	28.99	12.23	5.18	72.14	15.02	19.89	27.02	36.12	46.16
HQ Liquidity Ratio	14.94	9.31	0.28	52.56	4.90	8.24	13.00	19.56	28.10
HQ-L1 Liquidity Ratio	3.11	5.04	0.00	38.12	0.03	0.20	1.06	3.72	8.93
Reserves	2.17	3.71	0.00	29.01	0.01	0.10	0.60	2.53	6.40
Treasury Securities	0.77	2.43	0.00	20.43	0.00	0.00	0.00	0.26	1.77
RMBS by GAs	0.01	0.19	0.00	5.58	0.00	0.00	0.00	0.00	0.00
Other Debt by GAs	0.05	0.36	0.00	5.41	0.00	0.00	0.00	0.00	0.00
HQ-L2a Liquidity Ratio	10.38	8.25	0.00	49.93	1.79	4.35	8.56	14.20	21.26
Other Debt by GSEs	4.18	5.97	0.00	34.08	0.00	0.00	1.53	6.37	12.23
RMBS by GSEs	5.81	6.45	0.00	40.80	0.05	1.01	3.85	8.34	13.82
CMBS by US Gov. (Pass-Throughs)	0.24	0.73	0.00	7.16	0.00	0.00	0.00	0.04	0.75
CMBS by US Gov. (Other)	0.37	1.11	0.00	9.04	0.00	0.00	0.00	0.00	1.09
LQ Liquidity Ratio	11.12	7.89	0.00	45.44	2.43	5.39	9.61	15.05	21.57
Fed Funds Sold & Reverse Repo	1.13	2.27	0.00	20.66	0.00	0.00	0.02	1.26	3.71
CMOs and REMICs by US Gov.	3.25	4.58	0.00	32.88	0.00	0.00	1.40	4.77	9.14
Securitites by Political Subdiv.	5.00	4.88	0.00	28.98	0.13	1.15	3.61	7.53	11.83
Other Debt Securities	0.70	1.53	0.00	11.69	0.00	0.00	0.01	0.65	2.24
RMBS by Privates	0.30	0.95	0.00	9.20	0.00	0.00	0.00	0.02	0.79
Other CMBS	0.01	0.10	0.00	1.73	0.00	0.00	0.00	0.00	0.00
ABS	0.09	0.45	0.00	6.54	0.00	0.00	0.00	0.00	0.02
Structured Financial Products	0.07	0.31	0.00	3.48	0.00	0.00	0.00	0.00	0.07
Foreign Debt Securities	0.03	0.18	0.00	2.37	0.00	0.00	0.00	0.00	0.01
Trading Account Assets	0.06	0.33	0.00	6.43	0.00	0.00	0.00	0.00	0.01
Liq. Coverage Ratio	0.58	0.41	-0.01	2.49	0.15	0.28	0.50	0.78	1.15

Notes: This table shows bank-level in-sample averages of the main liquidity ratios. Variables are all scaled by gross total assets, except the Liquidity Coverage Ratio. For a dynamic representation of the data, see Figure 2.

Second, banks exhibit considerable heterogeneity in their investments in liquid assets from the different categories. Table 1 column 2 highlights significant variation in liquidity ratios. The in-sample standard deviations reveal a dispersion of 12.2pp concerning total liquidity, 9.3pp for HQ liquidity, and 7.9pp for LQ liquidity. Beyond the average estimates, Figure 2 illustrates the evolution over time of heterogeneity across banks concerning the biggest liquidity categories. Notably, the degree of heterogeneity across the different types of liquidity has remained relatively stable over time, with a slight and temporary increase in dispersion of LQ liquidity observed after the Global Financial Crisis. Banks' HQ liquidity ratios move uniformly across the percentiles, while changes in LQ liquidity ratios in the bottom 20 percentile exhibit different patterns relative to the remaining sample.

Figure 2: Cross-Sectional Heterogeneity in Liquidity Ratios



Notes: The graph shows the evolution of the 10, 25, 50, 75, and 90 percentiles and the standard deviation across No-LCR commercial banks from 2001q4-2018q1. Vertical dashed lines indicate 2008q4, 2013q2, and 2015q1.

Figure 2, beyond showing how banks differ concerning their liquidity holdings, highlights that liquidity presents a significant cyclical component. To understand if economic cycles and banks' invariant characteristics fully explain the degree of heterogeneity observed, evidence on the evolution of residualized-liquidity after controlling for banks and quarter-fixed effects is presented in Appendix Figure 26. The differences in liquidity ratios across banks are lower; however, around 6 percent of the heterogeneity remains unexplained.

Additional descriptive statistics characterizing the heterogeneity for narrower asset categories and the portfolio of liquid assets by quintile groups are presented in Appendix C.2.1. Furthermore, Table 8 presents the transition matrices for liquidity ratios.

3.2.2 Balance Sheet Characteristics

What are the distinctive attributes that differentiate banks according to their varying levels of liquidity? Table 2a presents detailed bank-level data, providing insights into the average balance sheet characteristics within each of the five liquidity quintiles.

Starting with banks' lending activities, as expected, banks at the top of the distribution of the different liquidity ratios tend to have lower shares of loans. Nonetheless, the composition of the loan portfolio adheres to a consistent pattern across the distributions. Banks tend to allocate more significant resources to commercial real estate loans, followed by residential real estate loans, with C&I loans representing the third category in this progression.

Regarding banks' funding composition, a consistent trend emerges across the spectrum of liquidity ratios, wherein total domestic deposits consistently represent approximately 78% to 80% of the total assets. In contrast, bank capital makes up approximately 10%. Delving into the breakdown of deposit funding on banks' balance sheets, a significant proportion of funds stem from non-transaction accounts, constituting an average of around 67%, with transaction accounts contributing around 12.5%. Although there are variations in the distribution of these shares across liquidity quintiles, the differences between quintiles are generally contained within a 2.0 percentage point range.

Among the different types of deposits, banks rely on sources that usually offer higher interest rates. That is the case for time deposits (e.g., CDs), which emerge as the primary source, accounting for 27.5%, followed by money market deposits at 23.4%, other savings deposits at 15.7%, and demand deposits at 8%. These patterns persist across the liquidity distributions, with slight variations in shares but not exceeding the 3.0 percentage point range between quintiles. Altogether, this composition implies that banks rely on high-rate funding sources that are more responsive to monetary policy[20].

Regarding interest-rate hedging, the data reveals that banks generally use only a few derivatives to manage their exposure to interest-rate risks. Notably, banks with lower HQ liquidity

[20] Recent evidence describing how rates on time deposits are typically higher but also rise more in response to a higher fed funds rate is available here https://libertystreeteconomics.newyorkfed.org/2023/04/deposit-betas-up-up-and-away/

tend to hold more interest rate contracts than those in higher liquidity quintiles. Swaps are the most common form of hedging employed by these banks. This aligns with findings from Gomez et al. (2021), which indicate that the median bank typically has no active interest-rate contracts.

Finally, Table 2b illustrates the variations in profitability among banks. Despite the association between larger holdings of liquid assets and lower profit margins, the differences in profitability among the different liquidity quintiles are relatively small. The average net interest margin in the sample stands at 3.8%, and notably, disparities in interest rate margins across the liquidity distribution do not exceed 0.48pp. Additionally, average interest rates earned and paid exhibit similarities across the quintiles. Further descriptive statistics detailing the evolution of cross-sectional heterogeneity in profit margins are available in Appendix C.2.2.

Table 2: Banks' Characteristics Grouping by Quintiles

(a) Balance Sheet

	Quintiles of HQ Liquidity Ratios					Quintiles of LQ Liquidity Ratios					Quintiles of Liq. Coverage Ratios					
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	Total
Gross Total Assets (Log)	13.59	13.76	13.59	13.47	13.43	13.58	13.64	13.56	13.45	13.61	13.60	13.76	13.52	13.53	13.43	13.57
Total Loans	71.72	69.05	65.54	61.78	52.15	71.38	67.89	63.54	62.76	53.92	70.62	68.88	65.40	61.73	53.38	63.98
Commercial Real Estate Loans	29.72	27.98	25.55	25.24	21.48	29.69	29.14	25.37	25.35	20.10	29.28	27.95	26.06	24.71	21.89	25.98
Residential Real Estate Loans	22.29	21.78	22.60	19.89	17.11	21.60	21.82	20.84	20.99	18.21	22.54	22.15	21.47	20.26	17.17	20.71
Commercial & Industrial Loans	11.93	12.58	10.32	9.92	7.93	12.55	10.24	9.78	10.35	9.56	10.91	12.15	10.86	9.92	8.76	10.51
Consumer Loans	3.90	3.79	4.74	4.19	3.30	4.07	3.48	4.71	3.87	3.79	4.43	3.76	3.98	4.68	3.05	3.98
Agricultural Loans	2.12	1.56	1.46	1.33	1.22	1.61	2.03	1.82	1.20	1.02	1.84	1.78	1.88	1.04	1.16	1.54
Total Domestic Deposits	79.33	78.80	80.04	79.75	79.75	80.13	79.77	79.48	79.94	78.35	80.21	79.65	79.48	79.22	79.14	79.54
Transaction Deposits	11.42	11.62	12.32	12.70	14.54	12.40	12.45	12.35	12.71	12.76	11.33	11.50	12.60	12.87	14.36	12.53
Demand Deposits	7.29	7.86	8.31	8.08	9.34	8.44	8.12	8.05	7.98	8.30	7.27	7.67	8.06	8.26	9.63	8.18
Non Transaction Deposits	67.86	67.18	67.59	67.02	65.00	67.69	67.29	67.06	67.22	65.30	68.83	68.17	66.84	66.24	64.54	66.92
Money Market Deposit	21.94	25.10	23.86	23.64	22.82	22.53	24.72	23.49	23.39	23.11	23.28	25.54	21.58	23.87	22.88	23.44
No Transaction Time Deposits	29.69	27.15	27.82	27.22	25.90	29.57	29.06	27.02	27.08	24.97	29.02	27.35	29.11	26.95	25.47	27.57
Other Savings Deposits	16.12	14.91	15.94	15.92	15.86	15.47	13.52	16.35	16.53	16.99	16.41	15.20	16.15	15.36	15.70	15.76
Fed Funds Purchased & Repos	2.88	2.82	2.96	3.12	4.13	2.67	3.12	3.18	3.13	3.85	2.88	2.84	2.71	3.64	3.83	3.19
Equity Capital	10.08	10.32	9.89	9.71	10.01	9.99	10.04	10.08	9.89	10.00	10.05	10.08	10.05	9.66	10.15	10.00
Core Deposits	67.99	68.73	70.62	69.99	70.34	68.59	69.47	69.78	70.14	69.72	69.58	69.59	69.09	69.80	69.59	69.53
bro_GTA	4.66	3.07	2.12	2.13	0.92	4.01	2.59	2.69	2.50	1.04	4.05	2.73	2.79	2.02	1.31	2.58
trnipcoc_GTA	9.76	9.84	10.45	10.52	11.81	10.82	10.44	10.28	10.14	10.71	9.68	9.57	10.55	10.69	11.91	10.48
ntripc_GTA	62.51	62.02	62.13	61.38	59.22	63.50	61.96	60.70	61.64	59.27	63.91	62.45	60.71	60.72	59.34	61.44
Total Time and Savings Deposits	72.02	70.90	71.63	71.64	70.25	71.68	71.61	71.41	71.96	69.76	72.90	71.97	71.40	70.85	69.33	71.29
Insured Deposits	59.27	56.27	59.79	58.63	57.80	59.15	59.37	58.59	58.33	56.36	59.97	57.19	59.42	58.81	56.50	58.37
Interest-bearing Deposits	65.54	64.87	65.74	64.62	63.52	65.63	65.14	64.78	64.88	63.77	66.20	65.36	65.86	64.40	62.49	64.85
Interest-bearing Deposits (Foreign)	1.02	2.52	31.19	5.60	6.70	2.85	2.60	2.45	0.06	24.18	0.53	1.94	0.90	27.82	8.02	9.30
Interest Rate Contracts	4.57	4.38	2.26	2.05	1.06	3.38	2.54	3.01	2.68	2.64	3.97	3.76	3.13	2.15	1.27	2.85
IR Swaps (NV)	1.85	2.20	1.44	1.01	0.60	1.17	1.49	1.56	1.49	1.36	1.73	1.79	1.59	1.23	0.72	1.41
IR Futures and Forward	1.26	0.87	0.48	0.48	0.22	1.07	0.47	0.48	0.58	0.70	1.05	0.87	0.63	0.53	0.23	0.66
IR Written Option Contracts	0.98	0.64	0.37	0.23	0.17	0.69	0.44	0.45	0.39	0.42	0.83	0.66	0.35	0.37	0.17	0.48
IR Purchased Option Contracts	0.31	0.26	0.19	0.19	0.08	0.14	0.09	0.34	0.25	0.21	0.29	0.24	0.15	0.20	0.14	0.21
Liquidity Creation (On BS)	36.21	34.80	30.90	28.70	21.58	36.56	33.77	29.84	29.26	22.14	35.38	34.95	30.52	28.50	22.60	30.38
Total Liquid Assets Ratio	20.83	23.41	27.42	31.29	41.63	21.17	24.68	29.22	30.42	39.89	22.07	23.64	27.43	31.42	40.29	28.99
Total Semiliquid Assets Ratio	27.19	26.65	28.17	25.30	21.31	26.68	26.08	26.51	25.94	23.20	28.00	26.90	26.33	26.00	21.27	25.69
Total Iliquid Assets Ratio	51.80	49.93	44.67	43.49	37.16	52.04	49.26	44.23	43.67	37.25	49.74	49.41	46.32	42.84	38.60	45.37
Total Liquid Liabilities Ratio	52.61	54.60	55.43	55.82	58.32	53.38	53.91	55.70	56.07	57.84	54.16	55.21	53.15	56.36	57.80	55.36
Total Semiliquid Liabilities Ratio	35.28	32.97	32.94	32.54	29.91	34.52	34.11	32.26	32.15	30.49	33.77	32.75	34.86	32.21	30.18	32.73
Total Iliquid Liabilities Ratio	11.05	11.39	10.72	10.65	10.91	11.00	10.92	10.99	10.80	10.98	11.01	11.01	10.99	10.58	11.09	10.94

(b) Profitability

	Quintiles of HQ Liquidity Ratios					Quintiles of LQ Liquidity Ratios					Quintiles of Liq. Coverage Ratios					
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	Total
Net Int. Rate Margin	3.99	3.89	3.84	3.79	3.51	4.01	3.84	3.84	3.75	3.57	4.06	3.87	3.79	3.77	3.52	3.80
Int. Rate Income	5.48	5.33	5.24	5.16	4.78	5.46	5.25	5.23	5.13	4.90	5.50	5.29	5.25	5.16	4.79	5.20
Int. Rate Expenses	1.51	1.44	1.40	1.37	1.27	1.46	1.41	1.39	1.39	1.33	1.45	1.42	1.45	1.39	1.27	1.40
Non Int. Income	1.21	1.25	1.11	1.04	1.19	1.21	1.07	1.33	1.09	1.11	1.24	1.18	1.12	1.06	1.20	1.16
Non Int. Expenses	3.05	3.02	2.98	2.92	2.88	3.13	2.93	3.09	2.91	2.79	3.08	3.00	2.96	2.90	2.91	2.97
ROA	1.14	1.09	1.02	1.04	1.04	1.06	0.98	1.15	1.02	1.11	1.17	1.06	1.05	1.02	1.02	1.06
Provision For Credit Losses	0.34	0.35	0.32	0.26	0.22	0.36	0.31	0.29	0.30	0.21	0.34	0.33	0.30	0.29	0.22	0.30
Int. Rate on Loans and Leases	3.68	3.64	3.71	3.72	3.73	3.75	3.67	3.73	3.67	3.65	3.72	3.62	3.71	3.73	3.69	3.69
Int. Rate on Safety	2.10	2.10	2.04	2.05	2.00	1.99	1.99	2.06	2.10	2.15	2.09	2.08	2.07	2.04	2.00	2.06
Int. Rate on Securities	2.17	2.13	2.08	2.09	2.04	2.04	2.04	2.11	2.14	2.19	2.15	2.11	2.11	2.09	2.04	2.10
Int. Rate on Fed Funds	3.71	4.46	3.59	3.50	3.88	4.32	3.95	3.35	3.81	3.61	3.84	4.46	4.31	2.79	3.84	3.81
Int. Rate on Balances Due from DIs	0.16	0.16	0.19	0.18	0.19	0.21	0.14	0.20	0.16	0.17	0.16	0.15	0.17	0.19	0.20	0.17
Int. Rate on Deposits	0.87	0.82	0.81	0.78	0.73	0.85	0.82	0.80	0.80	0.75	0.85	0.82	0.84	0.79	0.73	0.80
Int. Rate on IB Deposits	1.03	0.97	0.95	0.94	0.89	1.01	0.97	0.95	0.95	0.90	1.00	0.97	0.98	0.95	0.89	0.96
Int. Rate on Deposits (Net)	0.62	0.56	0.53	0.50	0.44	0.59	0.55	0.50	0.53	0.48	0.57	0.57	0.56	0.50	0.45	0.53

Notes: This table shows bank-level in-sample averages of the main liquidity ratios by quintile groups based on liquidity ratios. The last column presents the in-sample average. Variables are all scaled by gross total assets.

3.2.3 Correlation Structure

What are the characteristics that exhibit strong correlations with liquidity ratios? Table 9 provides an overview of the linear correlation structure among banks' characteristics in the sample. Examining columns 1 to 3, we observe that liquidity ratios exhibit strong negative correlations with profitability measures, which aligns with the expectation that higher levels of liquid assets generally lead to lower interest rate income. Furthermore, several variables stand out with notably high correlation coefficients: a) Positive linear correlation with deposit-spread-betas with coefficients between 0.11 and 0.13. b) Positive and high linear correlation with risk-weighted capital-to-asset ratios with a coefficient of 0.47-0.45 for HQ liquidity and 0.24 for LQ liquidity[21]. c) Positive and high linear correlation with duration mismatch with coefficients between 0.15 and 0.22[22]. d) Negative and high linear correlation with income gaps with a coefficient between -0.17 and -0.23. Finally, some exclusive correlations: HQ liquidity is negatively correlated with expected loan growth (-0.18 and -0.20), while LQ liquidity is positively correlated with deposit markups (0.20).

Are these correlation coefficients driven by common factors? To explore the importance of common factors in the correlation structure of Table 9, I estimate correlation coefficients accounting for aggregate business cycle fluctuations and banks' specific business models. To do so, I present binned scatter plots illustrating the relationship between residualized liquidity ratios and residualized banks' characteristics, where the residuals are obtained after controlling for bank-fixed and time-fixed effects. Figure 3 displays the results for the variables that remain strongly correlated with the liquidity ratios. The results of this exercise confirm the directional trends observed in Table 9, with a couple of noteworthy exceptions: HQ liquidity ratios exhibit a stronger correlation with deposit volatility than indicated by the previous correlation coefficients[23]. Additionally, LQ liquidity is found to be uncorrelated with

[21] The high correlation can be mainly attributed to the presence of capital requirements. Since assets such as excess reserves or Treasury securities (HQLA-1) carry a zero risk weight, banks can comply with their capital requirements with additional HQ liquidity (See Ihrig et al., 2017).

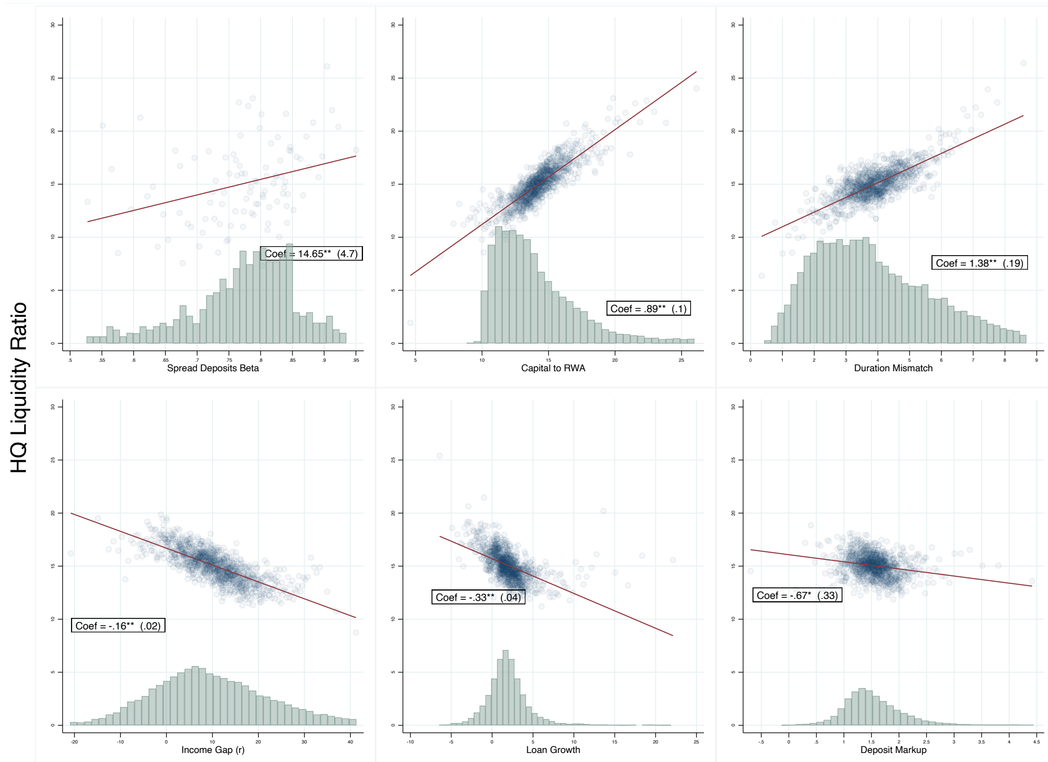
[22] This correlation might be explained because liquidity is composed of long-term assets, and banks hedged their deposit franchise by extending the maturity of their balance sheet (See Drechsler, Savov, and Schnabl (2021)).

[23] This aligns with the evidence presented in Stulz, Taboada, and Dijk (2022), suggesting that banks' holdings of liquid assets are influenced more by their lending opportunities than by precautionary motives.

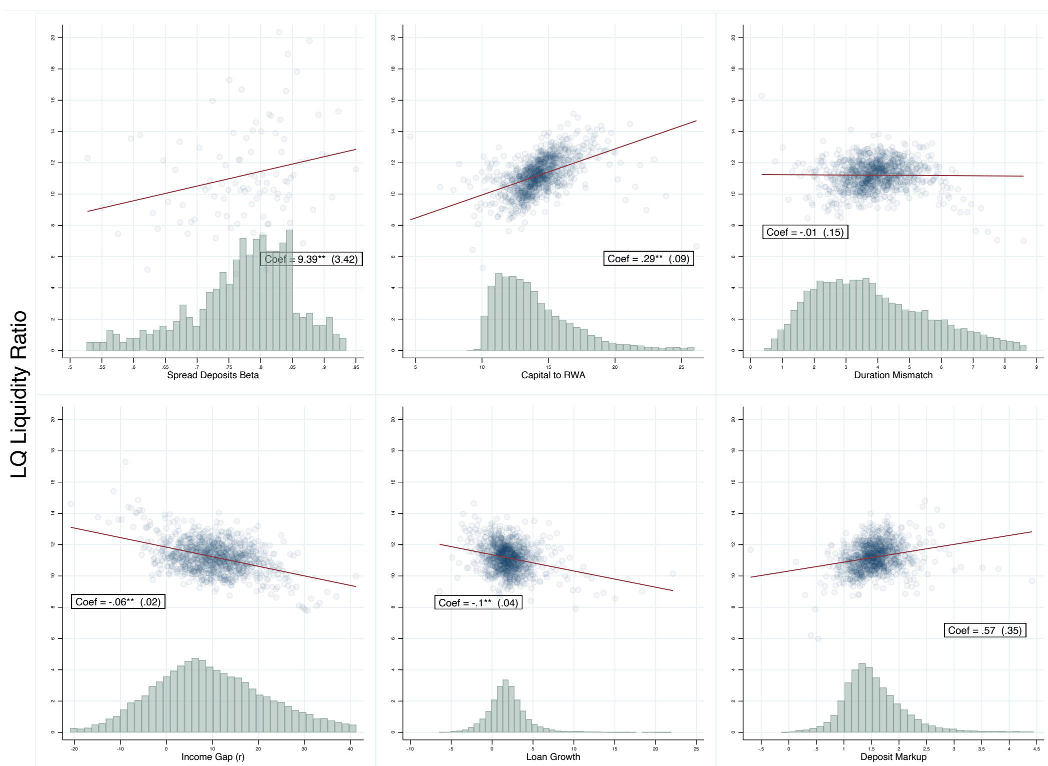
duration gaps. This evidence underscores the importance of considering potential sources of omitted variable biases in the analysis.

Descriptive statistics for other banks' characteristics and using extra bank-specific controls are left in Appendix C.3.

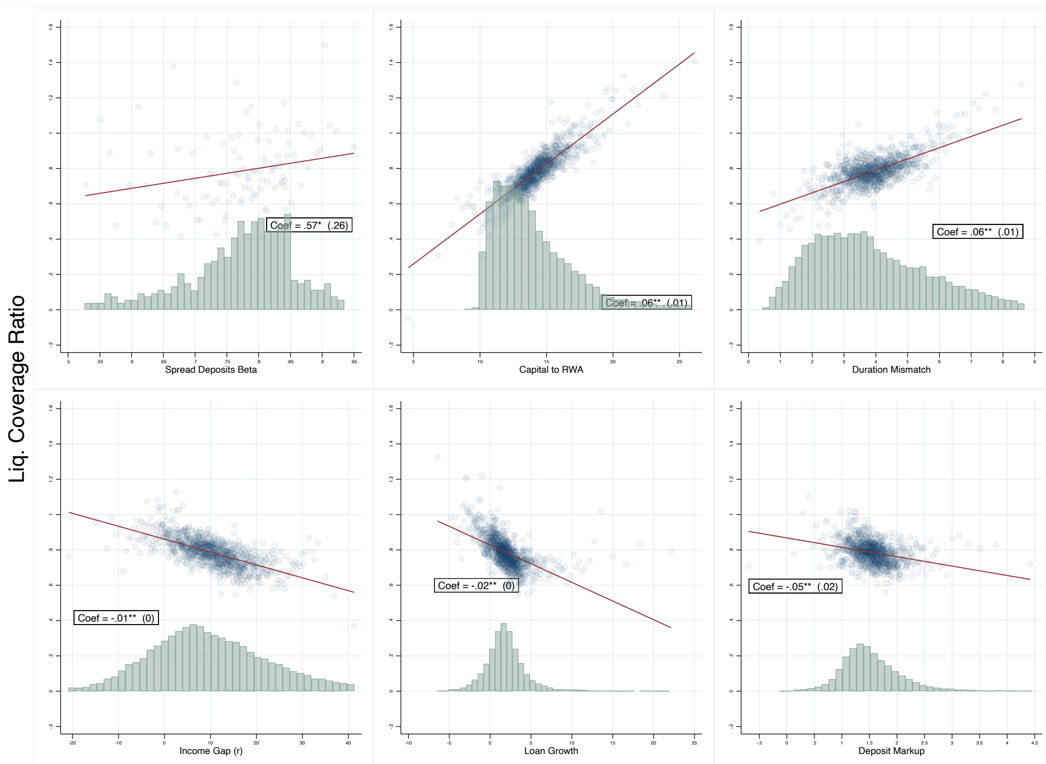
Figure 3: Liquidity Ratios and Banks' Characteristics: Correlation Analysis Excluding Business Cycle Fluctuations and Bank-Specific Business Models



(a) HQ liquidity and Banks' Characteristics



(b) LQ liquidity and Banks' Characteristics



(c) LCR and Banks' Characteristics

Notes: **a)** To prepare the data, the x-axis and y-axis variables were residualized using bank and quarter-fixed effects. Subsequently, the sample was divided into 1000 equally sized bins based on the residualized x-variable. The Spread Deposit Betas, however, were not residualized, and the data was divided into 100 bins. For each bin, the unweighted average of the x-axis and y-axis variables was calculated, and the mean of each variable was added back to the corresponding residual. Spread Deposit Betas are not residualized, and data was divided into 100 bins. **b)** The resulting graph provides a visual representation of the underlying distribution of the x-variable.

4 Empirical Specification

4.1 Benchmark Specification

Throughout the following sections, I employ local projection methods to study whether the documented evidence on the cross-sectional heterogeneity in liquidity ratio affects monetary policy transmission into the banking system. To this end, I estimate panel regressions projecting measures of bank-level characteristics on the interaction term of the banks' liquidity-to-GTA ratio and a structural monetary shock.

The baseline set of local projections follows:

$$\Delta_h Y_{i,t+h} = (\psi^h + \gamma^h mp_t) LR_{i,t-1} + \Gamma^h mp_t X_{i,t-1} + \Psi^h Z_{i,t-1} + f_i^h + f_{t+h}^h + u_{i,t+h}^h \qquad (1)$$

where $h = 0, 1, \ldots, H$ denotes the horizon at which the relative impact effect is estimated, with $H = 16$[24].

$\Delta_h Y_{i,t+h} \equiv Y_{i,t+h} - Y_{i,t-1}$ denotes the cumulative difference h-quarters after the monetary shock. Banks' characteristics studied are the ratio of on-balance sheet liquidity creation to gross total assets, deposit flows, interest rate margins, and loan growth. The coefficients of interest in equation (1) are γ^h, which capture the average differential impact of a monetary tightening shock on characteristic-Y conditional on ex-ante liquidity ratio LR.

The different liquidity ratios $LR_{i,t-1} = \{HQLR, LQLR, LCR, TOTLR\}$ are measured as the four-quarter rolling average. This is to address the joint determination of liquidity and banks' future decisions[25], and to reduce issues related to the seasonality in the Reporting (see Jeenas, 2018). These variables are also included in lagged values to ensure a degree of exogeneity concerning the monetary shock.

The quarterly monetary structural shocks (mp_t) are measured as the sum of daily shocks from Jarociński and Karadi (2020). In robustness exercises, I present results using other

[24] For the 2001q4 (2010q1) sample, the estimation for the horizon h=0 includes 65 (32) quarters per bank and for the horizon h=16 includes 48 (15) quarters per bank.

[25] Consider, for instance, banks might potentially accumulate a significant amount of reserves or treasuries to expand future lending.

identified monetary shocks.

f_i^h denotes bank-level fixed effects in banks' cumulative difference over horizon $h+1$. Bank-level fixed effects are included to account for unobserved banks' characteristics that might be correlated with the interaction term and the characteristic-Y. For instance, specific business models can expose banks more to monetary shocks and simultaneously induce banks to hold higher holdings of liquidity[26]. Moreover, it is argued in the literature that it helps to reduce serial correlation problems in local projection estimations.

f_{t+h}^h denotes quarter fixed effects for the $h+1$-quarter difference measured in period $t+h$. I include quarter fixed effects to control for aggregate shocks, which might induce correlation between depository institutions in the US banking system across time[27].

Finally, $Z_{i,t-1}$ and $X_{i,t-1}$ are vectors of lagged bank-level and time-varying controls, with $X_{i,t-1} \subseteq Z_{i,t-1}$. Control variables are included as lagged values to reflect that banks' decisions are made before the monetary policy shocks.

Clustering Standard Errors

Ideally, to build the confidence intervals, the strategy is to obtain standard errors that allow for fully flexible dependence in the error term in two dimensions: a) Across time within each bank, which might be the case if some bank-level shocks have some degree of persistence. b) Across banks within each quarter, which might be the case if some bank-level shocks have contagion effects[28]. For this purpose, I include confidence intervals robust to both arbitrary heteroskedasticity and arbitrary autocorrelation. The confidence intervals are obtained using heteroskedastic and autocorrelation-consistent standard errors (Newey-West)[29].

[26] Regarding this last point, Ihrig et al. (2017) highlights the fact that internal liquidity risk management decisions reflect individualized liquidity needs. Hence, banks specializing in payment, settlement, or clearing activities might hold higher stocks of liquid assets.

[27] To estimate the linear regression with multiple fixed-effects parameters, I use the Stata package *reghdfe* described in Correia (2017).

[28] Since I control for quarter-fixed effects, this is only necessary if bank-level shocks are correlated within any given quarter because of other reasons besides system-wide shocks. For instance, we can think about the presence of local-contagion effects.

[29] Another alternative was to use robust standard errors clustered two ways at the bank and quarter levels. However, this clustering assumes that local-contagion effects are not relevant. To deal with this is to cluster at the quarter-county levels; however, data in Call Reports about geographical locations is about the main branch, so it is not representative of the presence of a bank in a specific county.

Variables adjustments

For ease of interpretation, I adjust variables in three ways consistent with the literature. First, to control for outliers, estimations at each horizon-h exclude observations of the dependent variable $\Delta_h Y_{i,t+h}$ below the 1st and above the 99th percentile per quarter. Second, I standardize the liquidity ratios $LR_{i,t-1}$ by centering the variable around its sample mean and rescaling by its standard deviation. Finally, the series of monetary policy shocks is equivalent to a 1bp surprise increase in the three-month fed funds future rate. To understand the quantitative relevance of the monetary shocks, we can use the coefficients presented in table (3). For example, an 11.85 bp increase in the HFI-monetary shock is equivalent to a 25bp increase in the 1y treasury yield. Notice also that the standard deviation of the shock in the estimation sample is 4.80 basis points (See Table (5)).

Altogether, estimates of γ^h represent the average cumulative response of outcome-Y after a 1bp surprise increase in the three-month fed funds future rate (3m-FFF). This response occurs over h quarters and is specific to banks with a liquidity ratio of 1sd above the average ratio.

Identification and Endogeneity

The identification strategy involves exploiting the time and cross-sectional variation in liquidity ratios (LR). The baseline regression exploits this cross-sectional heterogeneity and consists of estimates γ^h in specification (1) where the vector on bank-specific characteristics $X_{i,t-1}$ is empty. Nevertheless, biases in the baseline estimates of γ^h might appear since the differential exposure in liquidity a) correlates with other banks' characteristics and b) might be itself a bank's endogenous choice.

First, I use the joint-regression approach to address omitted variable bias, which reduces the bias due to *observable* omitted characteristics. Specifically, the baseline regression is extended by including in specification (1) a non-empty vector on bank-specific characteristics $X_{i,t-1}$ that interacts simultaneously with monetary policy shocks. The selection criteria of the subset $X_{i,t-1}$ depends on the outcome of interest Y, and it is discussed separately in each of the following sections. However, the common conduct I follow is to choose variables that are coincident with the decisions about holdings of liquid assets and, at the same time, that might directly impact characteristic-Y via the transmission of monetary policies. I select a small set of variables to reduce biased estimators at longer horizons, as suggested in Herbst and Johannsen (2021).

Second, I follow the standard practice in the literature to address reverse causality. For baseline and joint specifications, I include one period lag of the 4-quarter rolling average of the HQ liquidity ratio. The underlying assumption is that banks' future Y-outcomes do not determine past liquidity choices. Other strategies to address other sources of endogeneity are discussed and implemented in paper 3.

4.2 Exploring Non-Linearitites

The heterogeneity in monetary policy transmission captured by the γ^h coefficients in (1) are obtained from examining the impact of marginal changes in liquidity ratios on the transmission of monetary shocks. To investigate the monotonicity of effect in the entire distribution, I group banks into bins based on liquidity ratios. This exercise allows for unearthing possible nonlinearities introduced by liquidity conditions and estimates group-specific impulse responses to shocks.

To explore potential non-linearities, the following specification is estimated.

$$\Delta_h Y_{i,t+h} = \sum_{g \in G} (\psi_{gr}^h + \gamma_{gr}^h mp_t) \mathbb{1}_{i,t-1}^g + \Gamma^h mp_t X_{i,t-1} + \Psi^h Z_{i,t-1} + f_i^h + f_{t+h}^h + u_{i,t+h}^h \tag{2}$$

Equation (2) introduces an interaction term with an indicator variable $\mathbb{1}_{i,t-1}^g$ that captures the membership of a bank in a specific region of the cross-sectional distribution of liquidity ratios one quarter before the monetary shock. The sample is divided into quintiles based on the distribution of liquidity ratios, with $\mathbb{1}_{i,t-1}^g$ taking a value of one if bank i falls into the g-th quantile at time $t-1$. The quintiles considered are $G = 2nd, 3rd, 4th, 5th$. The parameter of interest, denoted as γ_{gr}^h, captures the differential effects of monetary policy shocks on the characteristic-Y of banks in the G groups compared to banks with liquidity ratios lower than the first quintile.

4.3 Alternative Specifications using Benchmark Specification

Before proceeding with the presentation and discussion of results based on the benchmark and non-linear specification, it is pertinent to make some preliminary observations.

a) It is imperative to acknowledge that the dataset at hand represents equilibrium realizations, and due to its inherent structure, the application of alternative fixed-effect identification strategies to disentangle demand- or supply-related effects is not feasible. In response to this limitation, an attempt is made to address these concerns by introducing measurements of bank-specific supply sensitivities in the spirit of the Deposit Channel (Drechsler, Savov, and Schnabl, 2017).

b) The potential repricing effects stemming from monetary policies on security prices have garnered increased attention in estimating interaction coefficients denoted as γ^h. However, it is noteworthy that the available dataset lacks the granularity necessary to incorporate bank-security-specific prices, which could enable direct control over such effects. In response to this limitation, an attempt is made to address these concerns by introducing control measures informed by the hedging strategy hypothesis, as outlined in the work of Drechsler, Savov, and Schnabl (2021).

The detailed methodologies for these supplementary analyses are elaborated upon in Appendix D. Given these inherent constraints and limitations, I hereby present preliminary results and advocate for exploring supplementary exercises in forthcoming research.

5 Effect on Deposit Flows

This section provides the results regarding the role of various types of liquid assets in transmitting monetary policy shocks to deposit flows. Before delving into the results, making a couple of clarifications is essential. First, the dataset reflects equilibrium outcomes within the deposit markets. Consequently, I interpret the γ^h coefficients as indicative of the effect of monetary policy shocks conditional on ex-ante liquidity ratios on *equilibrium* deposit flows[30].

[30] Theoretically, the deposits channel advocates for a transmission mechanism via deposit supply, while theories on self-fulfilling bank runs propose a transmission mechanism driven by depositors' demand. In the classic Diamond and Dybvig (1983) model, depositors withdraw deposits because monetary policy induces

Second, the set of control variables, denoted as X_i in this section, comprises bank size (measured as the logarithm of total assets) and capitalization (measured as the total capital ratio adjusted for risk). These variables capture various constraints that banks may encounter in deposit markets, typically related to their size or risk level. Although I've tested the inclusion of other pertinent controls—such as variables measuring profitability (quantified as net interest rate margins or the return on total assets), insolvency risk (measured using the z-score and the ratio of non-performing loans), income shocks triggered by changes in monetary policy (assessed as the income gap), and interest rate risk exposure (quantified by the maturity gap)—their addition did not lead to significant changes in the joint-estimates coefficients.

5.1 Results on Bank-Level Estimation

Figure 4 presents estimates of γ^h in specification (1) when the dependent variable is the log change in total deposits. Each impulse response function depicts the differential impact of a 1bp monetary tightening shock on deposit growth rates for banks standing 1sd above the mean of the respective liquidity distribution. At any horizon h, positive coefficients mean that banks with larger liquidity ratios stabilize more the outflows of deposits induced by monetary policy shocks (less negative growth rate)[31]

Starting with the impact of HQ-liquid assets, the dynamics based on the baseline point estimates are negative for banks with an HQ liquidity ratio standing 1sd above the mean of the distribution. However, once we account for variables that reflect the constraints banks encounter in deposit markets, the dynamics change both quantitatively and qualitatively. Focusing on the joint regression point estimates, banks with larger holdings of HQ liquidity

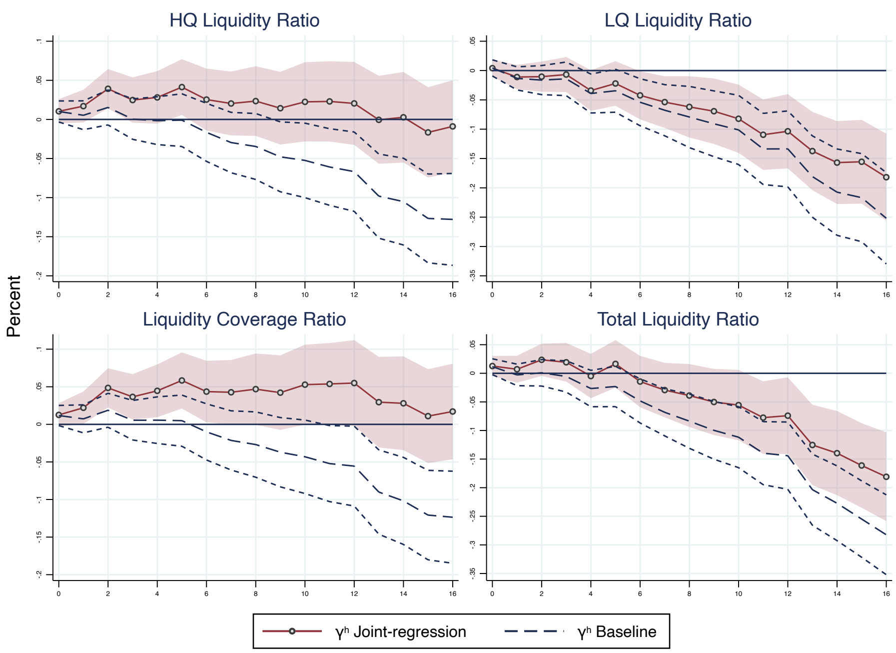
banks to sell their assets at distressed prices, leading depositors to run on their banks in anticipation of insolvency. An alternative is proposed by Drechsler, Savov, Schnabl, and Wang (2023) in which uninsured depositors withdraw their funds because tightening monetary policy disproportionately increases the value of the deposit franchise relative to the value of banks' assets. This heightened liquidity risk prompts the breakdown of banks' interest-rate hedging strategies, leading to depositors anticipating bank insolvency and initiating a run on their banks.

[31] This is arguably the more appropriate interpretation because evidence suggests that aggregate deposits flow out when monetary policy tightens—alternatively, greater inflow of deposits (more positive growth rate). Including quarter-FE does not allow me to estimate the unconditional effect of monetary policy but favors the estimation of γ by controlling for other non-monetary aggregate shocks destabilizing deposits.

experience lower outflows in total domestic deposits in the short term, specifically within 0 to 6 quarters after the shock. Only the differences manifesting over short horizons are statistically significant, suggesting that HQ liquidity does not exert prolonged effects.

In terms of quantitative relevance, the estimates imply that in response to a monetary tightening shock causing a surprise 1bp increase in the fed funds futures rate, banks with higher HQ liquidity ratios witness deposit growth approximately 0.05% higher in the first two years after the shock[32]. This evidence underscores HQ liquidity stabilizes short-term deposit fluctuations induced by monetary tightenings. This phenomenon could be attributed to the notion that liquid assets might alleviate banks' constraints, reducing wholesale market costs.

Figure 4: Monetary Tightening Shock Conditional on Liquidity: Effect on Total Domestic Deposit Flows (Baseline)



Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

[32] To rephrase it, a 25bp increase in the 3-month fed funds futures rate (3m-FFF) corresponds to a 1.25% higher growth rate. From Table 3, it is worth noting that a 25bp increase in the 3m-FFF results in an 87.33bp increase in the Fed funds rate (FFR). Therefore, in terms of the FFR, a monetary tightening shock, which causes a 25bp increase in the FFR, leads to approximately 0.35% higher deposit growth in banks with higher HQ liquidity ratios in the first two years after the shock.

Turning to the influence of LQ-liquid assets, both the baseline and joint-regression point estimates reveal similar dynamics. The point estimates are negative for banks with an LQ liquidity ratio that stands 1sd above the mean of the distribution. This suggests that banks with higher LQ liquidity ratios experience larger outflows in total domestic deposits when subjected to a monetary tightening shock. Importantly, this negative effect persists and remains statistically significant for up to six quarters after the shock. Regarding quantitative significance, the estimates imply that in response to a monetary tightening shock causing a surprise 1bp increase in the fed funds futures rate, banks with larger LQ liquidity ratios witness deposit growth approximately 0.2% lower over the four years following the shock[33].

Combining both sets of results, the heterogeneity stemming from the total liquidity ratio encompasses the characteristics of both HQ and LQ liquidity. Specifically, total liquidity acts as a buffer for banks against more substantial deposit outflows during the first five quarters after the shock, akin to the effect of HQ liquidity. However, this beneficial impact of HQ liquidity appears to be short-lived, as evidenced by the subsequent weaker deposit growth attributed to LQ liquidity. These findings underscore the importance of distinguishing among various liquidity types, as their combined influence on banking outcomes can be quite nuanced and dynamic over time.

In the analysis of heterogeneity resulting from differences in liquidity coverage ratios, the dynamic response closely mirrors the impulse response function of the HQ liquidity ratio. This alignment is expected since the numerator of the liquidity coverage ratio is comprised of only HQ-liquid assets. However, it's worth noting that this ratio might capture more precisely the capacity of banks to cover unexpected deposit outflows and provide better insights into banks' abilities to handle short-term liquidity demands. Having said this, heterogeneity in banks' capacity to address short-term liquidity needs translates into larger estimated coefficients relative to the coefficients from the simple HQ liquidity ratio.

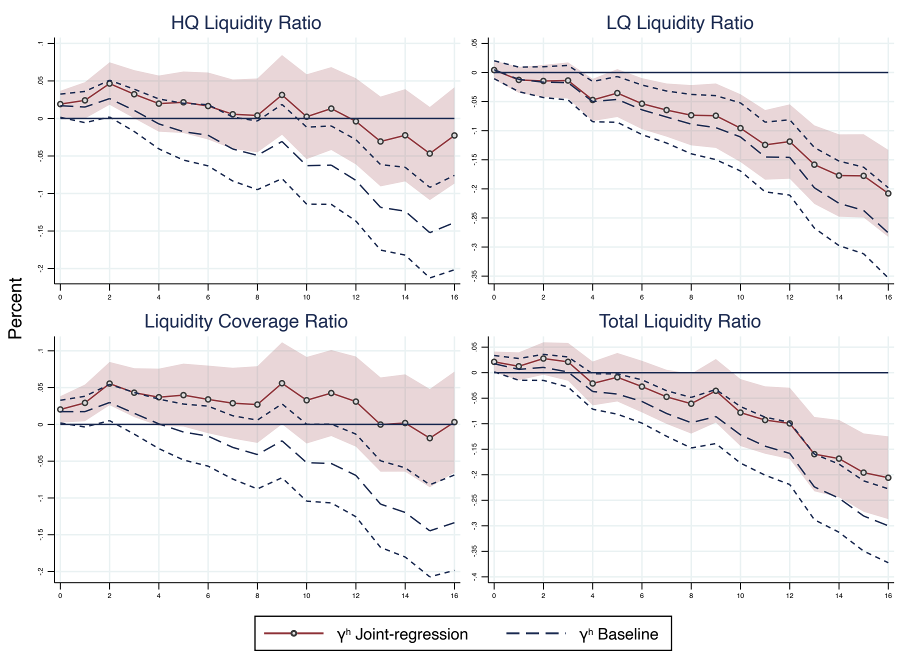
The same results apply when the dependent variable is the log change in core deposits (see fig. 5) instead of total deposits[34].

[33] Similar as in the footnote Page 38, a 25bp increase in the FFR is equivalent to a 1.43% growth rate.

[34] Total deposits are equivalent to core deposits plus wholesale deposits. Notice that core deposits are the main source of deposits in the sample studied since they are equivalent to 70% of total assets on average

Figure 6 displays the outcomes derived from the non-linear specification (2) including control variables. The results indicate that the impact of liquidity ratios on transmission is not strictly monotonic. The coefficient's magnitude (absolute value) from the second until the fourth quintile does not consistently increase with higher quintile groups. In contrast, banks positioned above the fifth quintile of the liquidity distribution have larger coefficients and closely mirror the dynamics in Figure 4 for each liquidity category.

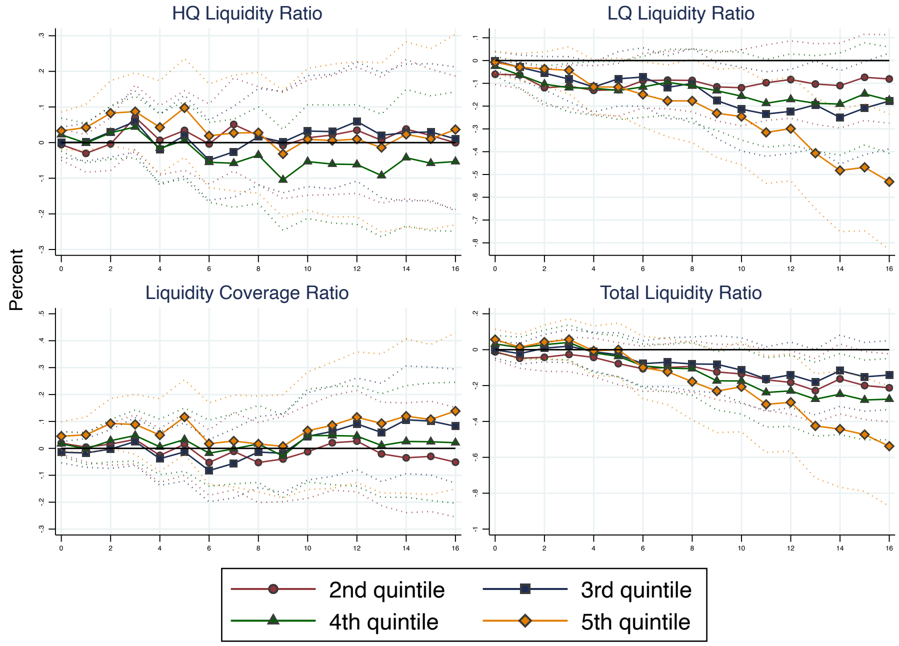
Figure 5: Monetary Tightening Shock Conditional on Liquidity: Core Deposit Flows (Baseline)



Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

(See Table 2a).

Figure 6: Monetary Tightening Shock Conditional on Liquidity: Effect on Total Domestic Deposit Flows (Non-linearities)



Notes: The graph displays the results for γ^h_{gr} obtained from specification (2). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

5.2 Robustness and Extensions

Results are left in Appendix E.1.

1. I investigate whether compositional effects can help explain the findings in Figure 4. Appendix E.1.2 Reports results based on the different types of deposit accounts: Money Market Accounts, Saving Accounts, Time Deposit Accounts, and Demand Deposits[35]. Figure 34 panel (a) shows that money market deposit accounts echo the conclusions drawn from the analysis of total deposits: a) High-quality liquidity has short-term stabilizing effects b) Low-quality liquidity, conversely, consistently reduces deposit growth in response to monetary shocks. Instead, other deposit accounts do not seem to follow the same dynamics, and most of the coefficients from baseline and joint regressions are non-significant different from zero. This can be consistent with the idea that money

[35]Usually, demandable deposits are highly liquid, while time deposits are locked in for a term and, hence, relatively illiquid.

market investors are more sensitive to banks' performance during monetary cycles.

2. I investigate the relevance of the monetary shocks used in the baseline analysis. Appendix E.1.3 Reports the results obtained using alternative policy measures where the dependent variable is Total Deposits. Changes in the monetary shocks do not change the magnitudes and dynamics observed in Figure 4, whether the analysis centers on baseline estimates or examines LQ liquidity as the source of heterogeneity. However, the results differ when looking at joint-regression estimates influenced by heterogeneity in HQ liquidity.

3. Appendix E.1.1 presents the results on alternative specifications.

   (a) In Figure 33, we observe coefficients that account for actual interest rate risk exposure following the specification outlined in (13). Specifically, in Panel A (Panel B), the η_2^h coefficients pertain to the influence of HQ liquidity (LQ liquidity) for banks with a NIMY-beta of zero. This signifies banks that are entirely hedged against fluctuations in interest rates. Conversely, the η_3^h coefficients reflect the impact experienced by banks with some exposure to interest rates.

   Comparing these η_2^h coefficients of the HQ liquidity interaction to the earlier γ^h coefficients in Figure 4, we observe that they follow the same patterns but exhibit a more pronounced magnitude. In essence, when we remove the influence of banks' vulnerabilities to interest rate risks, the stabilizing effect of HQ liquidity becomes more prominent and remains statistically significant up to quarter seven. Regarding LQ liquidity, the destabilizing effect vanishes for banks with a NIMY-beta of zero. In fact, the point estimates are positive, although they do not reach statistical significance. The destabilization effects of HQ- and LQ liquidity are fully captured by η_3^h coefficients.

   (b) In Figure 32 we observe coefficients that account for supply sensitivity to monetary policy following specifications (12). Specifically, in Panel A (Panel B), the η_0^h coefficients pertain to the influence of HQ liquidity (LQ liquidity) for banks with a deposit-spread-beta of zero[36]. This signifies banks exert monopoly power and hence shift more supply to increase profits. Conversely, the η_1^h coefficients reflect the impact experienced by banks with lower capacity to adjust deposits supply.

The results presented here are preliminary, and no definitive conclusions can be drawn at this stage. This is because the coefficients η_0^h and η_1^h exhibit perfect symmetry. I have conducted diagnostics to understand this phenomenon better, and one potential explanation is that the heterogeneity in deposit spread betas within quintile groups of the liquidity ratios' distribution is very low. Further research and analysis are needed to explore this observation further and draw meaningful conclusions.

6 Effect on Loans Growth

The concept that liquidity acts as a buffer against contractions in banks' lending growth in response to tight monetary policy has been the subject of extensive research. The pioneering work of Kashyap and Stein (2000) proposes that when a bank experiences deposit outflows due to monetary policy, it can utilize its liquid assets to offset the reduction in lending supply. Subsequent studies have expanded upon these findings and investigated the suitability of various measures of monetary policy for assessing bank lending behavior(e.g., Bluedorn, Bowdler, and Koch, 2017).

This section builds upon this existing body of literature in three distinct ways: Firstly, I assess the heterogeneity in lending responses to monetary policy with a specific focus on different types of liquidity. Secondly, I employ various measures of monetary policy that are characterized by their ability to remove the influence of new shocks, a feature typically present in other studies[37]. Finally, using local projections enables the identification of the conditional effect of monetary shocks on loan sensitivity in a more dynamic manner.

[36] Or its minimum value .57

[37] For example, while Bluedorn, Bowdler, and Koch (2017) employs high-frequency identification techniques to derive monetary shocks, their measurements do not differentiate between purely monetary surprises and FED-news shocks. The type of shocks I utilize for the estimations offers a much clearer separation of these two effects (See Section B.3 for the case of Jarociński and Karadi (2020) shocks)

Like the previous section, the γ^h coefficients identify equilibrium conditions. This means that the results are understood as the heterogeneous effect of ex-ante liquidity ratios on policy-induced changes in the loan market equilibrium. Assuming that lending drops in response to monetary tightening policy, the positive coefficient can be interpreted as liquidity stabilizing loan growth when monetary policy tightens.

The empirical strategy remains consistent, following the specification (1). The dependent variable is the log change in the book value of three types of loans: Total Loans, Commercial and Industrial Loans, and Real Estate Loans. The set of controls in the joint regressions includes the standard variables known to affect the transmission of monetary policy to bank lending: size and leverage (Kishan and Opiela, 2000; Paz, 2022), local deposit concentration (Drechsler, Savov, and Schnabl, 2017), the repricing/maturity gap (Drechsler, Savov, and Schnabl, 2021; English, Van Den Heuvel, and Zakrajšek, 2018), and the income gap (Gomez et al., 2021).

Crucially, including the maturity and income gap variables helps account for banking channels that have previously been overlooked in the analysis of liquidity-related heterogeneity. Liquid assets play a significant role in the cash flow and balance sheet channels. On the one hand, certain liquid securities adjust their value in the short term, influencing cash flow effects. On the other hand, some securities represent long-term debts, and their value declines in response to monetary tightening, impacting the balance sheet effect. Without controls, the monetary shock interacting with the liquidity ratio is more likely to encompass both effects. Therefore, incorporating income and maturity gaps provides the advantage of regulating both channels.

However, it's important to note that since other assets are also factored into the calculation of these variables, the policy-induced repricing of assets beyond securities is also being considered. An alternative approach, recently adopted in Krainer and Paul (2023), is to directly control for market value losses on securities during specific monetary tightening cycles. This approach relies on utilizing security prices at the bank level from the FRY-14Q dataset. Unfortunately, this data is not publicly accessible.

6.1 Results on Bank-Level Estimation

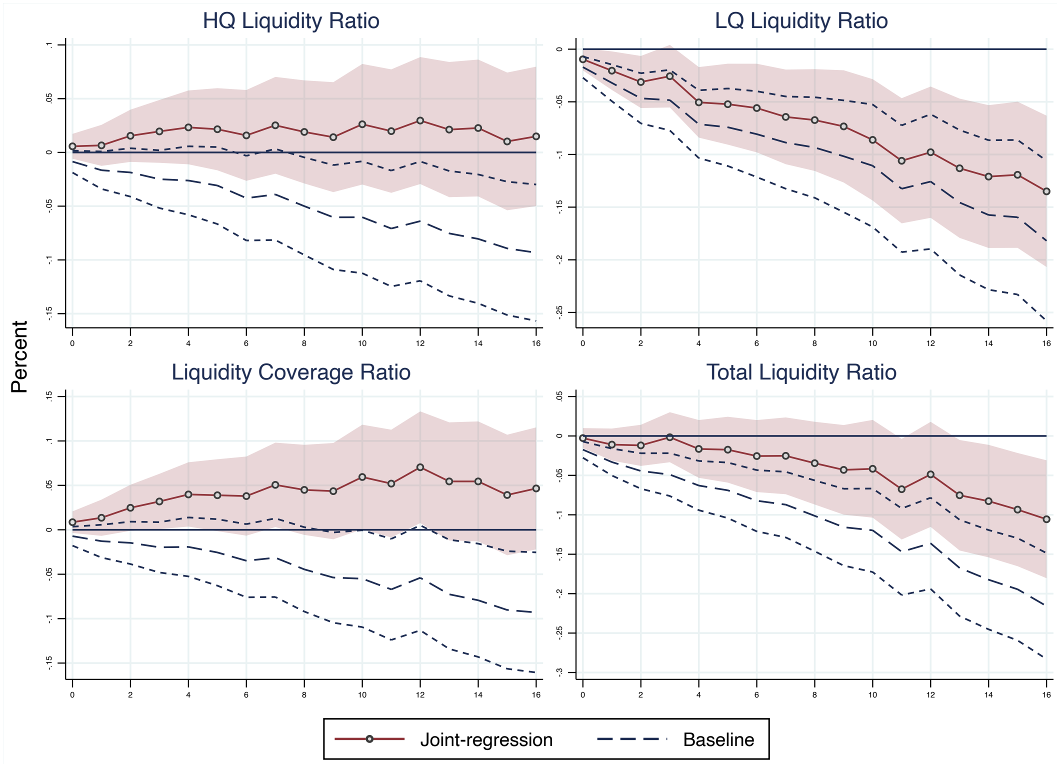
Figure 7 presents estimates of γ^h in specification (1) when the dependent variable is log changes in total loans[38]. Based on the baseline estimations, the loan growth of banks with HQ liquidity standing 1sd above the mean is about 0.1% permanently lower[39], meaning that HQ liquidity does not shield lending during tightening cycles. This evidence goes against the results in Kashyap and Stein (2000) but is consistent with empirical strategies using HFI-monetary shocks. In fact, Bluedorn, Bowdler, and Koch (2017) argues that the *fund of last resource effect* is only observed when using changes in the realized fed fund rate, suggesting that biases from confounding factors explain this result.

Nonetheless, the findings from the joint-regression analysis do not contradict the outcomes Reported in Kashyap and Stein (2000) even when considering the policy measure as HFI-monetary shocks. Upon closer examination of the point estimates, banks with HQ liquidity positioned 1sd above the mean undergo more loan growth in response to the monetary shock (the average point estimate is between 0% and 0.025%). Note that these estimates do not reach statistical significance. In contrast, when looking at heterogeneity due to liquidity coverage ratios, the magnitudes of the effects are larger and significant. After a monetary tightening shock caused a surprise 1bp increase in the fed funds futures rate, banks with higher LCRs experienced loan growth approximately 0.05%[40] higher in the following four years after the shock.

What's particularly noteworthy is that these results emerge after accounting for income and duration gap variables. This suggests that when controlling for income and valuation shocks prompted by monetary policy, high-quality liquidity relative to total assets or expected deposit outflows does not appear to have a destabilizing effect on loan growth, as implied by Bluedorn, Bowdler, and Koch (2017).

[38] I also try real rates of growth but results remain unchanged.
[39] To express it in terms of a 25bp increase in the FFR, this corresponds to approximately a 0.72% change.
[40] or 0.35% after a 25bp increase in the FFR.

Figure 7: Monetary Tightening Shock Conditional on Liquidity: Effect on Total Loans Growth (Baseline)

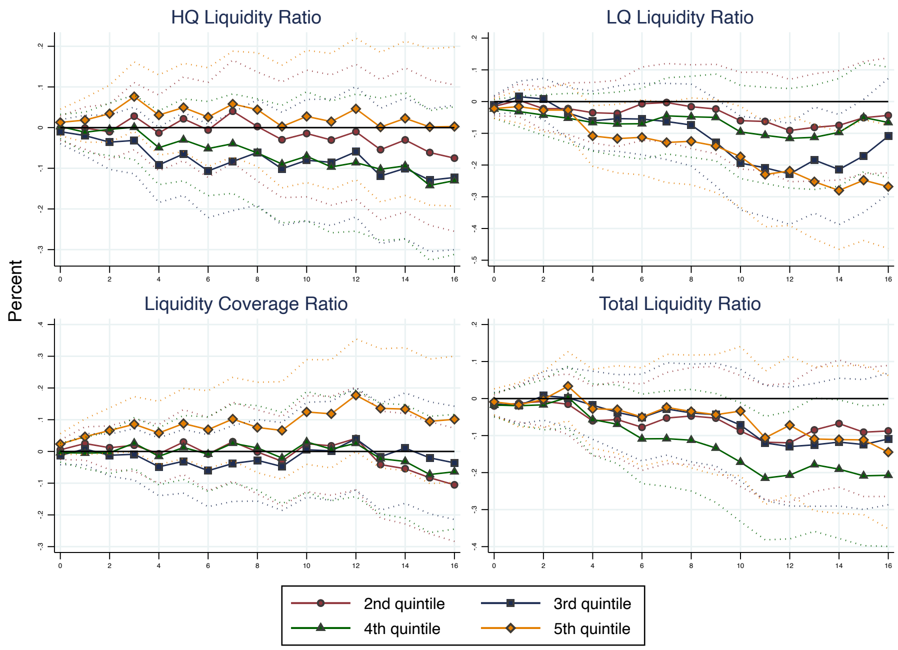


Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

The story is different when looking at low-quality liquidity-related heterogeneity. Evidence suggests that in response to monetary shocks, banks standing 1sd above the mean experience permanently lower growth rates (-.15%). This pattern persists even after accounting for income and valuation shocks induced by monetary policy. When analyzing total liquidity, the dynamics follow the pattern of LQ liquidity. This indicates that LQ liquidity's destabilization effect predominates over HQ liquidity's non-effect.

Figure 8 displays the outcomes derived from the non-linear specification (2) including control variables. The results indicate similar conclusions to the one derived when analyzing deposit flows. The impact of liquidity ratios on the transmission channel is not strictly monotonic. a) banks positioned above the fifth quintile of the liquidity distribution closely mirror the dynamics in Figure 7 in each liquidity category. b) The average impulse responses of banks falling between the second and fourth quintile exhibit similar patterns and magnitudes.

Figure 8: Monetary Tightening Shock Conditional on Liquidity: Effect on Total Loans Growth (Non-linearities)



Notes: The graph displays the results for γ_{gr}^{h} obtained from specification (2). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

6.2 Robustness and Extensions

Results are left in Appendix E.2.

1. In line with prior research, I investigate whether compositional effects can help explain the earlier findings. Section E.2.2 replicates the same analysis for two specific loan categories: Commercial and Industrial Loans and Real Estate Loans. The results, as illustrated in Figure 38, echo the conclusions drawn from the analysis of total loans: a) High-quality liquidity has, at best, neutral effects on transmitting monetary shocks to loan growth after accounting for income and duration gaps. b) Low-quality liquidity, conversely, consistently reduces loan growth in response to monetary shocks.

2. Results using alternative policy measures are Reported in Appendix E.2.3. Changes in the monetary shocks do not change the magnitudes and dynamics observed in Figure 4

if focusing on HQ liquidity. However, the results differ when looking at joint-regression estimates influenced by heterogeneity in LQ liquidity (the effect is non-negative).

3. Appendix E.2.1 presents the results on alternative specifications.

   (a) In Figure 37, we observe coefficients that account for actual interest rate risk exposure following the specification outlined in (13).

   When we compare the η_2^h coefficients of the HQ liquidity interaction to the earlier γ^h coefficients in Figure 7, we notice that the η_2^h coefficients are positive and larger. This suggests that removing the influence of banks' vulnerabilities to interest rate risks reveals evidence consistent with the findings in Kashyap and Stein (2000) when considering HQ liquidity. However, the impact of LQ liquidity remains, at best, non-positive but non-significant. The η_3^h coefficients capture the destabilization price effects of both HQ and LQ liquidity.

   (b) In Figure 36 we observe coefficients that account for supply sensitivity to monetary policy following specifications (12). Same as the previous section, the results presented here are preliminary, and no definitive conclusions can be drawn at this stage because coefficients η_0^h and η_1^h exhibit perfect symmetry.

7 Effects on Banks Liquidity Creation

Within the financial system, banks undertake a multifaceted role where their functions of liquidity creation, risk transformation, and maturity transformation can intersect or diverge depending on the context. Given the intricate interplay between the core banking operations, this section concentrates on factors that enable banks to transform/create liquidity[41]. Specifically, I examine directly the role of different types of liquid assets in transmitting

[41] Recent studies have shown that this measure of banks' activity has a substantial influence on various macroeconomic variables and is a superior measure of banks' output. For instance, Berger and Sedunov (2017) studies the relation between bank liquidity creation and economic output. Davydov, Vähämaa, and Yasar (2021) and Zhang et al. (2021) investigates whether liquidity creation affects systemic risk. Davydov, Fungáčová, and Weill (2018) investigates whether liquidity creation may amplify business cycle fluctuations. Fungacova, Turk, and Weill (2021) estimate that high liquidity creation is associated with a greater probability of bank failure using Russian banks.

monetary policy shocks toward on-balance sheet liquidity creation[42].

The empirical strategy remains consistent, following the specification (1). The dependent variable is the change in liquidity creation ratios[43] from quarter $t-1$ to quarter $t+h$. The control variables used in the joint regressions include variables known to affect the transmission of monetary policy: size (e.g., Kashyap and Stein (2000)), local deposit concentration (e.g., Drechsler, Savov, and Schnabl (2017) and Li, Loutskina, and Strahan (2023)), the repricing/maturity gap of English, Van Den Heuvel, and Zakrajšek (2018).

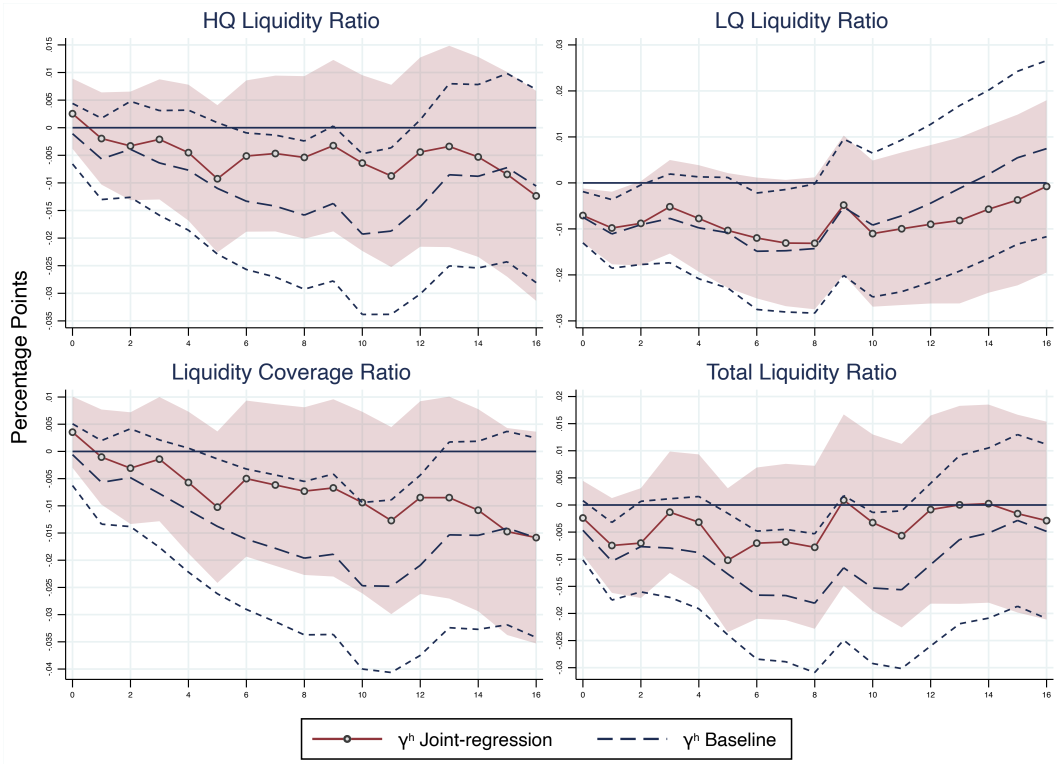
7.1 Results on Bank-Level Estimation

Figure 9 presents estimates of γ^h in specification (1) when the dependent variable is the on-balance sheet liquidity creation to asset ratio. Each impulse response function depicts the conditional effect of monetary policy for banks standing 1sd above the mean of the respective liquidity distribution. At any horizon h, negative coefficients mean that banks with larger liquidity ratios at the time of a shock create less liquidity than banks with lower levels of liquidity.

[42]Other strands of the literature focus on maturity transformation, arguing that this role is central to business cycle dynamics. For instance, Li, Loutskina, and Strahan (2023) argues that deposit market power, by increasing long-term credit supply, helps alleviate credit cycles. higher risk borrowers choosing to borrow long term to alleviate refinancing risk

[43]Liquidity Creation per billion dollars of assets.

Figure 9: Monetary Tightening Shock Conditional on Liquidity: Effect on Liquidity Creation (Baseline)



Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

Based on the baseline point estimates, banks with more HQ liquidity (and greater LCR) at the time of a monetary contraction incur less in liquidity transformation activities. Specifically, after a 1bp surprise increase in the 3-month fed funds future rate, banks with HQ liquidity ratios 1sd deviation above the distribution experience a reduction in liquidity creation activities equivalent to -0.02pp of total assets[44]. This effect is statistically significant 6 to 12 quarters after the shock[45]. Once controlling for other confounding factors, the effect is non-significant.

Analyzing heterogeneity in LQ liquidity, point estimates are consistently negative and similar

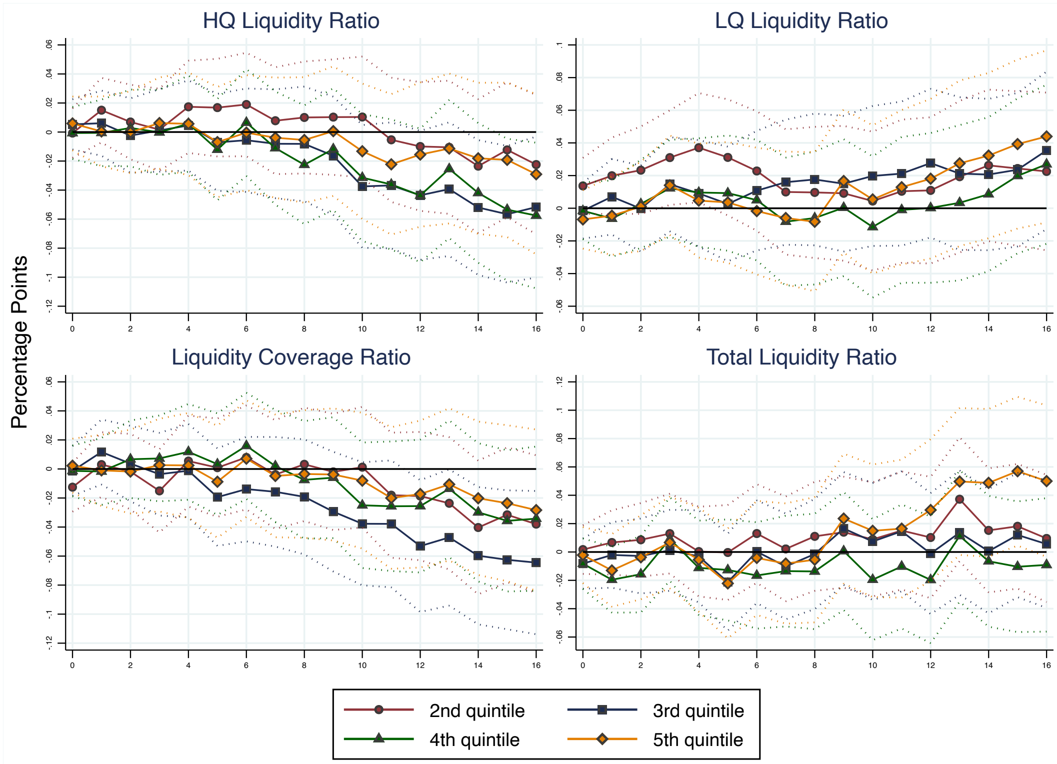
[44]Equivalent to -0.14pp relative to a 25bp increase in the FFR.

[45]Evaluated at the average liquidity creation ratio in the sample (30.3%), this translates into cumulative differences in liquidity creation of around \$2.5 million, equivalent to only about 0.2% of the banking industry liquidity creation.

between baseline and joint regression specifications. To provide specifics, following a 1bp surprise increase in the 3-month fed funds future rate, banks with LQ liquidity ratios 1sd above the distribution witness a reduction in liquidity creation activities equivalent to -0.01pp of total assets. It is important to note that this effect is statistically significant, only up to 2 quarters. Similarly, the impact of total liquidity is minor and non-statistically significant, different from zero.

Figure 10 displays the outcomes derived from the non-linear specification (2) including control variables. The impulse response functions across the various quintile groups do not exhibit a monotonic pattern. In other words, the coefficient's magnitude (in absolute value) does not consistently increase with higher quintile groups. However, each group follows relatively similar dynamics. For example, when looking at HQ liquidity, the average impulse responses of banks in the third and fourth quintiles exhibit similar patterns and magnitudes over all horizons.

Figure 10: Monetary Tightening Shock Conditional on Liquidity: Effect on Liquidity Creation (Non-linearities)



Notes: The graph displays the results for γ_{gr}^{h} obtained from specification (2). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

7.2 Robustness and Extensions

Results are left in Appendix E.3.

1. To explore the previous results deeply, I reestimate equation (1) using the liquid, semi-liquid, and illiquid categories of the liquidity creation index as dependent variables. The RHS remains unchanged for both the baseline and joint regressions. The parameters of interest are named γ_h^{CAT} for $CAT = \{IA, SA, LA, IL, SL, LL\}$[46]. Results are left in Appendix E.3.2.

   The absence of a heterogeneous effect observed in Figure 9 can mainly be attributed to the fact that banks encounter higher liquid liabilities ratios in response to the shock.

[46]As remarked by Berger and Bouwman (2009), the γ^h coefficients are expected to equal the weighted sum of the γ_h^{CAT} coefficients.

However, they also experience a similar increase in liquid assets. Because these factors offset each other in the liquidity creation index, the total heterogeneous effect on liquidity creation is nearly zero. In other words, banks expand liquid liabilities without creating liquidity because they invest in liquid assets.

2. A concern about the baseline regression specification is that liquid assets are included (with a weight of $-1/2$) in the liquidity creation variable via the liquid-asset component. In contrast, the lagged liquid assets ratio is the variable interacting with the monetary policy shock. To explore the consequences of this, I reestimate equation (1) replacing the dependent variable by $\Delta_h \widehat{LIQR}_{i,t+h} = LIQR_{i,t+h} - \widehat{LIQR}_{i,t-1}$ where $\widehat{LIQR}_{i,t-1}$ excludes liquid assets to avoid potential direct mechanical relation. The findings from this exercise, as shown in fig. 42, are quantitatively and qualitatively similar to those presented in Figure 9.

8 Effect on Banks' Profits and Income

Liquid assets might play different roles in transmitting monetary policies toward banks' profits. On the one hand, the capacity to generate instantaneous cash flows could be used to finance (or refinance) new high-interest-rate loans, hence profiting from better loan conditions. On the contrary, the interest rate risk inherent to long-term securities might expose banks to larger valuation losses, which can tighten constraints (or break hedges), preventing them from generating more profitable loans. This section presents results on how liquidity -and its different categories- increases or mitigates banks' net income exposure to monetary policy shocks.

This section contributes to the empirical literature on the effect of monetary policy on banks' profits and capital. Remarkably, evidence in this branch is diverse and sometimes does not convey the same results. Drechsler, Savov, and Schnabl (2021) present empirical evidence suggesting that even if banks engage in significant maturity transformation (maturity mismatch of 3.4 years), they actively match the interest sensitivities of their income and expenses so that banks do not experience large drops in their net worth in response to monetary tightening. In contrast, Paul (2023) suggest that banks are exposed to interest rate risk via the effect of monetary policies on future expected short-term rates and term premiums. Their evidence based on equity prices suggests that bank profit margins decline to an increase in future expected short-term rates but rise if term premia increases. My contribution to this literature centers on assessing how the initial holdings of liquid-to-asset ratios influence the sensitivity of banks' cash flows to monetary shocks. To conduct this analysis, I employ the cash flow approach, which differs from the Present-Value Approach, as it relies on book values rather than market equity values[47].

The strategy employed here follows the specifications outlined in equation (1). The dependent variable represents changes in profit margins from time $t-1$ to time $t+h$. The examined profit margins include net interest margins and their constituent parts, encompassing interest rate income and expenses. Additionally, it considers total net income (quantified as the return on assets) and the remaining components, which comprise non-interest rate income and expenses[48].

For the joint regressions, the vector $X_{i,t-1}$ includes bank size (measured as log total assets), capitalization (measured as the total capital ratio adjusted for risk), balance sheet maturity mismatch, a proxy capturing expected income shocks generated by changes in policy rates (measured as income gap), and a proxy for local market power (measured as the HHI index in deposit markets as suggested by Drechsler, Savov, and Schnabl (2021)). Since banks' income gap controls for any positive (or negative) income shock induced by changes in policy rates, γ^h estimates from the joint regressions explain the effect of liquid assets beyond repricing effects. Furthermore, since liquid assets expose banks to interest rate risks (in the absence of hedges), the maturity gap variable helps control interest rate risk exposure.

[47] See Drechsler, Savov, and Schnabl (2021) for the differences in the approaches.

[48] All variables are expressed annually and as a ratio of the average earning assets, except for total net income, which is presented as net income after taxes (annualized) as a percentage of average total assets.

8.1 Results on Bank-level Estimations using the Cash Flow Approach

HQ-Liquidity Figure 11 displays the results depicting the conditional effect of monetary policy on changes in all profit margins, specifically focusing on the influence of HQ liquidity. It highlights that higher HQ liquidity ratios are associated with lower net interest income in response to a monetary tightening shock. Remarkably, this result arises over a relatively long horizon and is statistically significantly different from zero.

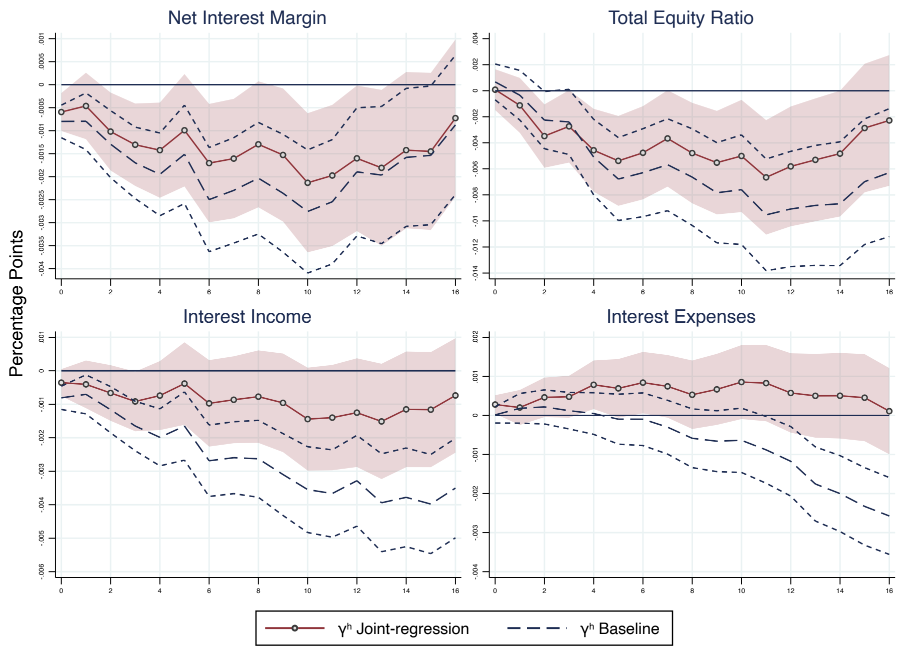
Focusing on the point estimates from the joint regression, in response to a 1bp surprise increase in the 3m-FFF rate, the net interest margins of banks standing 1sd above the HQ liquidity distribution are about 0.002pp lower at its peak which is quarter 10[49]. These patterns remain consistent across both baseline and joint-regression estimates, albeit with slightly bigger differences in responses in the baseline-regression estimates[50].

Changes in interest-rate income and expenses drive the differences in net interest margin dynamics. Firstly, banks with higher HQ liquidity ratios tend to display greater sensitivity in interest rate income, leading to reduced interest rate income in response to monetary shocks. This discrepancy can be attributed to the joint regression's consideration of profit losses from long-term assets through the maturity gap, which is expected to be higher for banks with elevated liquidity ratios. Secondly, banks with higher HQ liquidity ratios tend to exhibit greater sensitivity in interest rate expenses, resulting in increased interest rate expenses in response to monetary shocks. In this instance, the dynamics between baseline and joint-regression estimates do not align. When accounting for exposure to income shocks via the income gap, the evidence suggests that banks with higher HQ liquidity ratios experience higher interest rate expenses. Finally, the net interest margin responses translate into similar equity ratio reactions. For higher HQ liquidity ratios, the book value of banks' capital as a percentage of total assets drops by about 0.006pp in response to the same monetary shock.

[49] Relative to a 25bp increase in the FFR, the coefficient is 0.014pp.

[50] Notice that the in-sample average net interest rate margin is 3.81%, while the in-sample average change in net interest rate margins is -.008pp per quarter.

Figure 11: Monetary Tightening Shock Conditional on HQ-Liquidity: Effect on Profit Margins (Baseline)



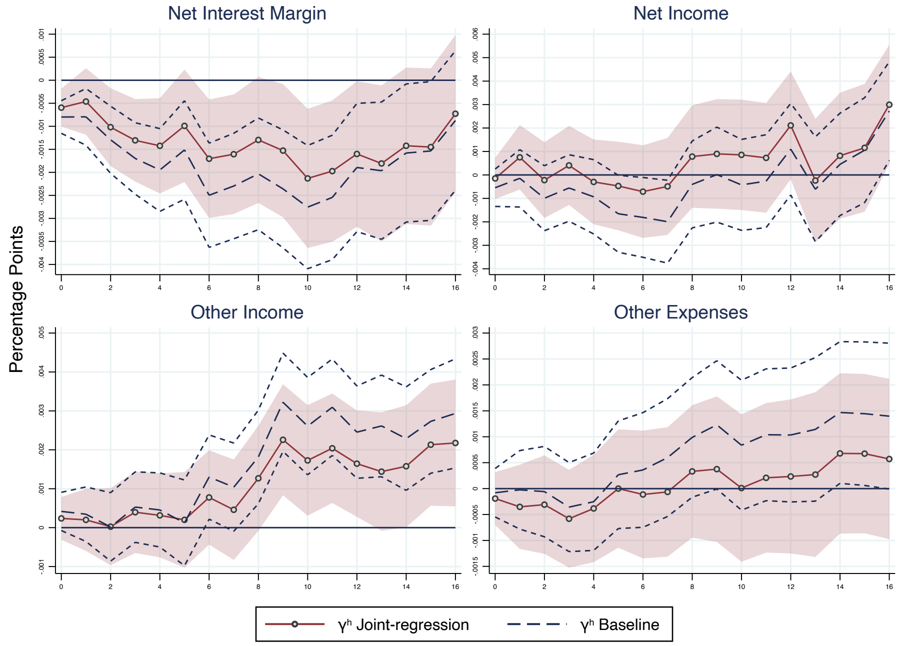
Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

The net interest margin responses do not translate into similar net income reactions. Figure 12 highlights that the conditional effect becomes non-significant when taking into account differences in sources of income and expenses not related to interest-earning assets or liabilities[51].

The dynamics in Figure 11 are monotonically decreasing, as highlighted in Figure 13. The absolute value of the coefficients increases with quintile groups, such that the higher quintiles experience lower net interest margins.

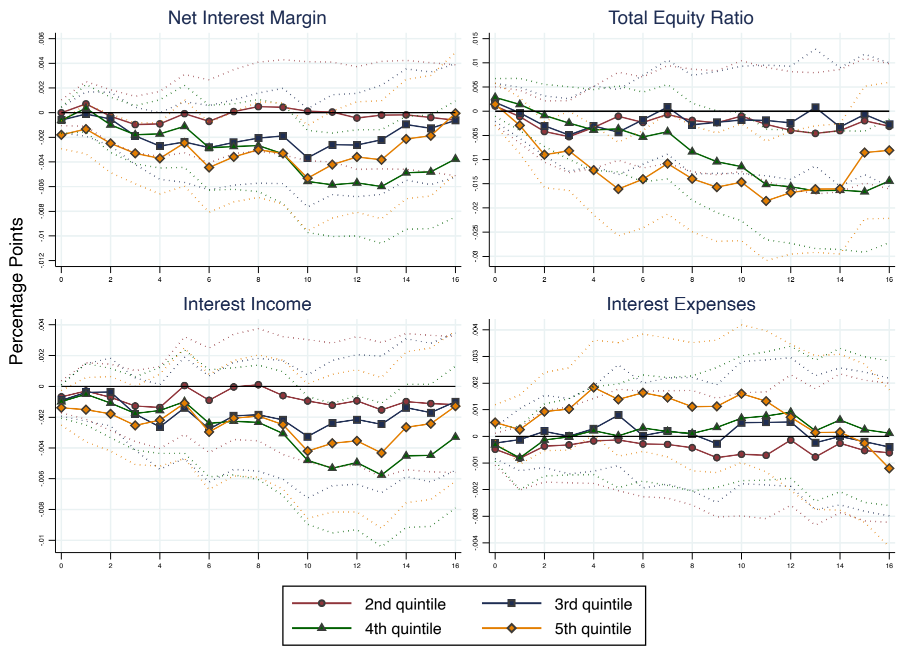
[51] Paul (2023) argues that this differences might be explained by the alternative denominator (total assets vs. total interest-earning assets) and possibly due to offsetting responses of noninterest income. This remark is relevant because – as discussed in the theoretical section– deposit franchise cost is usually translated into operational cost that enters into the other expenses variable.

Figure 12: Monetary Tightening Shock Conditional on HQ-Liquidity: Effect on Profit Margins - Part II (Baseline)



Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

Figure 13: Monetary Tightening Shock Conditional on Liquidity: Effect on Profit Margins - Part I (Non-linearities)



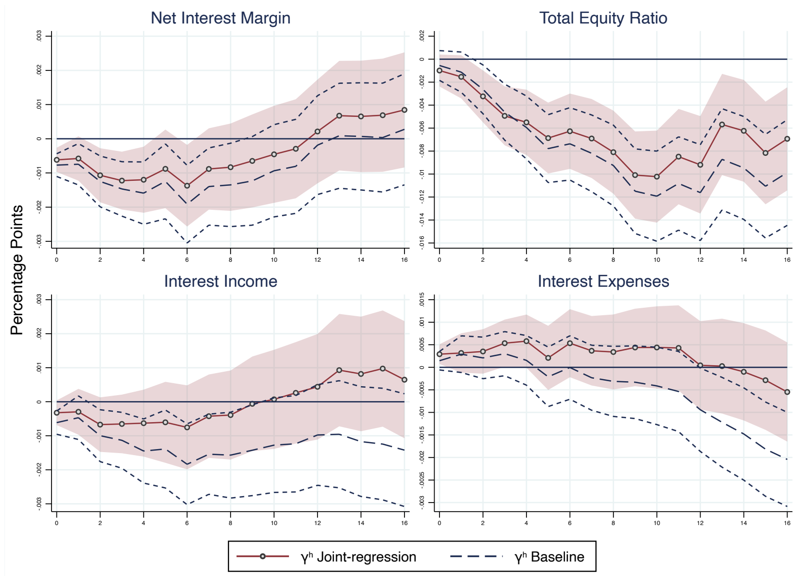
Notes: The graph displays the results for γ^h_{gr} obtained from specification (2). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

LQ-Liquidity Figure 14 presents results on the impact of monetary policy on profit margins, focusing on LQ liquidity. Both baseline and joint regression estimates reveal that banks with higher LQ liquidity experience lower net interest income six quarters after a monetary tightening shock.

One notable distinction between the two liquidity types is that the impact on equity ratios seems to be more pronounced and longer-lasting when examining LQ liquidity. When confronted with a 1bp unexpected increase in the 3m-FFF rate, banks positioned 1sd above the LQ liquidity distribution experienced a reduction of approximately 0.01pp in their equity ratio at its peak in quarter ten. These trends persist across both baseline and joint-regression estimates, although the differences in responses are somewhat more pronounced in the baseline-regression estimates.

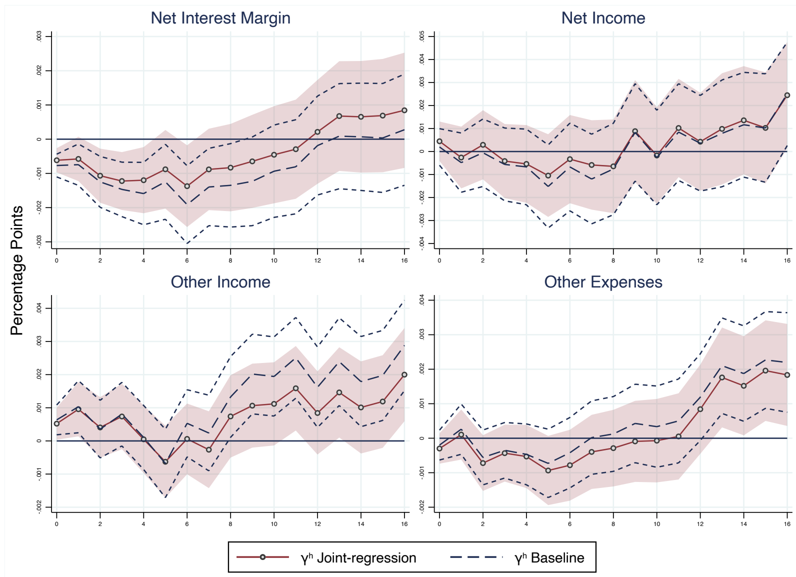
Total Liquidity The findings related to total iquidity ratios (See Figure 43) mirror the patterns observed in the analysis of LQ liquidity.

Figure 14: Monetary Tightening Shock Conditional on LQ-Liquidity: Effect on Profit Margins Part I (Baseline)



Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

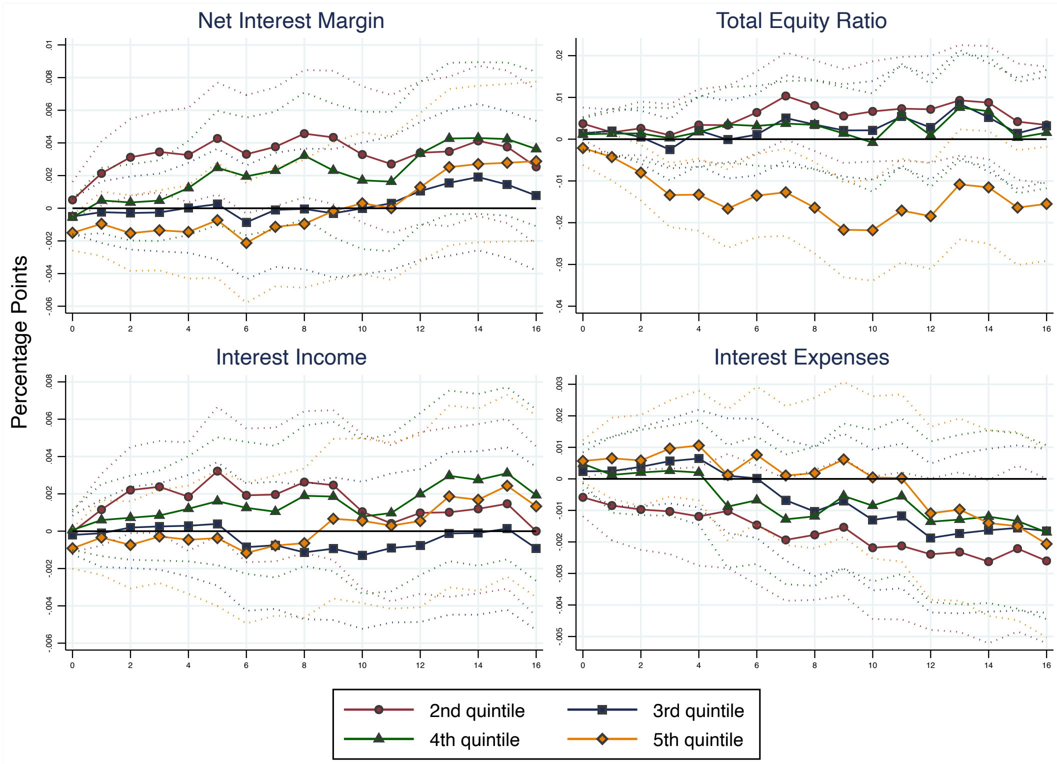
Figure 15: Monetary Tightening Shock Conditional on LQ-Liquidity: Effect on Profit Margins - Part II (Baseline)



Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

The dynamics in Figure 14 are non-strictly monotonic, as highlighted in Figure 16. Looking at net interest margins, while the value of the coefficients of banks in the second and fourth quartile is positive over the four-year horizon, the coefficients for banks in the third and fifth quintile are non-positive up to quarter ten and, after that, positive. Further, looking at equity ratios, banks in the fifth quintile group mainly explain the dynamics in Figure 14.

Figure 16: Monetary Tightening Shock Conditional on LQ-Liquidity: Effect on Profit Margins - Part I (Non-linearities)



Notes: The graph displays the results for γ_{gr}^{h} obtained from specification (2). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

9 Unconventional Monetary Policies

Is the role of liquidity distinct depending on the type of monetary policy? The conduct of the monetary policy has evolved, and new tools have been deployed. Each instrument might destabilize banks' outcomes in different ways and, more importantly, might deter or improve the capacity of liquidity to counteract these effects.

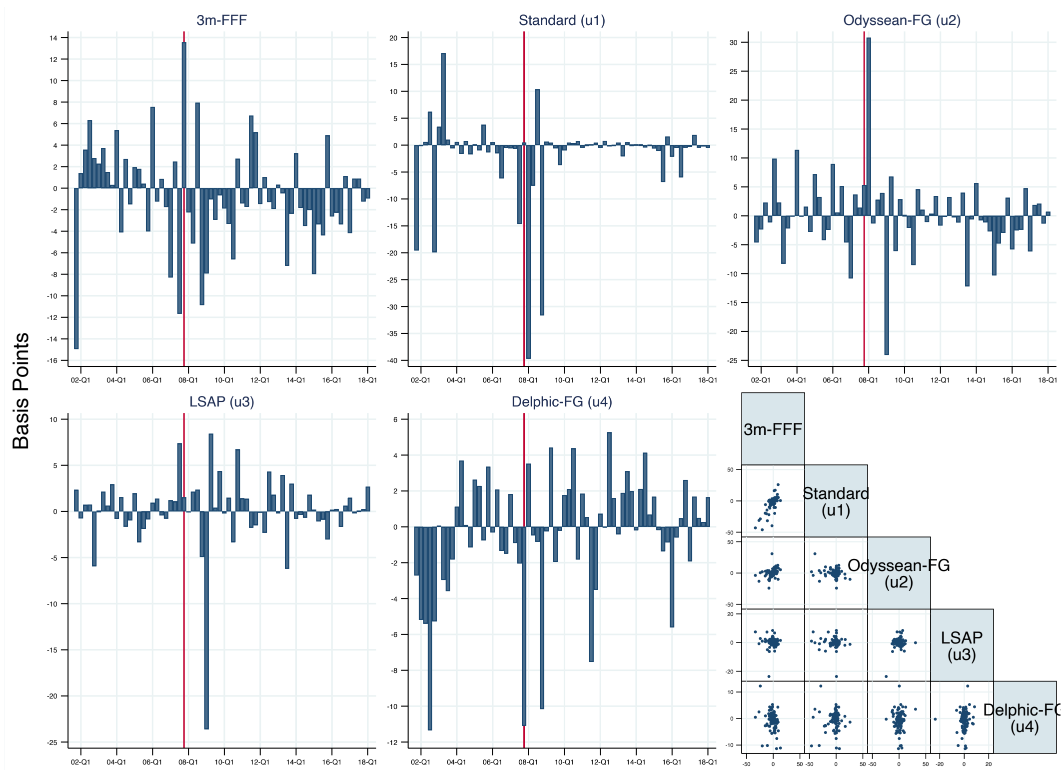
The distinction between various policy shocks has demonstrated its significance in the banking literature, particularly when examining banks' profitability and income responses to interest rate surprises. For instance, studies that concentrate on policy-induced changes in government bond yields with different maturities (e.g., English, Van Den Heuvel, and Zakrajšek, 2018; Paul, 2023), and shifts in term premiums (e.g., Paul, 2023) as indicators of monetary policy, reveal evidence indicating that banks exhibit a high degree of exposure to interest rate risks. In contrast, research by Drechsler, Savov, and Schnabl (2021), which centers on changes in the level of the federal funds rate, suggests that banks achieve nearly perfect interest rate hedging.

To better understand the consequences of the post-GFC monetary policy framework, I use Jarociński (2021) monetary shocks to test whether differences in the policy instruments have different consequences for the results observed previously. Figure 17 presents the time series of the structural monetary shocks used in this section. Each shock accounts for standard and non-standard monetary policy since each expresses unexpected changes in the near-term fed funds futures, 2- and 10-year Treasury yield, and the S&P500 stock index. The economic interpretation of each series goes as follows.

- The Standard monetary shock (u1) captures unexpected changes in the near-term fed funds futures that have a diminishing effect on longer maturities and depress stock prices. These characteristics align with conventional monetary policy actions.
- The Odyssean shock (u2) captures unexpected changes in the 2-year Treasury yield, no effects on longer or shorter maturities, and depress the stock prices. It replicates the intended effects of underlying commitments regarding the future course of short-term policy rates.
- The LASP shock (u3) captures unexpected changes in the 10-year yields, little effect on shorter maturities, and significantly negative changes in asset prices during some of the most important asset purchase announcements. It replicates long-term rate changes and is interpreted as a large-scale asset purchase policy.
- The Delphic shock (u4) captures Fed-news shocks. It captures the same changes in yields as the u2 shock, with the difference that it triggers an increase, rather than a decrease, in the stock prices.
- The measure of monetary shocks used in the previous sections (3m-FFF) is placed on the left top for comparison. This single catch-all monetary policy shock is highly correlated with both u1 and u2 (but does not capture asset purchases u3).

The strategy employed here follows the same specifications outlined in equation (1), and I keep the same set of controls used in the previous sections. Following the literature, for the ease of interpretability, each shock is rescaled so that a one unit u1 shock raises the expected fed funds rate after FOMC meetings (MP1) by 1bp, a one unit u2 and u4 raises the 2-year Treasury yields (ONRUN2) by 1bp, and a one unit u3 shock raises the and 10-year Treasury yields (ONRUN10) by 1bp.

Figure 17: Conventional and Unconventional Monetary Policy Shocks



Notes: This figure depicts the time series of conventional and unconventional monetary policy shocks and their correlation. Data on the baseline 3m-FFF shock comes from Jarociński and Karadi (2020), and the remaining series come from Jarociński (2021). Series corresponds to the unweighted sum of the high-frequency shocks within a quarter.

9.1 Results on Bank-level Estimations

Figures 46 to 49 summarizes the role played by HQ liquidity (Panel a) and LQ liquidity (Panel b) in the transmission of multiple monetary shocks.

Deposit Flows Figure Figure 46 provides the results concerning the role of HQ and LQ liquidity in transmitting various monetary policy shocks on the log change of total deposits.

In response to standard monetary shocks, the short-term stabilization effect of HQ liquidity disappears. However, this stabilization effect is relatively present in response to QE and Odyssean shocks. The destabilization effect of LQ liquidity observed in Figure 4 is captured by the interaction with standard monetary shocks. Odyssean shocks also show a negative effect on deposit growth. QE and Delphic shocks, on the other hand, have no interaction effect.

Loan Growth Figure 47 provides the results concerning the role of HQ and LQ liquidity in transmitting various monetary policy shocks on the log change of total loans.

The interaction between HQ liquidity and standard or Odyssean monetary shocks resembles the dynamics observed in Figure 7. Notably, the interaction with QE shocks suggests that banks with larger HQ liquidity ratios experience greater loan growth up to one year after the shock, with the coefficients being significant. In the baseline estimates, banks with larger HQ liquidity ratios experience permanently greater loan growth in response to a Delphic shock. However, after including controls, this effect becomes zero.

In contrast, the interaction between LQ liquidity and standard shocks partially resembles the dynamics observed in Figure 7, with only the baseline coefficients reflecting similar trends. Notably, the interaction with QE and Delphic shocks suggests that banks with larger LQ liquidity ratios experience greater loan growth, with a particular emphasis on the coefficients being significant for the Delphic shock.

Liquidity Creation Figure 48 provides the results concerning the role of HQ and LQ liquidity in transmitting various monetary policy shocks on liquidity creation.

The interaction between HQ liquidity and standard monetary shocks better captures the dynamics observed in Figure 9. Baseline estimates suggest negative and significant coefficients up to quarter ten, but once controls are included, the coefficients become non-significant. The interaction with the remaining shocks suggests that banks with larger HQ liquidity ratios transform more liquidity as a fraction of their total assets. However, these coefficients are mainly non-significant in both baseline and joint-regression estimates.

When examining LQ liquidity, the interaction with multiple shocks reveals various trends. For up to 4 quarters after a Standard shock, liquidity creation is lower for banks with larger LQ liquidity, but then it becomes positive. In contrast, for up to 4 quarters after an Odyssean shock, liquidity creation is greater for banks with larger LQ liquidity, but then it turns negative. Finally, the interaction with QE and Delphic shocks suggests that banks with larger LQ liquidity ratios experience greater loan growth, with the coefficients being significant for the Delphic shock.

Net Interest Margins Figure 49 provides the results concerning the role of HQ and LQ liquidity in transmitting various types of monetary policy shocks on interest rate margins[52].

When examining the interaction between HQ liquidity and Standard shocks, the negative effect on net margins observed in Figure 11 is only replicated up to 8 quarters. In contrast, the interaction with Odyssean and LSAP shocks does not provide substantial evidence to support the idea that HQ liquidity plays a significantly different role in transmitting these shocks. However, a noteworthy trend emerges when considering the interaction with the Delphic shock: banks with higher HQ liquidity ratios tend to experience greater profit margins in the eight quarters following these shocks.

The interaction between LQ liquidity and standard monetary shocks better captures the dynamics observed in Figure 14. Notably, the interaction with Odyssean and QE shocks suggests that banks with larger LQ liquidity ratios experience greater net interest margins, particularly emphasizing the significant coefficients for the Odyssean shock. The interaction with Delphic shocks is zero and non-significant up to quarter ten and becomes positive and significant in quarter 12.

Baseline and joint-regression estimates yield nearly identical results.

[52]Figure 50 depicts the changes in the total book value of banks' capital ratio.

10 Robustness Assessments: Investigating Permanent Heterogeneity in Monetary Policy Transmission and Addressing Endogeneity Concerns

The benchmark specification in Section 4.1 and the subsequent results have established a foundation by presenting evidence of the interaction between liquidity ratios and the transmission of monetary policy. I expand upon this groundwork in this section by addressing specific methodological concerns. The focus lies on ensuring the robustness of previous findings in the face of two key issues: biases resulting from persistent differences in monetary policy transmission and endogeneity resulting from reverse causality.

In Section 4.1, I employ a specification strategy to account for heterogeneity in the transmission of monetary policy arising from other time-varying bank characteristics. Moreover, the strategy uses bank fixed effects to control for *permanent differences* in outcomes$-Y$ across banks (e.g., differences in bank business models). Nevertheless, according to Ottonello and Winberry (2020), the standard fixed effects estimator is not immune to biases produced by permanent differences in how banks respond to aggregate monetary shocks. For this reason, Section 10.1 implements alternative specifications intended to address heterogeneity in the transmission of monetary policy caused by factors of a more permanent nature.

In Section 4.1, I address endogeneity by incorporating lagged values of the four-quarter rolling average in the liquidity ratios, a commonly used strategy in the literature. However, it's noteworthy that while this approach helps mitigate endogeneity (arising from observed characteristics), it may not eliminate endogeneity related to unobserved characteristics or reverse causality. For this reason, Section 10.2 addresses other sources of endogeneity by instrumenting liquidity ratios with a Bartiks-like instrumental variable approach.

10.1 Consequences of Permanent Heterogeneity in the Transmission Channel

To understand the motivation for the exercise, let's consider the argument in Ottonello and Winberry (2020). Assume that the following process generates the bank's outcome-Y

$$\Delta_h Y_{i,t+h} = \beta_i^h mp_t + \gamma^h mp_t LR_{i,t-1} + \left(\Psi^h + \Gamma^h mp_t\right) X_{i,t-1} + f_i^h + f_{t+h}^h + u_{i,t+h}^h \tag{3}$$

The elements in specification (3) remain consistent with those in the previous paper, with the sole exception being the inclusion of the *permanent responsiveness* term β_i^h. This term indicates the presence of permanent bank-specific characteristics that induce permanent heterogeneity in the transmission of monetary policy shocks mp_t.

Consider that $\beta_i^h = f(\mathbb{B}^h \mathbb{W}_i)$, where $\mathbb{B} = b_1, b_2, ...b_l$ is a vector of coefficients, and $\mathbb{W}_i$ is a vector of unobserved characteristics inducing permanent heterogeneity in policy transmission. For the estimation of the parameters of interest γ^h, a source of bias might be that the characteristics within β_i^h correlate with the liquidity ratios, $Corr(LR_{i,t-1}, \mathbb{W}_i) \neq 0$.

This section controls for two factors that cause the correlation between the permanent heterogeneity factor and the liquidity ratios. The first specification tackles permanent heterogeneity caused by permanent cross-sectional differences in liquidity ratios. The strategy follows the within-bank estimation approach (or direct orthogonalization) of Ottonello and Winberry (2020), which is thoroughly explained in section 10.1.1. The second specification tackles permanent heterogeneity in the transmission due to permanent differences in how banks adjust their liquidity ratios in response to monetary shocks. This issue is addressed in section 10.1.2 and consists of mixing Ottonello and Winberry (2020) with the state-dependent local projections approach of Cloyne, Jordà, and Taylor (2023).

10.1.1 Controlling for Within Bank Liquidity Variation

Consider the case when the average value of the bank's liquidity position is proportional to the permanent heterogeneity in responsiveness β_i, in other words, $\beta_i^h = b_1^h \mathrm{E}_i[LR_{i,t}]$. In the context of this thesis, banks may be ex-ante heterogeneous in how they respond to monetary policy due to cross-sectional differences in liquidity ratios for various reasons: For example, low-beta-banks are permanently less exposed to monetary policy and more likely to have permanently lower liquidity ratios.

Under this assumption, a high value of LR_{it} in the cross-section may influence how the bank responds to the aggregate shock: a) through the coefficient of interest γ or b) through the permanent responsiveness term. In the absence of variables controlling for the permanent responsiveness term, Ottonello and Winberry (2020) proposes to construct regressors that are by construction orthogonal to the omitted terms. This approach yield to the following specification:

$$\Delta_h Y_{i,t+h} = \gamma^h_{wb}\Big(LR_{i,t-1} - \mathbb{E}_i[LR_{i,t}]\Big)mp_t + \Psi^h_{wb}Z_{i,t-1} + \Gamma^h_{wb}mp_t\widetilde{X}_{i,t-1} + f^h_i + f^h_{t+h} + u^h_{i,t+h} \quad (4)$$

Unlike specification (1), equation (4) includes an interaction term that measures liquidity ratios relative to the average liquidity position, denoted as $\widetilde{LR}_{i,t-1} \equiv LR_{i,t-1} - \mathbb{E}_i[LR_{i,t}]$[53]. By construction, $\widetilde{LR}_{i,t-1}$ is uncorrelated with $\mathbb{E}_i[LR_{i,t}]$; hence results are less likely to be driven by permanent heterogeneity in monetary policy responsiveness across banks.

For the baseline specification, the vector $\widetilde{X}_{i,t-1}$ is empty while $Z_{i,t-1}$ is a vector including only the level of the liquidity ratio $LR_{j,t-1}$. For the joint-regressions approach, the vector $\widetilde{X}_{i,t-1}$ includes demeaned control variables while $Z_{i,t-1}$ includes the levels of these control variables plus the level of the liquidity ratio. The selection of variables in $\widetilde{X}_{i,t-1}$ is unchanged compared to the ones used in paper 2. Finally, the right-hand side variables are winsorized at 1% and then standardized by subtracting the sample mean and dividing by the sample standard deviation of each respective variable.

The primary coefficients of interest, denoted as γ^h_{wb}, quantify the sensitivity of outcome-Y to monetary shocks based on the heterogeneity in within-bank variations in the liquidity ratios. For interpretability, these coefficients indicate how a bank's response to a monetary policy shock is influenced by the fact that the bank is more or less liquidity relative to its typical

[53] $\mathbb{E}_i[LR_{i,t}]$ denotes the average value the liquidity ratio for a given bank over the sample.

level. Once again, results in the following sections represent equilibrium outcomes. Results are left in Section G.1.

10.1.2 Controlling for Permanent Adjustments in Liquidity Ratios

Banks may be ex-ante heterogeneous in how, in response to monetary policy, they adjust their liquidity ratios. Similar to the previous section, these policy-induced adjustments can be a source of bias if they convey permanent effects on monetary policy transmission. In that sense, consider the case when permanent heterogeneity in responsiveness β_i^h is explained by changes in the expected liquidity ratio, such that $\beta_i^h = b_2^h \mathbb{E}_i[\Delta_h LR_{i,t}]$. The objective of this section is to identify if estimates are less likely to be driven by permanent heterogeneity in banks' liquidity adjustments in response to monetary policy.

Two-stage Local Projection Approach To explore the consequences of this source of permanent heterogeneity, I employ an approach inspired by the Cloyne, Jordà, and Taylor (2023) approach. Their methodology consists of Kitagawa-Blinder-Oaxaca decomposition of the traditional Local projection. Specifically, the estimation consists of two-stage local projections. In stage one, I estimate the bank-specific average cumulative response of liquidity ratios to monetary shocks from the following specification:

$$\Delta_h LR_{i,t+h} = f_i^h + \Theta_i^h mp_t + \Gamma^h mp_t \widetilde{X}_{i,t-1} + \Psi^h B_{i,t-1} + \varphi^h A_{t-1} + \epsilon_{i,t+h}^h \tag{5}$$

The notation remains consistent with the previous section. In equation (5), the right-hand side represents the cumulative changes in the liquidity ratios. The vector A_{t-1} includes other state variables[54]. The vector B_i includes bank-specific controls[55]. Finally, the parameters of interest are Θ_i^h, which proxies the bank-specific sensitivity of their liquidity ratio(s) to the monetary tightening shocks (mp_t). Descriptive statistics on the distribution of these parameters are provided in Section G.2.2.

[54]The set of time-variant controls includes quarter dummies and four lags of the national unemployment rate, real GDP growth, CPI inflation, market expectations of near-term volatility conveyed by stock index option prices (VIX), and the change in the fed funds rate to capture persistence in the policy rate.

[55]The set of bank-specific controls includes the lagged change in the liquidity ratio to capture persistence in liquidity adjustments, size and leverage, local deposit concentration, the repricing/maturity gap, the income gap, z-scores, and the ratio of non-performing loans.

In stage two, I extend the baseline panel regression (4) by including the estimated coefficient $\hat{\Theta}_i^h$ as follows:

$$\Delta_h Y_{i,t+h} = \beta^h mp_t + \gamma_{SLP}^h \left(mp_t \widetilde{LR}_{i,t} \right) + \theta^h mp_t \hat{\Theta}_i^h + \Gamma_{SLP}^h mp_t \widetilde{X}_{i,t-1} + \Psi_{SLP}^h Z_{i,t-1} + f_i^h + \varphi^h A_{t-1} + u_{i,t+h} \tag{6}$$

the parameters of interest are γ_{SLP}^h, which do not capture the indirect effects of monetary shocks on bank-specific liquidity ratios.

Results are left in Section G.2. One clarification before presenting the results: State-dependent local projection methods are typically used in exercises that study state dependence, focusing on how the effect of policy varies with some lagged state variables, like the lagged output gap. However, I am not directly estimating the state-dependent impulse response function in this section. These methodologies inspire the empirical specification here. Furthermore, endogeneity issues are not expected to be addressed by including the estimated coefficient $\hat{\Theta}_i^h$. I still use four-quarter moving averages in this section to control for possible reverse causality.

10.2 Consequences of Endogeneity - Reverse Causality

This section implements the Bartik Instruments following the basic idea of the instrumental variable approach[56]. The estimation employs two-stage least squares. In stage one, $(mp_t \times z_{i,t}^j)$ and $z_{i,t}^j$ are used as instruments for $mp_t \times LR_{i,t}^j$ and $LR_{i,t}^j$. The first stage estimation goes as follows

$$\begin{aligned} mp_t \cdot LR_{i,t}^j &= f_i + f_t + \beta_1 \left(mp_t \times z_{i,t}^j \right) + \beta_2 z_{i,t}^j + \Gamma' mp_t X_{i,t-1} + \Psi' Z_{i,t-1} + \epsilon_{i,t} \\ LR_{i,t}^j &= f_i + f_t + \beta_3 \left(mp_t \times z_{i,t}^j \right) + \beta_4 z_{i,t}^j + \Gamma' mp_t X_{i,t-1} + \Psi' Z_{i,t-1} + \epsilon_{i,t} \end{aligned} \tag{7}$$

The second stage consists of estimating the following specifications

$$\Delta_h Y_{i,t+h} = f_i^h + f_{t+h}^h + \gamma_{iv}^h (\widehat{mp_t \cdot LR}_{i,t}) + \Gamma_h' mp_t X_{i,t-1} + \Psi_h' Z_{i,t-1} + u_{i,h,t+h} \tag{8}$$

[56] Section G.3.2 provides the foundational understanding of the Bartik approach.

where $\widehat{mp_t \cdot LR_{i,t}}$ is the instrumented treatment obtained in stage-one[57]. As for how I include the sets of financial conditioning variables $X_{i,t-1}$, I repeat the same strategy as in the OLS regressions from the previous sections. I consider the relevance of the liquidity ratio separately (baseline regression) and finally jointly (joint regression). For the joint regressions, I limit the set of controls to three main control variables: capitalization, income gaps, and maturity mismatch[58]. Results are left in Section G.3.

11 Conclusion

This paper traces the effects of monetary policy conditional on holdings of multiple types of liquidity into different banking industry outcomes. I use local projections to estimate the dynamic heterogeneity in deposit flows, lending, liquidity creation, and profit margins generated by the interaction between monetary shocks and ex-ante liquidity ratios. The main evidence is derived from a sample of U.S commercial banks with assets less than $50 billion dollars. The analysis centers on the interaction between HFI-monetary shocks and four liquidity ratios: High-quality, Low-quality, total liquidity, and liquidity coverage ratios, producing the subsequent findings.

When analyzing conventional monetary policy shocks: High-quality liquidity stabilizes deposit outflows in response to monetary shocks in the short term. In comparison, low-quality liquidity does lead to a permanent decrease in deposit growth in response to monetary shocks (Section 5). High-quality liquidity shows no statistically significant heterogeneous effects in transmitting monetary shocks on loan growth after controlling for income and duration gaps. In contrast, low-quality liquidity does lead to a decrease in loan growth in response to monetary shocks (Section 6). High- and Low-quality liquidity do not create heterogeneity in the transmission of monetary shocks to banks' liquidity creation (Section 7). High- and Low-quality liquidity expose banks to larger profit losses in response to tightening monetary shocks. The findings indicate that most banks experience lower net interest income flows

[57] $\widehat{LR}_{i,t}$ is included in the Z_i vector.

[58] In this respect, I limit the set of control variables because the joint-regressions estimates are not stable when including a large number of controls. However, the instruments are more likely to be uncorrelated with unobserved bank-quarter characteristics, thereby improving control for confounding factors.

when short-term interest rates rise, even when accounting for sources of interest rate risk exposure (8). Finally, the paper concludes with an exercise exploring the role played by liquidity ratios in response to monetary shocks that reflect unconventional monetary policy instruments (Section 9).

This paper also assesses the robustness of the previous findings from two distinct angles: by studying potential biases stemming from persistent differences in monetary policy transmission and by considering issues related to endogeneity–reverse causality.

In Section 10.1, the robustness analysis accounts for biases product of permanent heterogeneity in monetary policy transmission. These biases might arise from two sources: a) differences in banks' holdings of liquid assets (Section 10.1.1) and b) differences in the adjustment of liquidity (Section 10.1.2). From a methodological perspective, I estimate the dynamic and heterogeneous response using standard and state-dependent local projections.

In Section 10.1.1, a key distinction lies in the orthogonalization of liquidity ratios before estimation. This method directly addresses the issue of permanent heterogeneity in monetary policy resulting from sustained differences in liquidity ratios across banks. Overall, the findings in Section 10.1.1 align with those based on the benchmark specification. However, a noteworthy difference is the quantitative relevance of permanent heterogeneity in liquidity ratios, impacting the estimates' magnitude. This impact is particularly evident when examining profit margins and liquidity creation. Specifically, the negative effect of liquidity ratios on profits is significantly amplified, indicating that banks with larger holdings of liquidity experience a greater reduction in profit margins. Moreover, the capacity of these banks to create liquidity is diminished. Concerning deposit flows, the stabilizing effect of HQ liquidity becomes more pronounced. In contrast, the conclusions regarding loan growth remain largely consistent with the OLS regression results.

In Section 10.1.2, the key distinction is that it accounts for bank-specific adjustments in liquidity ratios in response to monetary shocks. The methodology is inspired by the state-local projection approach of Cloyne, Jordà, and Taylor (2023). In the first stage, I estimate the expected sensitivity of banks' liquidity ratios to monetary shocks, and in the second stage –where the conditional effect of monetary policy is estimated– I control for these permanent policy-driven adjustments in liquidity. Results closely mirror the short-term dynamics of the estimates from the benchmark specification.

In Section 10.2, I conducted a robustness analysis to address concerns about reverse causality arising from endogenous bank-specific choices. The evidence obtained from the IV approach presents a more nuanced picture compared to the results of OLS regressions from the benchmark specification and Section 10.1. While HQ liquidity continues to act as a stabilizer in the short term, the evidence regarding LQ liquidity ratios does not align with the dynamics observed in previous sections. Importantly, the exercise highlights a potential limitation: the exogenous factors obtained from the Bartik decomposition do not seem to provide sufficient variation in liquidity ratios; therefore, their statistical power might be inadequate to serve as proper instruments for liquidity ratios. Further research should explore alternative identification strategies or alternative methods to construct more suitable instruments for liquidity ratios.

In summary, this paper improves our understanding of how monetary policy is transmitted within the banking sector. Altogether, the empirical contribution of this paper complements and expands previous literature that has explored the role of liquidity in the transmission mechanism of monetary policy into the banking system. Since the literature has uniquely explored one dimension of liquidity, this research contributes to studying multiple types of liquidity and identifies that liquidity might play alternative roles in transmitting shocks outside the traditional fund-of-last-resort view.

Although this study does not explicitly explore the implications of macroprudential instruments, the findings indicate potential adverse effects of high-quality liquidity and liquidity coverage ratios, such as reduced profit margins. This suggests unintended destabilizing factors associated with recent trends in banks' accumulation of high-quality liquidity. This point raises questions for future research regarding the interaction between monetary policies and macroprudential instruments.

Appendix

A Banking Channels of Monetary Policy

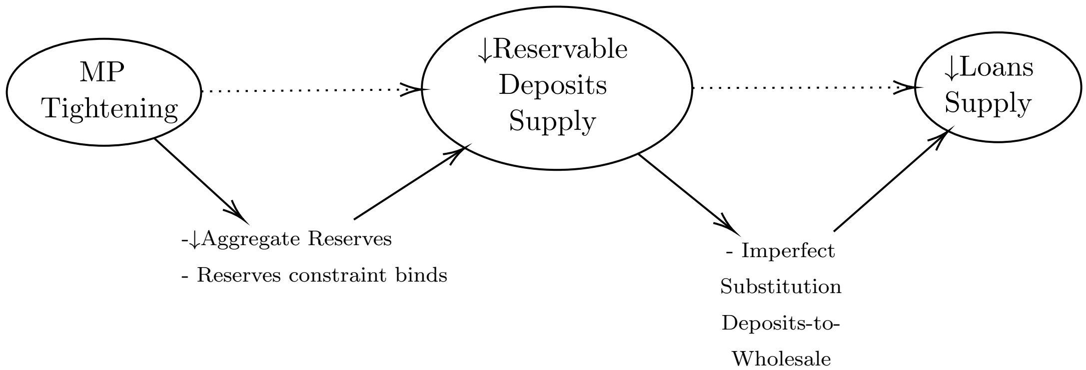
To set the foundational knowledge necessary to delve into the empirical analysis of how monetary policy actions and the management of liquid assets influence the performance and stability of the banking sector, in this section, I introduce and discuss the different predictions proposed by the literature regarding the transmission of monetary policy into banks' outcomes.

A.1 Bank Lending Channel

The bank lending channel (BLC) argues a causal relationship between monetary policy and banks' loan supply. In a nutshell, in response to monetary tightening, banks are forced to contract the supply of (reservable) deposits. Due to the failure of the Modigliani-Miller theorem, banks are forced to contract lending supply since raising alternative funding is costly.

In the canonical version of the BLC Bernanke and Gertler (1995), this relationship is explained by the effect of monetary policy on systemwide reserves and how the contraction in aggregate reserves ultimately conditions the capacity of banks to raise reservable deposits. Specifically, a contractionary monetary shock via an open market operation reduces the aggregate level of reserves in the economy. Costly reserves limit banks' access to liquidity, so banks' reserve constraints start tightening. Banks must lower reservable deposits once they start experiencing a scarcity of reserves. The reduction of reservable deposits can be compensated by increased non-reservable liabilities (e.g., CDs, FED funds, equity, wholesale deposits, etc.). However, these alternative sources of funds are expensive, so the substitution is less than one-to-one. Ultimately, banks are forced to contract their loan supply if they operate with lower deposits due to costly alternative funding.

Figure 18: Cannonical Bank Lending Channel



The main takeaway is that the transmission of monetary policy on lending is predicted to be negative. To be operational, banks must be liquidity-constrained in response to tightening monetary policy and have limited access to alternative funding sources.

A.2 Bank Capital Channel

The bank capital channel (BCC), pioneered by Van den Heuvel (2002), formalizes how changes in *capital adequacy* due to monetary policy affect banks' lending behavior.

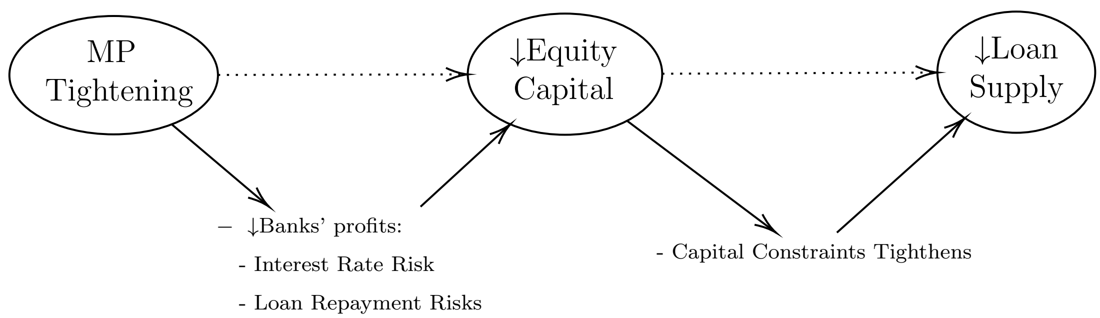
The channel involves two main stages. Initially, a contractionary monetary policy that increases loan default rates (due to slower economic activity) induces banks to experience reduced profitability. Consequently, banks' capitalization starts decreasing, and capital requirements start tightening. Like the BLC, since rising new equity is costly, capital requirements compel banks to forgo profitable lending opportunities and allocate funds to assets not subject to regulations[59]. In the BCC, monetary policy leads weaker banks to cut back on new lending to maintain regulatory capital requirements[60].

[59]Notice that banks' precautionary motives might be a source of amplification effects. While capital constraints may not always be binding, banks may limit lending to mitigate the risk of future capital inadequacy. With precautionary motives, banks become more sensitive to their capital constraints when monetary policy is tightened (making them care about hitting it).

[60]Note that there is an interaction between the BLC and the BCC. This occurs in two ways. Firstly, when risk-based capital requirements are binding, banks cannot expand lending without additional capital, which limits the effectiveness of liquid assets as a source of last-resort funding. Secondly, the amount of equity in banks can help mitigate adverse selection or moral hazard issues in the market for non-reservable bank liabilities. This, in turn, enables banks to respond more effectively to monetary tightening, as the cost of other sources of liabilities is expected to be lower.

Notably, the BCC is operational if banks' capital responds endogenously to monetary policy. In the canonical BCC framework, a contractionary monetary policy shock negatively impacts profitability, directly translating into a weak capital position. However, the signs of these relationships are being debated in the existing literature. Due to the importance of these considerations, a discussion is left in section A.6.

Figure 19: Cannonical Bank Capital Channel



A.3 Balance Sheet Channel

The balance sheet channel (BSC), pioneered by Bernanke and Gertler (1989), primarily centers on the sensitivity of *the valuation* of banks' assets and liabilities to changes in interest rates. Its functioning relies on the differential effect of monetary policy on the *valuation* of assets relative to liabilities. Specifically, in response to a monetary tightening policy, the *book value* of assets is expected to decline by more than *the book value* of liabilities, thereby depressing net worth and forcing banks to shrink their balance sheets.

Contrary to the capital channel, whereby profits shocks are at the center of the mechanics, the balance sheet channel operates through equity-value shocks generated by monetary policy, which can tighten even more banks' constraints.

A.4 Deposits Channel

Recent versions of the BLC aim to identify different driving forces that explain the relationship between monetary policy and deposit supply. One alternative that has gained significant attention is the deposits channel (DC), named after Drechsler, Savov, and Schnabl (2017). What sets the DC apart is that it establishes a direct causal relationship between monetary policy and the supply of different deposit accounts, encompassing not only those subject to liquidity requirements, as seen in the BLC.

The functionality of the DC is grounded in banks' incentives to increase their intermediation margins within a monopolistic competition framework. Specifically, banks, leveraging their power in local deposit markets[61], can secure a deposit spread – the differential between risk-free illiquid bonds and deposit rates. Consequently, banks do not correspondingly elevate deposit rates one-to-one when faced with a rise in short-term policy rates. Instead, like any monopolist, they optimize intermediation margins by offering fewer deposit contracts.

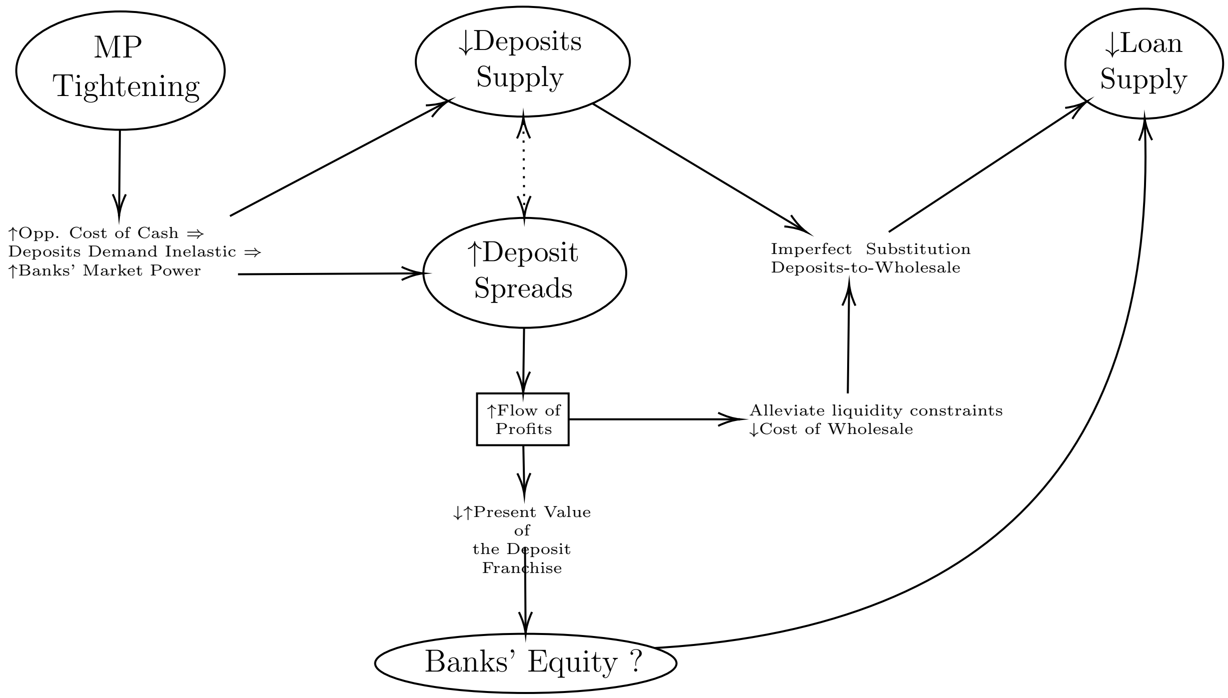
In Drechsler, Savov, and Schnabl (2017), banks provide differentiated liquidity services through deposit accounts in an imperfect competition environment[62]. This source of market power allows banks to offer deposit rates below the prevailing market rates (i.e., charge a deposit spread on clients). Households are willing to pay the deposit spread because they have preferences over liquidity services (cash and deposits), and physical currency and deposits are substitutes.

Monetary policy influences deposit market equilibrium in two ways. First, it shapes the elasticity of (aggregate) deposit demand since short-term policy rates impact the opportunity cost of holding cash. When policy rates are high, demand becomes inelastic as cash becomes a comparatively expensive source of liquidity. Ideally, households would prefer to hold bonds; however, since bonds do not provide liquidity, households will rely heavily on deposits to cover their liquidity needs. Conversely, when policy rates are low, cash becomes a less expensive source of liquidity, and households rely less on deposits to cover their liquidity needs. Second, monetary policy activates a market power channel. In response to a tightening shock, banks contract deposit supply to maximize deposit spreads. As deposit spreads widen, depositors respond by reallocating their portfolios towards alternative sources of liquidity that provide higher profitability, such as money market funds.

[61] Choi and Rocheteau (2023) argue that market power is insufficient for the deposit channel to operate.

[62] Differentiation in liquidity services is initially primitive in the model. In Drechsler, Savov, and Schnabl (2021), differentiability is a product of an investment in a deposit franchise. The deposit franchise gives banks market power over retail deposits, which allows them to borrow at rates that are both low and insensitive to market interest rates. Running a deposit franchise incurs operating costs (branches, salaries, marketing, technology), which tend to be relatively constant over time and are insensitive to interest rates.

Figure 20: Deposits Channel



The DC and the BLC share similar predictions about the effect on lending; however, there is a difference concerning the expected magnitudes. For a lower level of (retail) deposits, lending supply is expected to decrease as banks partially offset deposit outflows with costly wholesale funding (i.e., the Modigliani-Miller theorem fails). However, a distinctive aspect of the DC is that the overall impact on lending is anticipated to be mitigated owing to the interplay between the profitability generated by broader deposit spreads and the presence of liquidity (or leverage) constraints.

In Drechsler, Savov, and Schnabl (2017), the increase in profit flows due to higher deposit spreads can help alleviate banks' liquidity constraints. This reduces the cost of funds in the wholesale market, partially offsetting the negative effect of the policy rate increase on lending. This latter characteristic of the DC is an additional interaction with the BSC. If a monetary tightening shock enables banks to increase intermediation margins, is this flow of profits increasing banks' net worth?

In the model proposed by Drechsler, Savov, and Schnabl (2017), which does not account for bank runs, it is not guaranteed that increasing profits translate into higher banks' equity.

Higher profits are subject to a higher discount rate, potentially resulting in an unchanged or even decreased present value of the deposit franchise. Empirical evidence from Drechsler, Savov, and Schnabl (2021) supports this notion.

However, considering the influence of bank runs can alter the conclusion. As discussed by Drechsler, Savov, Schnabl, and Wang (2023), the occurrence of bank runs could constrain banks' ability to profit from deposit franchises, disrupting their interest rate hedging strategy and leading to a reduction in banks' capital. When monetary policy tightens, the likelihood of a run increases because the deposit franchise's value increases with interest rates. It implies that in a tightening cycle, banks' reliance on the deposit franchise is larger so that runs become even more costly ("deposit franchise is only valuable if depositors remain in the bank"). This exacerbates banks' vulnerability and introduces uncertainty that can amplify the negative consequences of monetary policy on capital and lending. To take-away, the effect on lending might be state-dependent, and banks' interest rate hedging strategies based on deposit franchises can magnify the adverse impact of monetary policy on lending.

Cash Flow Channel

In a study by Gomez et al. (2021), income gaps take the center of the monetary policy transmission. The fundamental concept bears a resemblance to the Deposit Channel in that both highlight the significance of income shocks resulting from monetary policy actions. These income shocks can boost bank profits and by easing liquidity or leverage constraints they support lending activities. However, a crucial distinction exists: income shocks generated by monetary policy tightening primarily stem from repricing floating-rate and matured positions, whereas in the DC channel, wider deposit spreads play a pivotal role in enhancing bank profitability.

A.5 Risk-Taking Channel

Previous channels emphasize the significance of the endogenous reactions of banks' capital (BCC) and deposits (BLC) to monetary shocks. Another perspective proposes that a pivotal factor in the transmission of monetary policies is how these policies influence agents' risk perceptions and willingness to bear risks. The risk-taking channel (RTC) formalizes the endogenous changes in banks' risk perception. In the literature, this channel operates through three main mechanisms (See Delis, Hasan, and Mylonidis (2017)): the search-for-yield mechanism, the valuation-default mechanism, and the moral hazard/adverse selection mechanism.

Increased Appetite for Riskier Assets In times of significantly low interest rates, bankers tend to become more willing to take on riskier assets in search of higher yields. This behavior is driven by the challenge of achieving nominal target returns in prolonged periods of expansionary monetary policy (Rajan, 2005).

Mispricing of Risks When interest rates are low and monetary policy contributes to high asset valuations with reduced price volatility, bankers may misprice risks. This mispricing occurs because low rates boost the values of assets and collateral while reducing perceived price volatility. As a result, bankers underestimate default probabilities and become more inclined to take on higher-risk positions, often leading to an increase in loan supply with lowered credit standards (Borio and Zhu 2008).

Greater Risk-Taking with Policy Commitments In situations where monetary policy is fully committed to avoiding large downside risk scenarios, bankers may opt to take on greater risks. When monetary policy commits to lowering future interest rates in response to threatening shocks, it reduces the probability of significant downturns. This commitment and moral hazard encourage banks to assume more risks. This phenomenon is sometimes referred to as the Greenspan or Bernanke put, and it operates based on the expectation of lower interest rates in the future rather than the current low rates.

A.6 Interest rate risks, profitability, and bank net worth

The literature has been extensively focused on understanding the sources of interest rate risk and the hedging strategies employed by banks. This is a pivotal area of study because the impact of monetary policies on banks' profitability, and consequently their overall financial health, is intricately tied to this interaction. To ascertain whether a bank is shielded, either partially or completely, from the effect of monetary via profits and capital, one must consider various factors.

Firstly, banks inherently face interest rate risk due to the nature of their business model, distinct from other financial and non-financial firms[63]. In essence, when monetary policy tightens, banks might witness a decrease in earnings coupled with rising expenses, potentially leading to reduced profits or even insolvency. Banks optimize their profits by engaging in maturity transformation, borrowing short-term while lending long-term. This is predominantly achieved through the issuance of fixed-rate loans instead of floating-rate loans, while a substantial portion of interest-bearing liabilities is susceptible to short-term repricing.

However, the extent of a bank's exposure to interest rate risk is influenced by other factors. Firstly, market imperfections, such as monopolistic competition, can result in imperfect rate pass-throughs. Secondly, banks employ various hedging strategies to partially or fully mitigate their exposure to interest rate risks. The ultimate impact on profits hinges on two critical elements: a) the responsiveness of rates to changes in policy rates and b) the effectiveness of the employed hedging strategies. In the subsequent discussion, I delve into these factors separately.

A.6.1 How changes in policy rates might reflect in banks' profits (or not)?

The degree to which banks' profits respond to changes in policy rates depends on the interest rate sensitivity of their asset's cash flows relative to their liabilities' cash flows (net cash flows). When the sensitivities are impaired, monetary policy might put under pressure banks' profitability.

In essence, maturity transformation leads to a situation where the sensitivity of a bank's liabilities to changes in interest rates is higher than that of its assets. When policy rates increase, it triggers a repricing effect in liabilities. However, long-term assets typically generate fixed nominal cash flows unaffected by short-term interest rate movements. This discrepancy

[63] Microfundations of why banks unlike other financial and non-financial firms, are exposed to this source of risk is discussed in Di Tella and Kurlat (2021)

between the repricing of liabilities and the unchanging nature of cash flows from long-term assets results in a scenario where tightening monetary policy causes net cash outflows for the bank. However, the literature has found contradictory evidence regarding this mechanism.

First, Drechsler, Savov, and Schnabl (2021) find that banks perfectly match the sensitivity of their assets and their liabilities in response to changes in the level of the Fed funds rate[64]. They suggest that this is a consequence of the deposit channel, in which monopolistic competition induces imperfect pass-through toward deposit rates[65]. Second, beyond imperfect pass-throughs, other components of banks' balance sheets might explain why banks' profits do not necessarily drop in response to monetary tightening cycles. For instance, floating-rate positions and maturing assets can generate enough cash flows to increase profits. Gomez et al. (2021) and Haddad and Sraer (2020) document cash-flow shocks generated by repricing and maturity of assets and liabilities are significant to the point that in response to Fed Funds rate increases, larger income gap banks generate more earnings.

A.6.2 How changes in policy rates might reflect in banks' equity (or not)?

Recent evidence suggests that banks engage in significant maturity transformation, with an average duration mismatch of about 3.4 years (Drechsler, Savov, and Schnabl, 2021). This metric implies that a 100 bp level shock to interest rates would cause an immediate drop in banks' net worth of 34 percent. However, contrary to what this back-to-the-envelope calculation suggests, alternative evidence suggests that a 100 bp shock to interest rates induces only a 4.2% drop in banks' net worth (Drechsler, Savov, and Schnabl, 2021). Why the effect on banks' net worth is smaller than that implied by their duration mismatch?

There are at least two reasons why policy-induced changes in profits are not necessarily translated into one-to-one changes in bank equity. First, the present value of profits does not rise because the higher profits are discounted at a higher rate. Second, banks are fully

[64] This result is replicated in Figure 22

[65] Recent evidence supports why adjustments in deposit rates are subject to upward rigidities. Some argue that this is due to monopolistic competition (Bellifemine, Jamilov, and Monacelli, 2022; Drechsler, Savov, and Schnabl, 2017), information asymmetries Choi and Rocheteau (2023) or smoothing motives (Polo, 2021). Other complementary evidence suggests that adjustments in loan rates are also subject to downward rigidities Bellifemine, Jamilov, and Monacelli (2022) and Gödl-Hanisch (2022)

insured against these risks due to their hedging strategies.

The hedging strategy hypothesis has been pioneered by Drechsler, Savov, and Schnabl (2021). They suggest that banks that operate under deposit franchise business models are effectively shielded against interest rate risk inherent to maturity transformation. This is because even though long-term fixed-rate assets expose banks to lower profits, the deposit franchise model allows banks to command higher deposit spreads (extract larger rents from depositors). Consequently, when banks' managers proficiently counterbalance both, the interest rate sensitivity of banks' cash flows approaches zero. Consequently, banks should not incur capital losses in response to monetary shocks.

The perfect hedging hypothesis posits that monetary policy exerts no impact on banks' capital. Nonetheless, alternative explanations have been proposed by other scholars. English, Van Den Heuvel, and Zakrajšek (2018) point out that an unexpected increase in either the level or the slope of the yield curve around the time of monetary policy announcements results in a substantial and statistically significant decline in bank equity values. Similarly, Paul (2023) aligns with this perspective, suggesting that monetary policy influences profits by inducing alterations in term premiums. Specifically, changes in anticipated short-term future interest rates could potentially have adverse effects on term premiums.

A.7 Interest Rates Pass-Throughs

Two arguments have challenged the mechanics of the canonical BLC. First, the effect of monetary policy on liquidity constraints seems to be limited (or non-existent) since the aggregate level of reserves in the US banking system is significantly high, so at the individual level, banks operate with excess reserves. Second, banks do not necessarily experience difficulties having full access to market-based funding in modern financial systems (See Disyata (2011)).

In response to this, alternative mechanisms propose that monetary policy is transmitted through adjustments in *required rates of return* (rather than changes in quantities levels induced by constraints) and, more specifically, on changes through interest rate premiums.

External Finance Premiums Disyata (2011) argues that monetary policy affects lending through the effect(s) on banks' funding costs. It highlights that funding costs might be influenced by policy in two ways.

On the one hand, deposit rates must reflect the compensation for depositors' alternative sources of liquidity, like risk-free bonds. Since monetary policy sets the opportunity cost of deposits, banks are forced to raise deposit rates to retain funds in response to increased policy rates (arbitrage channel).

On the other hand, monetary policy might influence banks' external finance premiums, that is, the premiums banks pay to uninsured depositors. In Disyata (2011), these premiums arise from the inherent riskiness of banks, which may not always be able to repay deposits fully. Banks' capital directly influences the likelihood of repayment, as it serves as a buffer against potential loan losses. Lower capital levels imply reduced depositor protection for a given loan amount. Consequently, when policy tightens and net worth declines, the conditional probability of banks defaulting increases. This leads to higher deposit rates and, consequently, elevated rates on bank loans.

Following Bernanke, Gertler, and Gilchrist (1999), this same logic applies between lenders (banks) and borrowers (firms). That is, banks can simultaneously ask for compensation for taking on credit risk, hence monetary policy might increase lending rates via external finance premiums.

Liquidity Premiums Another way monetary policy might induce changes in lending and deposits is via the direct effect on liquidity premiums. In the banking context, liquidity premiums are the component of the interest rate spread of an asset (loans, government bonds, and deposits) relative to a liquid asset (reserves) that is directly attributable to the risk of facing a need for liquid funds. Due to liquidity risk exposure, market interest rates must encompass compensation for scenarios where banks may face elevated expenses to acquire liquid funds – costs incurred through fire sales or borrowing in imperfect liquidity markets. By influencing the cost of liquidity, monetary policy changes banks' exposure to liquidity risk, ultimately influencing banks' portfolio choices.

Bianchi and Bigio (2022) put forth a framework where monetary policy has real effects via liquidity premiums. Monetary tightening increases liquidity scarcity, so the cost of accessing liquidity is high. In the form of compensation for the high costs of experiencing a liquidity shortage, banks pass through this cost into market interest rates (liquidity premiums). For instance, lending rates must compensate a bank for the risk-adjusted interbank market return, considering whether the bank has a liquidity surplus or a liquidity deficit.

Term Premiums In the banking context, the term premium compensates banks for engaging in arbitrage by investing long-term while financing it with short-term borrowing. Recent evidence from Paul (2023) suggests that changes in term premia have historically been reflected in banks' net interest margins. Consequently, if monetary policy influences term premiums, it indirectly affects banks' profits.

How might monetary affect the term premium? Bernanke (2020) points out the importance of the portfolio balance effect of monetary policies. In simple terms, when central banks buy a particular type of security (like government bonds, mortgage-backed securities, and corporate bonds), it can lead investors to shift their investments toward other securities, influencing their prices.

For instance, in the context of large-asset purchases (QE), monetary policy might induce changes in the net supplies of long-term securities, which removes interest rate risk from the Treasury market, pushing investors to bid up the values of both remaining longer-term Treasuries.

B Data

B.1 Variables

B.1.1 Categories of Liquidity

I employ the methodologies proposed by Ihrig et al. (2017) and Roberts, Sarkar, and Shachar (2021) to calculate the stock of high-quality assets. These approaches align with the 2013 final rule, which implements a quantitative liquidity requirement in accordance with the Liquidity Coverage Ratio (LCR) standard established by Basel III. In the United States, the eligible assets falling under the high-quality category include excess reserves, treasury securities, debt or mortgage-backed securities issued by government agencies and enterprises, and privately-issued securities. The high-quality assets are further divided into three sub-categories: Level-1, Level-2A, and Level-2B. Table 4 summarizes the specific assets deemed eligible, with further details provided in Appendix B.2.

The total stock of HQLA is simply the weighted sum of all eligible liquid assets ($HQ = Reserves, Treasuries, ...$), where the weights ($w_a$) are haircuts defined by the LCR requirement[66]:

$$HQLA_{i,t} = \sum_{a \in HQ} w_a * A_{i,t} = \sum_{a \in L1} A_{i,t}^{L1} + \sum_{a \in L2a} 0.85 \cdot A_{i,t}^{L2a}$$

For the baseline estimations, I do not consider regulatory haircuts and caps; instead, I assume that $w_a = 1 \; \forall \; a$. I will use these haircuts in robustness exercises. Furthermore, baseline estimations are based on the total level of HQLA. For robustness, I also use Level-1 HQLA (the most liquid category)[67]. Finally, I normalize liquidity creation by GTA to make these variables relative to the size of each bank. To alleviate possible concerns on endogeneity due determination of banks' decisions, the measure of HQ-liquid assets used in the regressions is the four-quarter rolling average $HQLA_{i,t} = \sum_{j=0}^{3} HQLA_{i,t-j}$.

The low-quality liquid category is the sum of all the remaining securities and debt assets issued by the US government or private agents, assets held in trading accounts, and federal funds sold and reverse repurchased. Important to note that I do not include other types of

[66]Unlike the references, the measurements are done at the bank-level i and not at the bank-holding level

[67]Notice that due to the lack of disaggregated data, I cannot estimate the Level-2B of HQLA.

cash (e.g., chcic, chus, chnus). These assets are summarized in Table 4.

Total holdings of liquid assets are defined as:

$$LA = HQ\text{-}Liquidity + LQ\text{-}Liquidity + Other\,Cash \tag{9}$$

This measurement is consistent with the methodology in Berger and Bouwman (2009).

Finally, the liquidity coverage ratio, by definition, is

$$LCR = \frac{HQLA}{ENCO30} \tag{10}$$

where $ECON30$ is the total expected net cash outflows over a prospective 30 calendar day period. I build this variable by using the methodology of Hong, Huang, and D. Wu (2014) and Sundaresan and Xiao (2023).

B.1.2 Structural Monetary Shocks

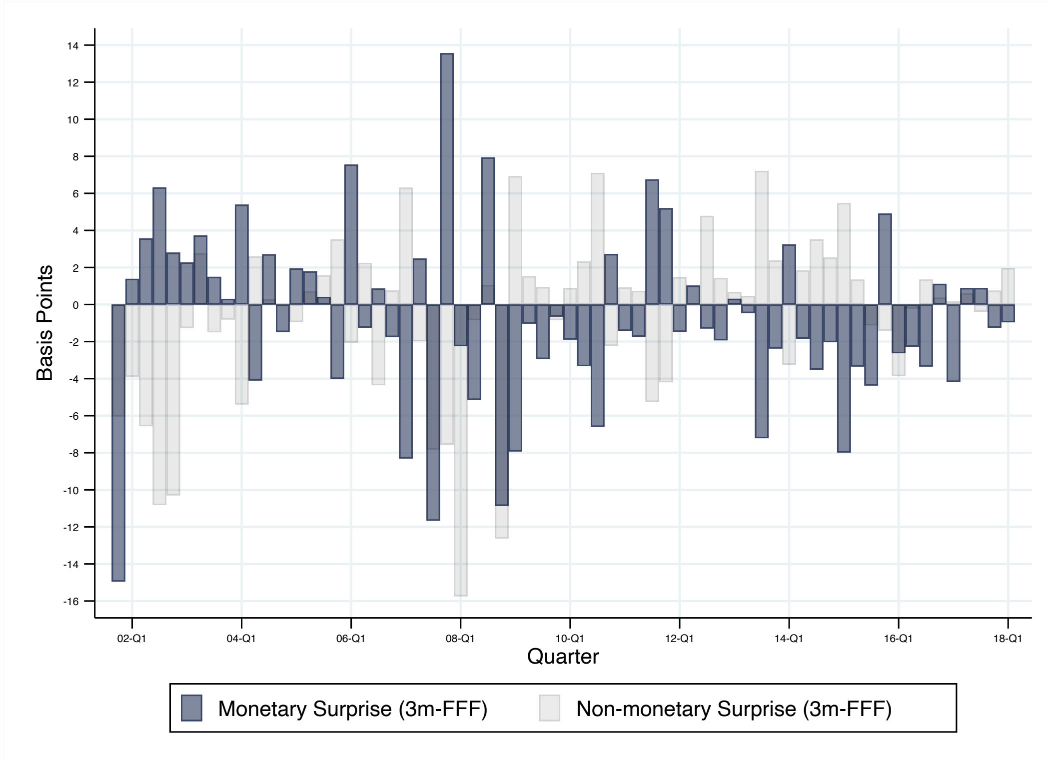
A common source of biases in the estimated effect of monetary policy on multiple banking variables is the co-determination of the Federal Reserve policies and aggregate economic conditions[68]. I address this concern using the high-frequency identified (HFI) quarterly measurement of structural monetary shocks constructed by Jarociński and Karadi (2020).

Figure (21) presents the quarterly measure of the structural monetary shocks (dark blue) together with the FED-information shocks (light gray). I use the sum of the daily structural monetary shocks within a quarter to obtain a quarterly measurement of the shocks. The structural monetary shocks are interpreted as policy-driven changes in the 3-month Fed funds futures rates[69] that is consistent with a decrease in equity prices. Moreover, these monetary shocks should capture the overall monetary policy stance, which is unexpected changes in expectations about short-term interest rates induced by either actual rate setting or near-term forward guidance.

[68] An issue common to other strands of the literature like Gareth and Ambrogio (2020) and Jeenas (2018)

[69] For robustness, I also use Jarociński and Karadi (2020) shocks estimated using the change in the first principal component of the surprises in fed funds futures and euro-dollar futures with one year or less to expiration. A proxy for changes in short-term rates suggested by Nakamura and Steinsson (2018)

Figure 21: High-Frequency Interest Rate Surprises Decomposition: Monetary vs. Non-monetary Surprises



Notes: a) Quarterly FED shocks using data from Jarociński and Karadi (2020). b) The underlying interest rate is the 3-month Fed funds future rate (FFF). By construction, $\Delta FFF_t = \Delta MS_t + \Delta NMS_t$

For comparison and future interpretability of the results, Table 3 shows the implied change of different market yields due to monetary shocks. A 25 basis points (1bp) increase in the monetary policy shock-ΔMS implies a 52.72 basis points (2.10bp) increase in the 1-year treasury yield or an 87.33 basis points (3.49bp) increase in the Fed Funds Rate. A 7.16bp increase in ΔMS equivalently implies a 25bp increase in the Fed fund rate.

Table 3: Normalization Parameters

	(1) ΔFFR	(2) $\Delta 1yTB$	(3) $\Delta 5yTB$	(4) $\Delta 10yTB$
ΔMS_t	87.33***	52.72***	9.141	1.259
	(7.43)	(3.41)	(0.51)	(0.08)
Constant	1.484	-0.948	-4.500	-4.958
	(0.43)	(-0.21)	(-0.86)	(-1.04)
Observations	118	118	118	118

Notes: a) This table presents OLS estimates obtained from regressing changes in interest rates on the monetary shocks estimated by Jarociński and Karadi (2020). Monetary shocks are rescaled such that one unit change equals a 25bp increase. The sample goes from 1990q1 until 2019q2. b) Data on Treasury yields comes from https://www.macrotrends.net.

B.1.3 Other Bank-Level Variables

Throughout the research, other bank-level variables, characterizing different dimensions of the banking system, are estimated using methodologies suggested by the literature. On-balance sheet liquidity creation is estimated following Berger and Bouwman (2009). The bank-level income gap is measured following Gomez et al. (2021). Estimates of bank-level 'betas', duration mismatch, and local deposit market power are obtained following the methodologies implemented by Drechsler, Savov, and Schnabl (2021, 2017) and English, Van Den Heuvel, and Zakrajšek (2018). Credit and deposit markups are calculated based on the methodology proposed by Bellifemine, Jamilov, and Monacelli (2022). Lending opportunities and deposits volatility following Stulz, Taboada, and Dijk (2022). For ease of exposition, details about methodologies, replication results, and potential differences in the estimations are left in Appendix B.4.

B.2 Liquidity Categories

Variables descriptions and limitations are sourced from the FDIC website[70]. Balance-sheet items are summarized in Table 4.

[70] https://banks.data.fdic.gov/bankfind-suite/help?helpTopic=glossary-and-variable-definitions For Securities https://www.fdic.gov/resources/bankers/call-Reports/crinst-031-041/2017/2017-03-rc-b.pdf

Table 4: Classification of Balance Sheet Items

		Assets	Liabilities
Iliquid		Commercial Real Estate Loans (cre) Loans to finance agricultural production (lnag) Commercial and industrial institutions loans (lnci) Other real estate owned (ore) All other assets (idoa) Goodwill and other intangibles (intan) Bank premises and fixed assets (bkprem)	Subordinated debt - Debenture (subnd) All other liabilities (idoliab) Total equity capital (eqtot)
Semi-liquid		Residential Real Estate Loans (rre) Consumer loans (lncon) All other loans & leases (lnotci)	Total nontransaction time deposits - CDs (ntrtime) Other borrowed funds (idobrmtg)
Liquid	**High Quality (Level 1)**	Cash Balances Due from Federal Reserve Banks (chfrb) Treasury Securities (scust) RMBS Pass-Through by GNMA (scgnm) Other Obligations by GAs (scaot)	Transaction accounts (trn) Money market deposit accounts (ntrsmmda) Other savings deposits excluding MMDAs (ntrsoth) Trading liabilities (tradel) Federal funds purchased and repos (frepp)
	High Quality (Level 2A)	RMBS Pass-Through by GSE (scfmn) CMBS Pass-Through by GAs (sccptg) CMBS Other by GAs (sccmog) Other Obligations by GSEs (scspn)	
	Low Quality	CMOs and REMICs by GAs and GSE (sccol) Securities by States & Political Subdivisions (scmuni) RMBS by Privates (scrmbpi) Other CMBS (sccmos) ABS (scabs) Structured financial products (scsfp) Other Domestic Debt Securities (scodot) Foreign debt securities (scford) Equity securities not held for trading (sceqnft) Assets held in trading accounts (trade) Federal funds sold and reverse repurchase (frepo)	
	Other	Cash and due from other institutions (chbal) + Cash items in process of collection (chcic) + Balances due from depository institutions in the U.S. (chus) + Balances due from foreign banks (chnus)	

Classification is based on Berger and Bouwman (2009) and Ihrig et al. (2017).

B.2.1 Description and limitations of High-Quality Liquid Assets - Level 1

1. **Balances Due from Federal Reserve Banks (chfrb)**

   The total cash balances due from Federal Reserve Banks as shown by the Reporting bank's books. This amount includes Reserves and Other Balances.

   - Beginning in 2001, FFIEC Call fillers did not Report this item with total assets $<$ \$300 million. Before 2001, this item was Reported in the "Cash and balances due" categories for FFIEC Call Report filers with total assets of $<$ \$100 million.

2. **U.S. Treasury Securities (scust*)**

   Total U.S. Treasury securities not held in trading accounts. It includes all bills, certificates of indebtedness, notes, and bonds, including T-Strips bonds and inflation-indexed bonds.

3. **Mortgage-Backed Pass-Through Securities issued by GNMA (scgnm*)[71]**

   MBSs structured as pass-throughs[72]. It only includes securities issued by the Government National Mortgage Association (GNMA). GNMA MBS benefits from an explicit government guarantee.

   - As of June 2018, banks filing an FFIEC Call Report 51, or banks with domestic offices only and total assets $<$ \$1 billion, Report these together with FNMA and FHLMC securities (below in scfmn).

4. **U.S. Government Agencies[73] Obligations (scaot*)**

   Other obligations (notes, bonds, and discount notes) that U.S. GAs issue. It excludes all MBSs.

[71] The mark * indicates that the item includes both held-to-maturity at amortized cost and available-for-sale at fair value on a consolidated basis.

[72] Structure such that mortgage payments are collected and passed through to investors, e.g., commercial banks holding the asset. Mortgage loans in an RMBS act as collateral in the event of default while principal and interest are passed on to investors otherwise.

[73] U.S. GAs include but are not limited to agencies such as the Government National Mortgage Association (GNMA), the Federal Deposit Insurance Corporation (FDIC), and the National Credit Union Administration (NCUA).

- This detailed item ended in March 2018 (2018q2). To extend the data, I use the total amount of obligations excluding MBS (idscas) and extrapolate it using the share observed in 2018q2.

B.2.2 Description and Limitations of High-Quality Liquid Assets - Level 2A

1. **Obligations Issued by U.S. Government Sponsored Entreprises[74] (scspn*)**

   Other obligations issued by US GSEs. It excludes all MBS.

   - Same as scaot.

2. **Mortgage-Backed Pass-Through Securities issued by FNMA and FHLMC (scfmn*)**

   MBSs structured as pass-throughs. They are only issued by the Federal National Mortgage Association (Fannie Mae) and the Federal Home Loan Mortgage Corporation (Fannie Mac). GSE debt carries the implicit backing of the U.S. government but is not a direct obligation of the U.S. government.

   - As of June 2018, this item includes GNMA-MBS for banks filling the FFIEC Call Report 51 or banks with domestic offices only and total assets less than $1 billion.

3. **Commercial Mortgage-Backed Securitites issued by US Governement (sccptg + sccmog)**

   Unlike RMBS, CMBSs are secured by mortgages on commercial properties rather than residential real estate.

   a. CMBSs structured as pass-through (sccptg*).

   b. CMBSs with other structures. Such as CMOs[75] (plus residuals), REMICs (plus residuals), stripped mortgage-backed securities, and commercial paper backed by loans secured by properties other than 1-4 family residential properties (sccmog*).

[74] U.S. GSEs include but are not limited to agencies such as the Federal Home Loan Mortgage Corporation (FHLMC) and the Federal National Mortgage Association (FNMA)

[75] Collateralized Mortgage Obligations are multiple pools of securities structured in slices or tranches. Each tranche is given a credit rating which determines the rates that are returned to investors.

- Data began in March 2011 (2011q1).

B.2.3 Description and limitations of Low-Quality Liquid Assets

1. **Securities Issued by States & Political Subdivisions (scmuni*)**

   All securities issued by states and political subdivisions in the U.S. not held for trading.

2. **Collateralized Mortgage Obligations and REMICS Issued by U.S. Government Agencies or Sponsored Agencies (sccol*)**

   All classes of CMOs (plus residuals), REMICs (plus residuals), and stripped mortgage-backed securities backed by loans secured by 1-4 family residential properties. It also includes REMICs issued by the U.S. Department of Veterans Affairs that are backed by 1-4 family residential mortgages.

3. **Asset Backed Securities (scabs*)**

   All ABSs excluding mortgage-backed securities. It includes asset-backed commercial paper non-held for trading.

   - Before March 2001, ABSs are included in SCODOT for those institutions that file a FFIEC Call Report.

4. **Other Commercial Mortgage-Backed Securities (sccmos*)**

   CMBS structured as CMOs, REMICs, CMO and REMIC residuals, stripped mortgage-backed securities, and commercial paper backed by loans secured by properties other than 1-4 family residential properties that have been issued or guaranteed by non-U.S. Government issuers.

5. **Other Domestic Debt Securities (scodot*)**

   It includes:

   a) Bonds, notes, debentures, equipment trust certificates, and commercial paper (except asse t-backed commercial paper) issued by U.S.-chartered corporations and other U.S. issuers.

b) Preferred stock of U.S.-chartered corporations and business trusts that, by its terms, either must be redeemed by the issuing corporation or trust or is redeemable at the option of the investor (i.e., redeemable or limited-life preferred stock), including trust preferred securities issued by a single U.S. business trust that is subject to mandatory redemption.

c) Detached U.S. Government security coupons and ex-coupon U.S. Government securities held as the result of either their purchase or the bank's stripping of such securities and Treasury receipts such as CATS, TIGRs, COUGARs, LIONs, and ETRs. Refer to the Glossary entry for "coupon stripping, Treasury receipts, and STRIPS" for additional information.

- Before March 2001, ABSs are included for FFIEC Call Reporters.

6. **Privately Issued Residential Mortgage-Backed Securities (scrmbpi*)**

   Privately Issued Residential Mortgage-Backed Securities

7. **Structured Financial Products (scsfp)**

   Total structured financial products (cash, synthetic and hybrid) on a consolidated basis. Data began in June 2009.

   One of the more common structured financial products is collateralized debt obligations (CDOs). Other products include synthetic structured financial products (such as synthetic CDOs) that use credit derivatives and a reference pool of assets, hybrid structured products that mix cash and synthetic instruments, collateralized bond obligations (CBOs), re-securitizations such as CDOs squared or cubed (which are CDOs backed primarily by the tranches of other CDOs), and other similar structured financial products.

8. **Federal Funds Sold & Reverse Repurchase Agreements (fRepo)**

   Total federal funds sold and securities purchased under agreements to resell in domestic offices.

9. **Equity Securities Not Held for Trading (sceqnft)**

All other equity securities available-for-sale at fair value. This item includes equity securities without readily determinable fair values at historical cost.

10. **Foreign Debt Securities (scford*)**

    All foreign debt securities includes:

    (1) Bonds, notes, debentures, equipment trust certificates, and commercial paper (except asset-backed commercial paper) issued by non-U.S.-chartered corporations.

    (2) Debt securities issued by foreign governmental units.

    (3) Debt securities are issued by international organizations such as the World Bank, the IDB, and other international institutions.

    (4) Preferred stock of non-U.S.-chartered corporations that, by its terms, either must be redeemed by the issuing enterprise or is redeemable at the option of the investor (i.e., redeemable or limited-life preferred stock).

    - Before 2001, institutions that filed an FFIEC Call Report and had less than $100 million in total assets included 'foreign debt securities' in 'other domestic debt securities.'

11. **Assets Held in Trading Accounts (trade)**

    All securities and other assets acquired with the intent to resell to profit from short-term price movements.

    - Effective January 1, 1994, this item includes revaluation gains.

B.2.4 Construction of Liquidity Creation Index

Berger and Bouwman (2009) offers a classification of assets and liabilities based on "the ease, cost, and time for customers to obtain liquid funds from the bank, and the ease, cost, and time for banks to dispose of their obligations to meet these liquidity demands" (Berger and Bouwman, 2009). Categories of assets are presented in Table 4.

Assets and liabilities are classified into three categories: liquid, illiquid, and semi-liquid. A general overview of the balance-sheet categories is as follows. Starting from the asset side of the balance sheet, illiquid assets (IA) are mainly commercial and agricultural loans and non-financial assets like fixed or intangible assets. Semi-liquid assets (SA) are all other loans that are more easily securitized, like residential real estate or consumer loans. Finally, liquid assets (LA) are cash holdings, securities (fixed or flexible rate), and reverse-REPOs. The composition of liabilities is the following. Liquid liabilities (LL) are mainly core deposits, money market deposits, and REPOs-lending. Semi-liquid liabilities (SL) are non-transaction deposits like certificates of deposit and other borrowed funds. Finally, illiquid liabilities (IL) are debts owed to unsecured creditors, liabilities on acceptances, and equity. Table 4 presents a detailed representation of this categorization.

Based on this categorization, the balance sheet liquidity creation of a depository institution i at quarter t is defined as:

$$LC_{i,t} = \frac{1}{2}\left(\sum_{a\in IA} \text{Iliq Asset}^a_{i,t} + \sum_{l\in LL} \text{Liq Liab}^l_{i,t}\right) - \frac{1}{2}\left(\sum_{a\in LA} \text{Liq Asset}^a_{i,t} + \sum_{l\in IL} \text{Iliq Liab}^l_{i,t}\right)$$

This index proxies the liquidity provision services offered by the banking sector, as it reflects how much illiquid assets are funded with liquid liabilities.

For the empirical analysis, I normalize liquidity creation by gross total assets (GTA[76]) to make the dependent variables comparable across banks and to avoid the results being driven by the most prominent institutions. I call this variable liquidity creation ratio (LIQR). Finally, I limit the empirical analysis to understand the dynamics of on-balance liquidity creation. I do not estimate liquidity created off-balance (through derivatives, commitments, or letters of credit, among other instruments). The main reason is due to data limitations. The second one relates to the fact that even if a significant amount of liquidity is created off-balance sheet, the related empirical literature has failed to identify a connection between monetary policy on these items.

[76]Total assets plus the allowance for loan and lease losses.

B.3 Monetary Shocks

B.3.1 Estimation of Baseline Monetary Shocks

Jarociński and Karadi (2020) methodology can be summarized in two stages, which combine high-frequency identification techniques and sign restrictions.

Stage 1 Similar to the literature, the objective is to identify contemporaneous shocks from changes in financial market variables within a 30-minute window around FOMC announcements. Like most event-study methodologies, the underlying assumption is that within narrow windows of time, no shocks besides monetary policy systematically influence changes in financial market yields.

Stage 2 Unlike the related literature, Jarociński and Karadi (2020) decomposes the raw-interest rate surprises obtained in the event-study application between purely structural monetary shocks and non-monetary or FED-news shocks. This strategy applies sign restrictions on two high-frequency surprise variables: a) one capturing expected short-term interest rates (measured as the change in the three months fed funds futures rate) and b) the other capturing stock price surprises (measured as changes in the S&P index). The underlying assumption is that shocks that lead to a positive co-movement of interest rates and equity prices reflect an accompanying information shock. If, instead, shocks that lead to a negative co-movement of interest rates and equity prices are interpreted as driven by structural monetary surprises. The key is that equity market prices help learn the content of the signal inherent in central bank announcements.

A few results from Jarociński and Karadi (2020) are worth mentioning regarding the macroeconomic relevance of these shocks in the US economy. In response to the monetary shocks, stock prices drop by about 1 percent while the excess bond premium increases by about five bps (financial conditions tighten). Concerning real activity, real GDP and the price level decline persistently by about 10 and 5 basis points, respectively.

B.3.2 Alternative Monetary Shocks

In the robustness exercises, I use other identified monetary shocks proposed by Acosta (2022) and Bu, Rogers, and W. Wu (2021).

Table 5: Descriptive Statistics on Int. Rates and Monetary Policy Shocks

	2001-2018				1990-2019			
	mean	sd	min	max	mean	sd	min	max
Δ Fed Funds Rate	-2.36	40.30	-165.00	58.00	-5.14	43.80	-165.00	91.00
Δ 1y T-bond	-0.61	42.43	-179.00	89.00	-4.95	49.73	-179.00	124.00
Δ 5y T-bond	-2.12	51.58	-146.00	101.00	-5.19	54.77	-146.00	102.00
Δ 10y T-bond	-2.87	49.28	-160.00	84.99	-5.05	49.92	-160.00	94.00
Δ S&P Index (around FOMC)	1.53	70.72	-203.88	143.37	5.30	74.02	-203.88	277.25
Δ Synthetic Rate (around FOMC)	-2.46	8.30	-36.12	9.99	-3.63	10.53	-46.99	17.97
Δ 3m-FFF (around FOMC)	-1.42	5.66	-23.50	9.00	-3.25	9.36	-43.50	17.00
Monetary Surprise (3m-FFF)	-0.79	4.80	-14.96	13.57	-1.90	7.12	-33.33	13.57
Monetary Surprise (Synthetic)	-1.32	6.47	-21.13	17.38	-2.14	8.38	-37.07	17.38
Monetary Surprise (BRW)	-0.93	7.12	-23.70	14.63	-0.70	6.13	-23.70	14.63
Monetary Surprise (Acosta)	-0.27	1.50	-3.83	5.18	-0.14	1.43	-3.83	5.18
Monetary Surprise (J2021)	-2.22	11.07	-47.28	20.14	-2.93	12.19	-53.22	23.00
Standard (u1)	-1.88	7.88	-39.70	17.11	-2.80	10.30	-46.03	26.01
Odyssean-FG (u2)	0.02	6.76	-24.08	30.82	0.14	6.02	-24.08	30.82
LSAP (u3)	0.08	3.95	-23.61	8.44	0.09	3.18	-23.61	8.44
Delphic-FG (u4)	-0.44	3.46	-11.34	5.27	-0.36	3.30	-11.34	12.26
Non-monetary Surprise (3m-FFF)	-0.63	4.46	-15.75	7.22	-1.35	4.75	-20.51	7.79
Observations	66				118			

Notes: a) Data in basis points b) 'Synthetic' refers to the synthetic interest rate. Implying that the underlying interest rate surprise indicator was computed by extracting a principal component from multiple markets' interest rates on future contracts.

B.4 Estimated Variables

B.4.1 Income gap

Gomez et al. (2021) computes income gaps at the bank holding level. They argue that this measure proxies the sensitivity of a bank's net interest income to changes in policy rates, also known as a bank's cash-flow exposure. Under some assumptions, it measures income shocks driven by policy interest rate changes.

$$IG_{i,t} = RSA_{i,t} - RSL_{i,t} \tag{11}$$

where RSA is the dollar amount of assets that either reprice or mature within a year and RSB is the dollar amount of liabilities that mature or reprice within a year. This measure is then normalized by the total assets.

Regarding repricing or maturity of assets, Call Reports provide detailed information about mortgage pass-through backed by closed-end first lien 1-4 residential mortgages, other debt securities, closed-end loans, and all other loans secured by first liens on 1-4 residential loans, and outstanding balance under the PPPLF. Regarding repricing or maturity of liabilities, Call Reports provide detailed information about time deposits, FHLB advances, and other borrowings.

In Tables 7, it's important to highlight that the in-sample average income gap at the bank level is 9.82% of gross total assets. This figure is somewhat lower than the average income gap of 12.2% Reported by Gomez et al. (2021). One potential explanation for this difference is that their measure is based on BHC-level averages, and their sample period spans from 1986 to 2013.

B.4.2 Duration Mistmatch

Banks' duration mismatch is approximated using the repricing maturity method employed by Drechsler, Savov, and Schnabl (2021) and English, Van Den Heuvel, and Zakrajšek (2018). Duration mismatch, measured in years, is the difference between the assets' repricing maturity and liabilities' repricing maturity.

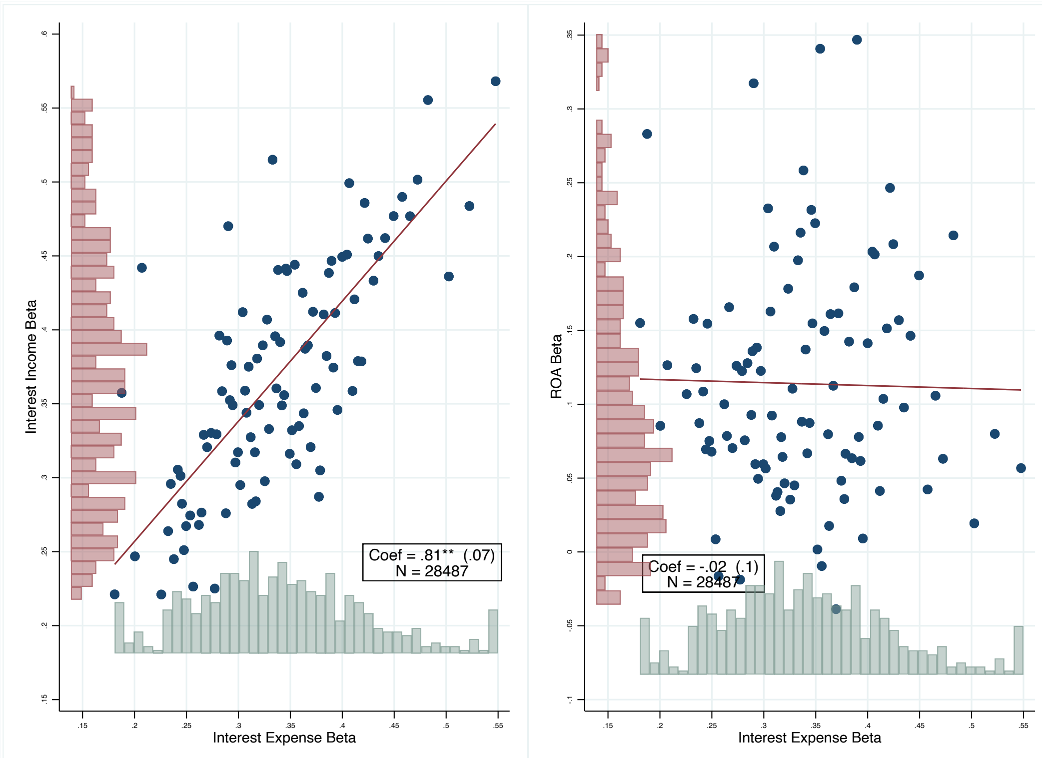
The in-sample average duration, at the bank level, is 3.76 years, similar to Drechsler, Savov, and Schnabl (2021) where the estimated mismatch is at 3.9 years for the period 1997 to 2017.

B.4.3 Betas

Estimates of bank-level deposit spread betas and local deposit market power are obtained following the methodology implemented by Drechsler, Savov, and Schnabl (2017). The average spread beta is 0.77 and the average local deposit concentration is 0.10.

Deposit Spread beta reflects how an increase of 1% in the Fed funds rate is transmitted towards the bank's deposit cost.

Figure 22: Testing Estimates of Betas: Replication Drechsler, Savov, and Schnabl (2021)



This figure shows binned scatter plots of interest expense, interest income, and ROA betas. This figure replicates Figure 6 in Drechsler, Savov, and Schnabl (2021) for the sample period 2000 to 2018.

B.4.4 Local Market Competition

To measure market power at the individual bank level, I calculate two concentration indices using branch-level data from the Summary of Deposits (SOD).

Based on Level of Deposit I follow Drechsler, Savov, and Schnabl (2017):

Step 1: Estimate Branch-HHI as the sum of the square of each bank's deposit share in a given county, year (c,t):

$$Branch - HHI_{c,t} = \sum_i (Deposit\, Market\, Share_{i,c,t})^2$$

This variable captures the competitive conditions in the county

Step 2: Estimate Bank-HHI (i,t) as follows:

$$Bank - HHI_{i,t} = \sum_{c} (Bank\, Deposit\, Share_{i,c,t}) \times Branch - HHI_{i,t}$$

This variable captures a bank's average market power across all markets in which it has branches, weighted by the share the bank raises in each market.

Based on Presence in Local Markets Following Drechsler, Savov, and Schnabl (2021), I calculate a Herfindahl-Hirschman index (HHI) for each U.S. county by computing each bank's share of the total branches in the county and summing the squared shares. Then, create a bank-level HHI by averaging the county HHIs of each bank's branches, using the bank's branches' presence in each county as weights.

Step 1: Estimate Branch-HHI as the sum of the square of each bank's share of branches in a given county, year (c,t):

$$Branch - HHI_{c,t} = \sum_{i} \left(\frac{Nbr.Branches_{i,c,t}}{Nbr.Branches_{c,t}} \right)^2$$

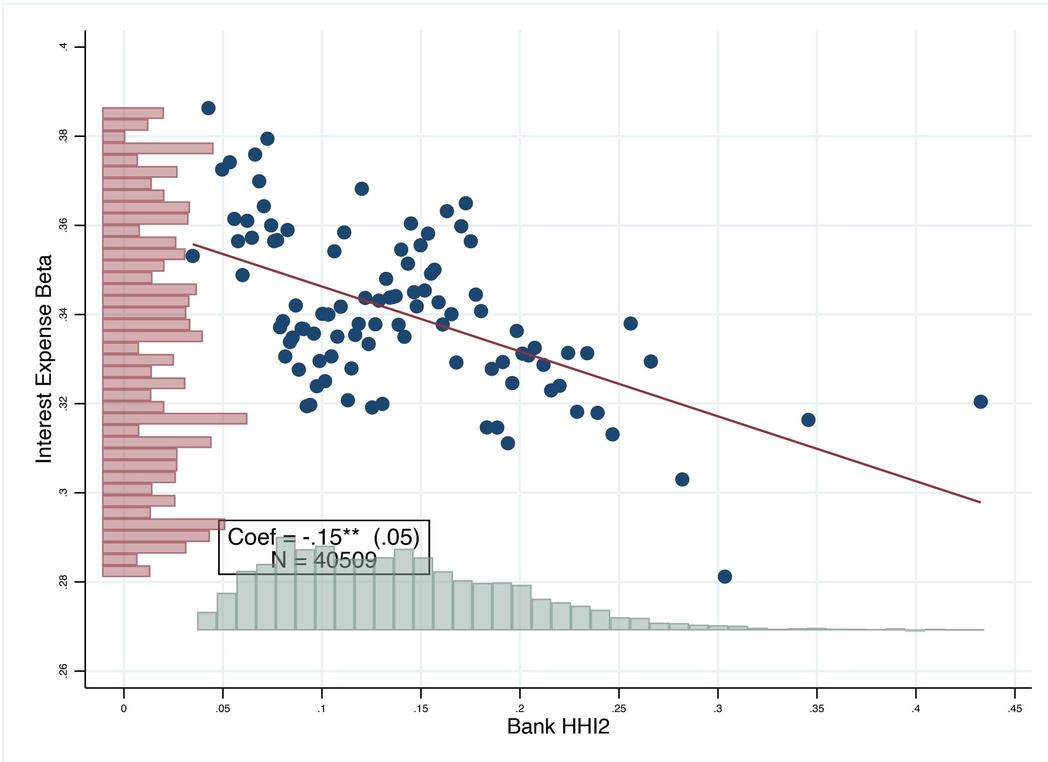
Step 2: Estimate Bank-HHI (i,t) as follows:

$$Bank - HHI2_{i,t} = \sum_{c} 1_{i \in c} \times Branch - HHI_{c,t}$$

B.4.5 Markups

Credit and deposit markups are calculated based on the methodology proposed by Bellifemine, Jamilov, and Monacelli (2022). Credit markup is the ratio between the price banks charge on loans over the marginal cost of producing an extra unit of credit. The average credit markup is 1.94. Deposit markup is the ratio of a proxy for the safe rate of return that banks can obtain out of their funds over the marginal cost of raising one additional unit of deposits. The average deposit markup is 1.58.

Figure 23: Testing Estimates of Bank HHI: Replication Drechsler, Savov, and Schnabl (2021) Drechsler, Savov, and Schnabl (2021)



Interest expense betas and market concentration based on Bank's presence in Local Markets. This figure replicates Figure 10 in Drechsler, Savov, and Schnabl (2021) for the sample period 2000 to 2018.

B.4.6 Lending opportunities, deposits volatility, bank size

Following Stulz, Taboada, and Dijk (2022), lending opportunities are proxied as the lagged eight-quarter average loan growth, and deposit volatility is proxied as the four-quarter standard deviation of the deposits to total assets ratio.

Following Berger and Bouwman (2009), bank size is proxied as the natural log of banks' total assets. The natural log is used to avoid potential specification distortions, coming from the fact that the dependent variable is generally in the [0,1] interval.

B.5 Other Call Report Variables

- Leverage ratio is the ratio of Tier-1 capital[77] over average total assets[78] minus ineligible intangibles[79].
- Non-current loans to gross total loans ratio to account for banks' risk[80].
- Earning Assets are all loans and other investments that earn interest or dividends

C Additional Descriptive Statistics

C.1 Banks' Size Categories

Following the related literature, banks are split by size and regulatory obligations.

For the categorization based on regulatory obligations, I use total consolidated assets obtained using the bank-holding level data set and map each depository institution with the bank-holding company (BHC) to which it belongs. Depository institutions that Report to be stand-alone banks are also included.

Categories based on regulatory obligations, and more specifically liquidity requirements, are formed as follows:

LCR-banks: Banks subject to the liquidity coverage ratio are BHCs with an excess of $50 billion in total consolidated assets.

Within the LCR category, BHCs with assets between $50 and $250 billion are considered modified-LCR banks, while those with assets larger than $250 belong to Standard-LCR. From the regulatory perspective, Standard-LCR BHCs have more stringent liquidity requirements than modified-LCR BHCs.

[77] Tier 1 capital includes common equity plus noncumulative perpetual preferred stock plus minority interests in consolidated subsidiaries less goodwill and other ineligible intangible assets.

[78] Total assets for the leverage ratio is average total consolidated assets, less deductions from common equity tier 1 capital and additional tier 1 capital, less other deductions defined by regulatory capital rules of the bank's primary federal supervisor.

[79] The amount of eligible intangibles (including mortgage servicing rights) included in core capital is limited by supervisory capital regulations.

[80] Total non-current loans and leases, Loans and leases 90 days or more past due plus loans in non-accrual status, as a percent of gross loans and leases

Non-LCR banks: Banks not constrained by LCR regulation are BHCs with less than $50 billion in total consolidated assets.

Within this group of banks, BHCs with assets between $3 and $50 billion are considered medium-size banks, while those with assets below $3 billion are considered small-sized banks. I define 2013q2 as the period of reference to create the categories[81].

C.2 Additional Cross-sectional Dynamics

C.2.1 Liquid Assets

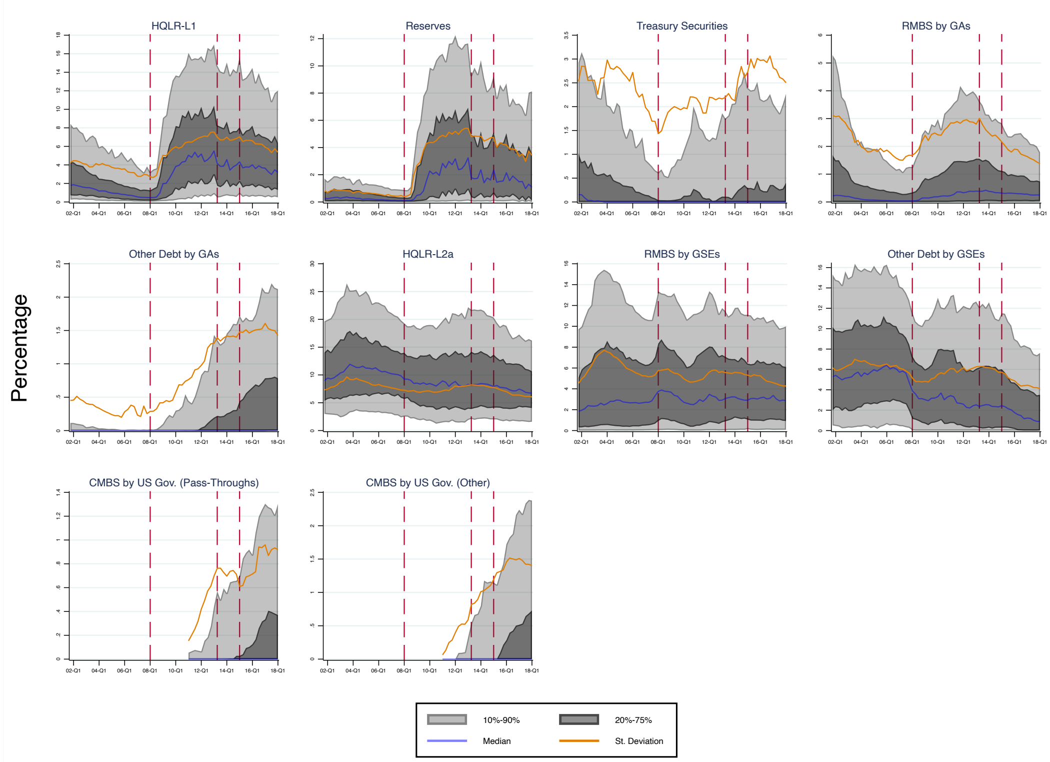
Regarding the overall dynamics of HQ liquidity ratios, four trends are observed. Before 2004, the HQ liquidity ratio dynamics were mainly driven by debt securities holdings issued by government-sponsored enterprises. In specific, residential MBS and other debt, both belonging to the L2A category). During 2004-2008, the ratios decreased as banks started to reduce their ratios of level 1 and level 2a liquid assets. After the GFC, L1-liquid assets started to gain participation, driving the positive trend of HQLA – consistent with the aggregate trend in the banking sector –.

The post-crisis trend has reverted since introducing new liquidity regulations (2013), decreasing until the end of the sample. In particular, the ratio decrease was driven by a rapid decrease in L1 assets and a softer decrease in L2a assets.

Figure 24 presents separately cross-sectional heterogeneity in the holdings of each asset belonging to the HQ categories. The degree of cross-sectional heterogeneity changes with the type of HQ asset. For instance, banks tend to differ more relative to the holdings of GSE securities than those of Treasuries or GNMA-MBS. In particular, it highlights the sudden increase in dispersion of L1-assets since the aftermath of the GFC relative to the pre-crisis period. Beginning with L1-assets, Reserves and MBS issued by GAs are the main drivers of the dynamics of L1-assets. In particular, GNMA-MBS better explains the pre-crisis trends, while reserves match the post-crisis dynamics. Furthermore, the degree of heterogeneity in reserves explains the degree of heterogeneity in L1-assets (especially since

[81] Following Roberts, Sarkar, and Shachar (2021), this date marks the quarter after the Basel liquidity coverage ratio rule was finalized.

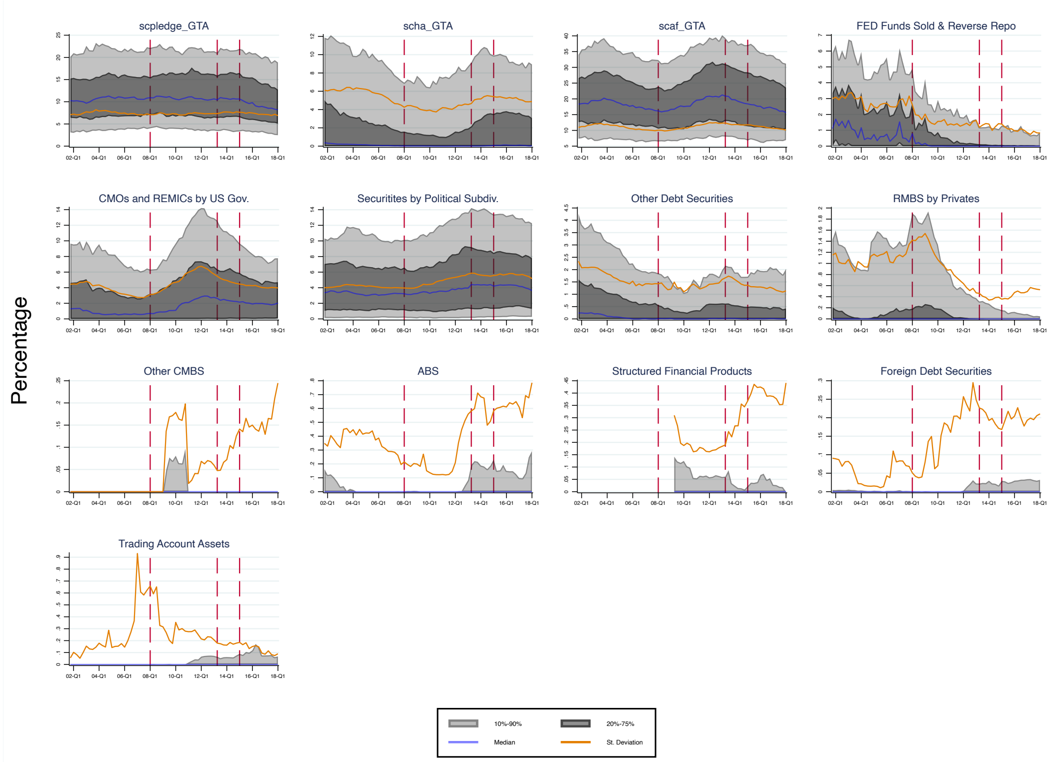
Figure 24: Heterogeneity on High Quality Liquid Assets



Notes: The graph shows the evolution of the 10, 25, 50, 75, and 90 percentiles and the standard deviation across No-LCR commercial banks from 2001q4-2018q1. Vertical dashed lines indicate 2008q4, 2013q2, and 2015q1.

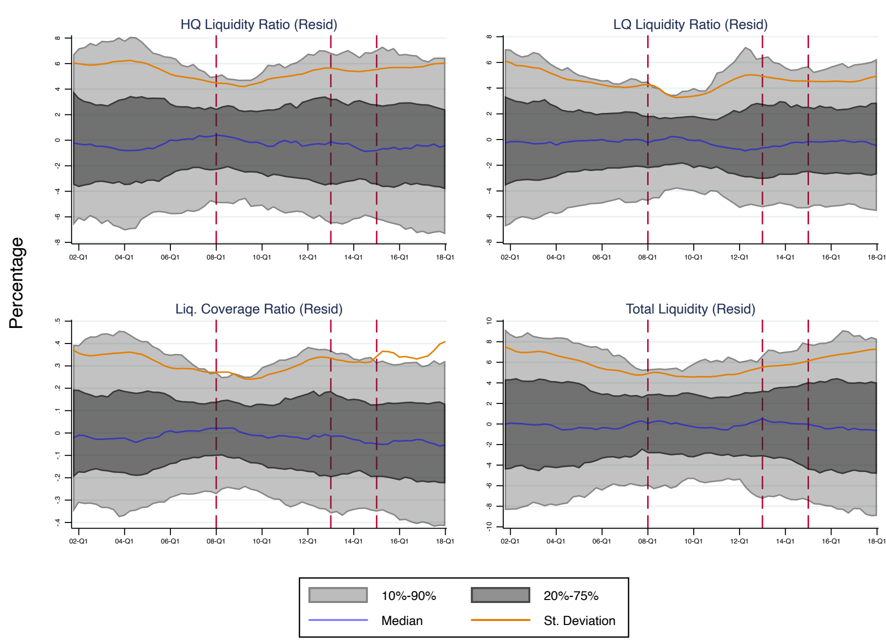
the aftermath of the GFC). In contrast, banks are more homogeneous concerning Treasuries and non-GSE debt (at least among 75% of banks). Regarding L2a assets, GSE Debt and GSE-MBS play the leading role in the dynamics of this category. Since 2008, there has been a significant decrease in dispersion regarding GSE-Debt (at least among 50% of banks), while dispersion in GSE-MBS has been constant. Looking at reserves, it is remarkable that there was almost no heterogeneity in the reserves-to-assets ratio before the GFC. In contrast, after the GFC dispersion, it increased significantly until the introduction of liquidity coverage ratios. Finally, notice that banks kept differences in the holdings of reserves even after the beginning of the full implementation of liquidity regulations.

Figure 25: Heterogeneity on Low-Quality Liquid Assets



Notes: The graph shows the evolution of the 10, 25, 50, 75, and 90 percentiles and the standard deviation across No-LCR commercial banks from 2001q4-2018q1. Vertical dashed lines indicate 2008q4, 2013q2, and 2015q1.

Figure 26: Heterogeneity on Residualized Liquidity Ratios



Notes: The graph shows the evolution of the 10, 25, 50, 75, and 90 percentiles and the standard deviation across No-LCR commercial banks from 2001q4-2018q1. Vertical dashed lines indicate 2008q4, 2013q2, and 2015q1. Residuals are obtained from panel regressions of the following specification $LR^j_{i,t} = f_i + f_t + \epsilon_{i,t}$ for any liquidity ratio-j.

Table 6: Liquidity Portfolio Grouping by Quintiles

	Quintiles of HQ Liquidity Ratios					Quintiles of LQ Liquidity Ratios					Quintiles of Liq. Coverage Ratios					
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	Total
Total Liquid Assets Ratio	20.83	23.41	27.42	31.29	41.63	21.17	24.68	29.22	30.42	39.89	22.07	23.64	27.43	31.42	40.29	28.99
HQ Liquidity Ratio	6.92	10.29	13.31	17.21	26.65	13.99	14.64	15.92	14.37	15.86	7.66	10.66	13.41	17.06	25.82	14.94
HQ-L1 Liquidity Ratio	1.72	2.31	2.85	3.23	5.40	3.66	2.82	3.38	2.73	2.96	1.64	1.99	2.77	3.38	5.75	3.11
Reserves	1.52	1.76	2.20	2.34	3.02	2.86	1.95	2.16	1.94	1.93	1.43	1.58	2.07	2.55	3.22	2.17
Treasury Securities	0.16	0.41	0.58	0.80	1.88	0.72	0.73	0.84	0.66	0.91	0.18	0.34	0.56	0.74	2.01	0.77
RMBS by GAs	0.00	0.01	0.01	0.01	0.03	0.02	0.01	0.02	0.01	0.01	0.00	0.01	0.01	0.01	0.03	0.01
Other Debt by GAs	0.04	0.05	0.05	0.04	0.06	0.02	0.03	0.08	0.06	0.04	0.03	0.05	0.05	0.04	0.07	0.05
HQ-L2a Liquidity Ratio	4.57	6.95	9.05	12.26	18.82	9.33	10.46	10.64	10.26	11.26	4.25	7.31	9.29	12.41	18.59	10.38
Other Debt by GSEs	1.79	2.51	3.93	4.80	7.77	4.66	5.11	3.68	3.72	3.70	1.35	2.62	4.01	5.11	7.80	4.18
RMBS by GSEs	2.62	4.11	4.84	7.10	10.27	4.47	4.93	6.54	6.13	7.09	2.61	4.37	5.04	6.93	10.09	5.81
CMBS by US Gov. (Pass-Throughs)	0.19	0.23	0.21	0.30	0.29	0.12	0.25	0.20	0.33	0.33	0.28	0.26	0.16	0.28	0.24	0.24
CMBS by US Gov. (Other)	0.15	0.48	0.41	0.46	0.34	0.18	0.38	0.39	0.46	0.43	0.33	0.46	0.30	0.46	0.27	0.37
LQ Liquidity Ratio	11.12	10.20	11.20	11.38	11.65	3.94	7.50	10.28	13.33	20.92	11.55	10.52	11.00	11.40	11.11	11.12
Fed Funds Sold & Reverse Repo	1.04	0.75	1.13	1.08	1.60	0.87	1.07	1.30	1.17	1.22	1.06	0.76	0.87	1.27	1.65	1.13
CMOs and REMICs by US Gov.	3.64	3.25	3.04	3.37	2.96	0.93	1.77	3.23	3.71	6.77	3.91	3.18	3.14	3.21	2.81	3.25
Securitites by Political Subdiv.	4.67	4.72	5.26	5.08	5.27	1.47	3.43	4.58	6.52	9.17	4.92	4.82	5.72	4.88	4.72	5.00
Other Debt Securities	0.65	0.65	0.58	0.83	0.79	0.33	0.59	0.50	0.83	1.27	0.53	0.75	0.57	0.83	0.84	0.70
RMBS by Privates	0.44	0.34	0.32	0.27	0.12	0.10	0.17	0.26	0.32	0.65	0.50	0.37	0.22	0.25	0.14	0.30
Other CMBS	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.01	0.02	0.01	0.01	0.01	0.01
ABS	0.12	0.08	0.09	0.09	0.04	0.03	0.07	0.06	0.13	0.15	0.12	0.15	0.03	0.06	0.07	0.09
Structured Financial Products	0.05	0.08	0.09	0.04	0.09	0.02	0.03	0.07	0.09	0.14	0.05	0.07	0.10	0.05	0.08	0.07
Foreign Debt Securities	0.02	0.03	0.03	0.04	0.03	0.01	0.03	0.01	0.02	0.08	0.03	0.02	0.02	0.04	0.05	0.03
Trading Account Assets	0.06	0.05	0.07	0.05	0.05	0.02	0.05	0.04	0.05	0.12	0.07	0.03	0.06	0.06	0.06	0.06
Liq. Coverage Ratio	0.27	0.40	0.52	0.67	1.04	0.58	0.58	0.61	0.55	0.60	0.24	0.39	0.52	0.68	1.08	0.58

Notes: This table shows bank-level in-sample averages of the main liquidity ratios by quintiles. Variables are all scaled by gross total assets, except the Liquidity Coverage Ratio.

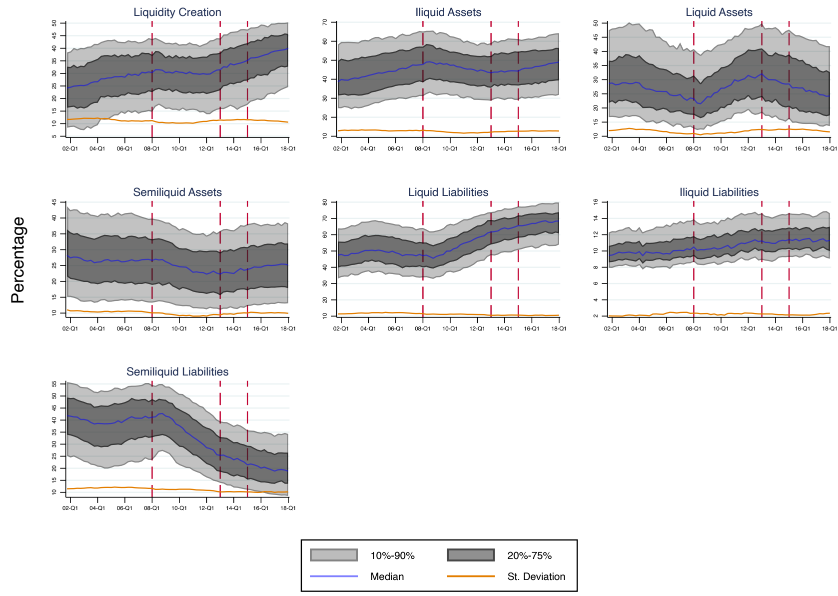
C.2.2 Other Banks' Characteristics

1. Figure 27 depicts the evolution of liquidity creation across the cross-section of banks. In general, liquidity creation increased steadily over time. Regarding the degree of heterogeneity, significant cross-sectional differences exist in liquidity creation of at least 10pp, and this heterogeneity has been constant over time (from the cross-sectional standard deviation). Section 7 attempts to explain this heterogeneity.

2. Figure 28 depicts the evolution of multiple profit margins in the cross-section of the sampled banks. Consistent with the literature, this picture shows that net interest margins have decreased steadily over time and across all the distribution of banks (e.g., Paul, 2023).

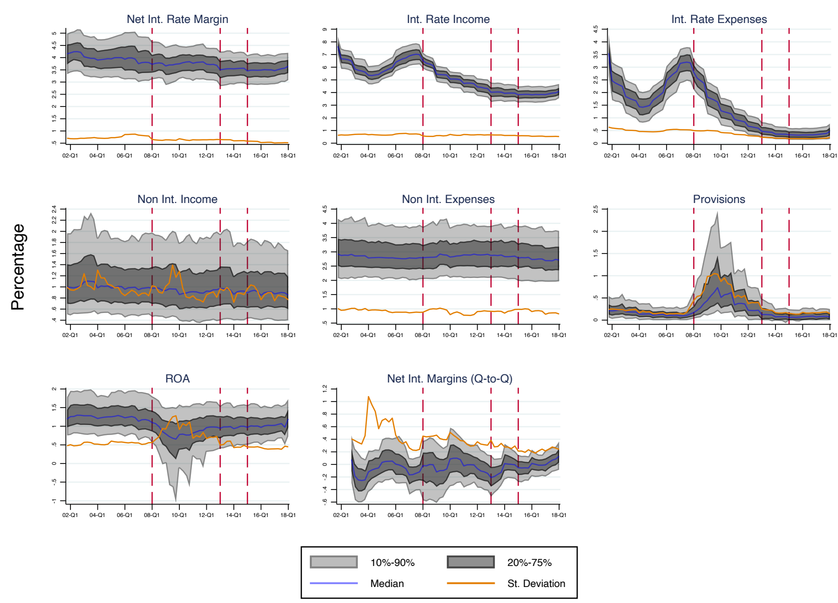
3. Figure 29 displays the cross-sectional evolution of the main control variables used in the joint regressions. Table 7 complements this by presenting average based on quintile groups.

Figure 27: Cross-sectional Heterogeneity on Liquidity Creation



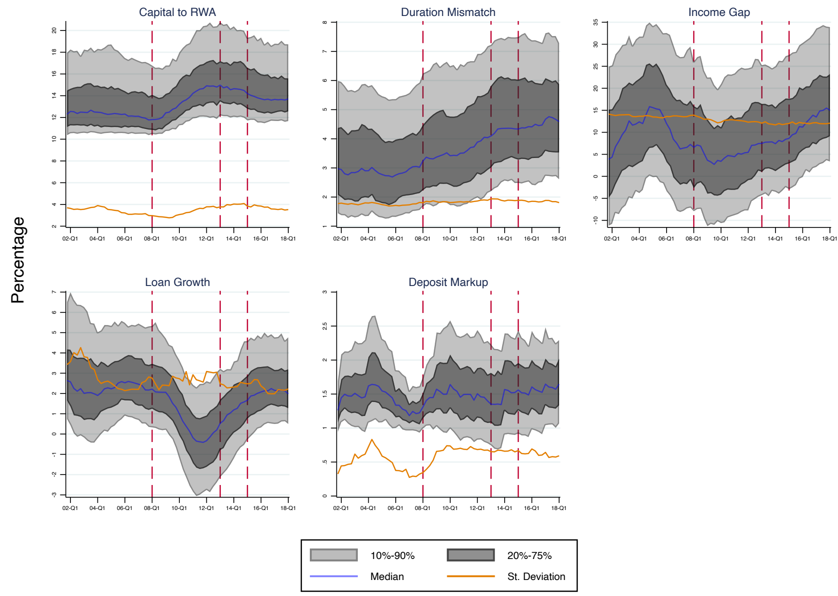
Notes: The graph shows the evolution of the 10, 25, 50, 75, and 90 percentiles and the standard deviation across No-LCR commercial banks from 2001q4-2018q1. Vertical dashed lines indicate 2008q4, 2013q2, and 2015q1.

Figure 28: Cross-sectional Heterogeneity on Profitability



Notes: The graph shows the evolution of the 10, 25, 50, 75, and 90 percentiles and the standard deviation across No-LCR commercial banks from 2001q4-2018q1. Vertical dashed lines indicate 2008q4, 2013q2, and 2015q1.

Figure 29: Cross-sectional Heterogeneity on Other Banks' Characteristics



Notes: The graph shows the evolution of the 10, 25, 50, 75, and 90 percentiles and the standard deviation across No-LCR commercial banks from 2001q4-2018q1. Vertical dashed lines indicate 2008q4, 2013q2, and 2015q1.

Table 7: Characteristics Affecting Monetary Policy Transmission Grouping by Quintiles

	Quintiles of HQ Liquidity Ratios					Quintiles of LQ Liquidity Ratios					Quintiles of Liq. Coverage Ratios					
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	Total
Leverage Ratio	9.32	9.35	9.19	9.07	9.55	9.44	9.17	9.33	9.20	9.34	9.34	9.05	9.41	9.02	9.65	9.29
Capital to RWA	13.05	13.44	13.72	14.26	16.86	13.42	13.57	14.55	14.21	15.71	13.27	13.05	14.14	14.11	16.81	14.28
T1 Capital to RWA	12.66	13.03	13.23	13.98	16.69	13.04	13.15	14.26	13.81	15.48	12.84	12.67	13.71	13.69	16.73	13.93
CET1 Capital to RWA	9.47	9.71	10.20	10.47	12.70	9.85	9.93	10.69	10.31	11.87	9.62	9.47	10.37	10.45	12.67	10.52
Noncurrent Loans	1.34	1.46	1.60	1.39	1.65	1.60	1.54	1.45	1.50	1.34	1.35	1.39	1.60	1.52	1.57	1.49
Z score	17.09	16.70	17.28	17.04	16.57	14.94	17.31	17.15	17.29	18.07	17.55	16.81	17.48	17.36	15.51	16.94
Duration Mismatch	3.42	3.34	3.69	4.10	4.22	3.28	3.59	3.78	3.90	4.27	3.42	3.51	3.85	3.94	4.09	3.76
Income Gap	11.54	13.54	10.90	7.37	6.06	13.53	9.19	10.53	9.56	6.18	10.92	12.83	9.35	8.30	7.72	9.82
Credit Markup	1.82	1.86	1.83	1.84	1.86	1.78	1.83	1.88	1.83	1.88	1.85	1.83	1.82	1.85	1.84	1.84
Deposit Markup	2.00	2.11	1.96	1.95	1.83	1.80	1.95	2.04	2.01	2.05	2.06	2.04	1.96	1.94	1.84	1.97
Deposit Market Power	0.10	0.09	0.10	0.10	0.11	0.10	0.09	0.10	0.11	0.10	0.10	0.10	0.10	0.10	0.11	0.10
Loan Growth	2.10	2.20	1.58	1.78	1.43	1.83	2.04	1.91	1.72	1.57	2.05	2.19	1.63	1.72	1.49	1.82
Dep. Volatility	1.34	1.35	1.13	1.17	1.18	1.26	1.22	1.24	1.22	1.22	1.22	1.30	1.21	1.20	1.23	1.23
Deposit Spread Beta	0.71	0.71	0.73	0.73	0.74	0.71	0.73	0.73	0.73	0.74	0.72	0.72	0.73	0.73	0.74	0.73
Int. Expenses Beta	0.36	0.34	0.32	0.33	0.32	0.34	0.33	0.34	0.33	0.32	0.35	0.34	0.32	0.33	0.33	0.33
Int. Income Beta	0.38	0.40	0.37	0.34	0.36	0.41	0.39	0.37	0.36	0.31	0.38	0.39	0.36	0.35	0.37	0.37
NIM Beta	0.02	0.05	0.04	0.01	0.03	0.06	0.05	0.03	0.02	-0.01	0.03	0.05	0.03	0.01	0.03	0.03
ROA Beta	0.12	0.13	0.15	0.08	0.08	0.14	0.12	0.11	0.12	0.06	0.12	0.12	0.13	0.10	0.08	0.11
Credit Markup Beta	-0.05	-0.05	-0.04	-0.05	-0.05	-0.04	-0.05	-0.05	-0.04	-0.06	-0.05	-0.04	-0.05	-0.05	-0.05	-0.05
Deposit Markup Beta	-0.17	-0.18	-0.16	-0.16	-0.13	-0.13	-0.15	-0.19	-0.16	-0.17	-0.18	-0.16	-0.18	-0.15	-0.14	-0.16

Notes: This table shows bank-level in-sample averages of the main liquidity ratios by quintiles. Variables are all scaled by gross total assets

C.3 Correlation Structure

This section includes data on the correlation structure of the liquidity ratios.

1. Table 9 contains in-sample means, standard deviation, and correlation coefficients of the main balance sheet variables. Columns 0 to 3 focus on the correlations between liquidity ratios and other banks' characteristics.

2. In the main text, Figure 2 shows that the percentiles of the liquidity ratios distribution vary considerably over time. Table 8 displays the Markov matrix for HQ- LQ liquidity ratios and the liquidity coverage ratio and highlights that the presence of a bank placed within a specific percentile group of the liquidity ratio distribution is persistent.

3. Figure 30 displays the correlation between liquidity ratios (y-axis) and other banks' characteristics (x-axis). This complements the correlation structure presented in the main text, specifically in Figure 3.

4. Figure 31 shows the correlations with the main variables (as in the main text) after controlling for other banks' characteristics. The objective is to remove the influence of other bank characteristics on the relationship between liquidity ratios and other bank-specific characteristics.

Table 8: Transition Matrices for Quarterly Liquidity Ratios

	1	2	3	4	5
1	0.85	0.13	0.01	0.00	0.00
2	0.14	0.68	0.16	0.02	0.00
3	0.01	0.17	0.66	0.15	0.01
4	0.00	0.01	0.16	0.73	0.10
5	0.00	0.00	0.01	0.10	0.89

(a) HQ liquidity

	1	2	3	4	5
1	0.87	0.12	0.01	0.00	0.00
2	0.12	0.72	0.14	0.01	0.00
3	0.01	0.14	0.71	0.13	0.01
4	0.00	0.01	0.13	0.75	0.10
5	0.00	0.00	0.01	0.10	0.89

(b) LQ liquidity

	1	2	3	4	5
1	0.85	0.14	0.01	0.00	0.00
2	0.14	0.67	0.17	0.02	0.00
3	0.01	0.17	0.66	0.15	0.01
4	0.00	0.01	0.16	0.72	0.10
5	0.00	0.00	0.01	0.11	0.88

(c) Liq. Coverage Ratio

The table shows that the probability of a liquidity ratio staying in its quintile in the next quarter (diagonal entries) is much higher than transitioning to any other quintile, with this result being particularly strong in the lowest and highest quintiles of the distribution. This result is necessary, but not sufficient, for bank-level liquidity ratios to encode important information about the liquidity state of banks.

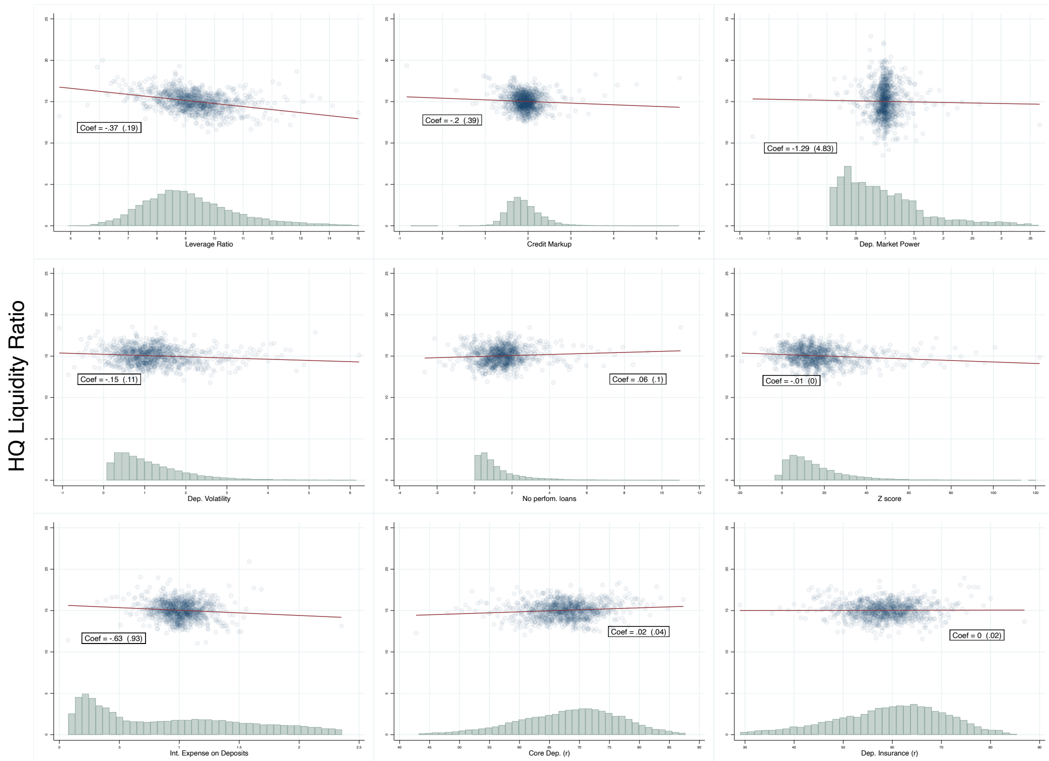
Table 9: Summary Statistics: Correlation Structure

	Avg	Sd	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Total Liquid Assets Ratio	28.90	12.08	-																																															
HQ Liquidity Ratio	14.94	9.31	0.73	-																																														
LQ Liquidity Ratio	11.05	7.77	0.59	-0.06	-																																													
Liq. Coverage Ratio	0.77	0.49	0.69	0.96	-0.09	-																																												
HQ-L1 Liquidity Ratio	4.36	5.74	0.39	0.54	-0.05	0.59	-																																											
HQ-L2a Liquidity Ratio	10.53	7.82	0.58	0.78	-0.04	0.70	-0.10	-																																										
Reserves	2.16	3.70	0.18	0.36	-0.13	0.38	0.72	-0.10	-																																									
Treasury Securities	0.77	2.43	0.24	0.28	0.02	0.30	0.52	-0.07	0.10	-																																								
Other Debt by GAs	0.28	0.97	0.15	0.14	0.06	0.13	0.30	-0.06	0.09	-0.03	-																																							
Other Debt by GSEs	5.35	5.98	0.34	0.49	-0.09	0.45	-0.10	0.66	-0.06	0.04	-0.09	-																																						
RMBS by GSEs	4.81	5.63	0.40	0.50	0.04	0.46	-0.04	0.63	-0.07	-0.13	-0.01	-0.14	-																																					
RMBS by GAs	1.02	2.29	0.27	0.31	0.06	0.35	0.46	0.03	0.00	-0.00	0.16	-0.12	0.16	-																																				
CMBS by US Gov. (Pass-Throughs)	0.24	0.71	0.07	0.04	0.07	-0.09	-0.03	0.08	-0.05	-0.04	0.15	-0.08	-0.03	-0.02	-																																			
CMBS by US Gov. (Other)	0.37	1.11	0.05	0.02	0.07	-0.13	-0.04	0.06	-0.09	-0.03	0.08	-0.10	-0.07	0.05	0.29	-																																		
Total Loans	64.04	11.67	-0.98	-0.72	-0.57	-0.68	-0.40	-0.56	-0.20	-0.22	-0.14	-0.31	-0.40	-0.28	-0.08	-0.05	-																																	
Commercial Real Estate Loans	26.02	9.86	-0.53	-0.33	-0.38	-0.32	-0.16	-0.27	-0.01	-0.14	-0.05	-0.14	-0.21	-0.16	-0.05	-0.02	0.53	-																																
Residential Real Estate Loans	20.72	9.09	-0.36	-0.27	-0.18	-0.25	-0.17	-0.20	-0.13	-0.09	-0.04	-0.13	-0.12	-0.08	0.04	-0.01	0.36	-0.13	-																															
Commercial & Industrial Loans	10.51	6.72	-0.30	-0.26	-0.14	-0.25	-0.13	-0.21	-0.09	-0.05	-0.06	-0.13	-0.14	-0.08	-0.04	0.01	0.32	-0.04	-0.33	-																														
Consumer Loans	3.97	4.55	-0.07	-0.09	-0.02	-0.08	-0.04	-0.07	-0.06	0.05	-0.05	-0.01	-0.06	-0.03	-0.06	-0.06	0.07	-0.34	-0.04	-0.02	-																													
Agricultural Loans	1.54	3.00	-0.13	-0.10	-0.08	-0.11	-0.09	-0.06	-0.05	-0.02	-0.05	0.05	-0.12	-0.08	-0.08	-0.01	0.15	0.02	-0.24	0.07	0.05	-																												
Total Domestic Deposits	79.61	7.11	-0.02	0.01	-0.06	-0.05	0.12	-0.08	0.15	0.10	0.06	0.09	-0.20	-0.06	-0.04	0.00	0.06	0.15	-0.04	-0.04	0.04	0.08	-																											
Transaction Deposits	12.54	8.12	0.13	0.11	0.01	0.10	0.13	0.04	0.12	0.11	0.00	0.06	-0.01	-0.00	0.02	0.01	-0.11	-0.10	-0.05	-0.04	0.07	0.06	0.18	-																										
Non Transaction Deposits	66.99	9.88	-0.13	-0.09	-0.06	-0.13	-0.02	-0.09	0.01	-0.02	0.04	0.01	-0.14	-0.04	-0.04	-0.01	0.14	0.19	0.02	0.01	-0.04	0.00	0.57	-0.70	-																									
Money Market Deposit	23.44	15.26	0.04	0.02	0.02	-0.03	0.07	-0.03	0.11	0.04	0.01	-0.06	-0.00	-0.05	0.05	0.08	-0.04	0.03	-0.14	0.16	-0.06	-0.08	0.16	-0.24	0.31	-																								
No Transaction Time Deposits	27.61	11.92	-0.22	-0.13	-0.16	-0.08	-0.17	-0.02	-0.18	-0.06	-0.14	0.11	-0.10	-0.00	-0.14	-0.13	0.23	0.15	0.10	-0.03	0.09	0.11	0.07	-0.06	0.10	-0.49	-																							
Other Savings Deposits	15.78	13.14	0.05	0.01	0.07	0.00	0.05	-0.02	0.04	-0.01	0.14	-0.02	-0.02	0.03	0.01	-0.01	-0.05	-0.01	0.10	-0.15	-0.04	-0.01	0.19	-0.21	0.31	-0.47	-0.25	-																						
Fed Funds Purchased & Repos	3.17	3.85	0.17	0.13	0.10	0.10	-0.03	0.17	-0.08	-0.01	-0.02	0.09	0.14	0.05	-0.04	-0.04	-0.17	-0.19	-0.09	0.06	0.04	-0.05	-0.60	-0.06	-0.38	-0.02	-0.12	-0.16	-																					
Equity Capital	10.00	2.22	-0.05	-0.04	-0.00	-0.01	0.09	-0.12	0.07	0.07	0.03	-0.13	-0.05	0.04	0.04	-0.04	-0.03	0.14	-0.10	-0.03	-0.09	-0.04	-0.09	-0.03	-0.04	0.03	-0.14	0.06	-0.14	-																				
Net Int. Rate Margin (%)	3.81	0.70	-0.37	-0.33	-0.19	-0.31	-0.26	-0.20	-0.20	-0.11	-0.11	-0.08	-0.16	-0.11	-0.03	-0.07	0.36	0.25	0.09	0.01	0.18	0.09	0.13	0.02	0.09	-0.01	0.09	0.00	-0.18	0.16	-																			
Int. Rate Income (%)	5.20	1.28	-0.33	-0.30	-0.18	-0.24	-0.40	-0.06	-0.38	-0.12	-0.22	0.06	-0.09	-0.10	-0.08	-0.13	0.34	0.13	0.15	0.05	0.21	0.09	-0.14	-0.05	-0.05	-0.28	0.54	-0.21	0.04	-0.15	0.61	-																		
Int. Rate Expenses (%)	1.40	1.02	-0.16	-0.15	-0.09	-0.10	-0.32	0.06	-0.35	-0.08	-0.20	0.13	-0.01	-0.05	-0.13	-0.14	0.19	-0.01	0.13	0.06	0.13	0.05	-0.27	-0.08	-0.13	-0.34	0.63	-0.26	0.17	-0.29	0.09	0.84	-																	
Non Int. Income (%)	1.16	0.95	0.02	-0.00	-0.04	0.02	0.03	-0.02	0.04	0.01	-0.01	-0.00	-0.02	-0.02	-0.01	-0.05	-0.06	-0.20	-0.02	0.03	0.21	0.01	-0.07	0.12	-0.18	0.07	-0.16	-0.08	0.13	-0.05	0.09	0.03	-0.02	-																
Non Int. Expenses (%)	2.97	0.92	-0.11	-0.08	-0.13	-0.05	0.02	-0.11	0.06	-0.02	0.02	-0.04	-0.10	-0.03	0.00	-0.04	0.05	-0.07	0.06	-0.02	0.19	0.02	0.10	0.15	-0.07	0.04	-0.14	0.02	-0.05	-0.05	0.32	0.11	-0.08	0.77	-															
Int. Expense on IB deposits (%)	1.01	0.73	-0.15	-0.14	-0.09	-0.09	-0.28	0.04	-0.31	-0.06	-0.20	0.13	-0.03	-0.03	-0.15	-0.17	0.18	0.00	0.09	0.07	0.15	0.05	-0.19	-0.04	-0.10	-0.33	0.63	-0.27	0.14	-0.25	0.15	0.82	0.94	-0.00	-0.04	-														
Provisions (%)	0.30	0.49	-0.18	-0.12	-0.12	-0.07	0.02	-0.15	0.09	-0.06	-0.06	-0.09	-0.09	-0.01	-0.08	-0.10	0.13	0.14	0.00	0.05	0.01	-0.04	-0.07	-0.11	0.04	-0.06	0.18	-0.06	-0.01	-0.03	0.10	0.13	0.10	0.08	0.14	0.16	-													
ROA (%)	1.06	0.69	0.02	-0.07	0.07	-0.08	-0.17	0.05	-0.21	-0.01	-0.05	0.05	0.01	-0.05	0.00	-0.00	0.03	-0.03	-0.04	-0.02	0.11	0.11	-0.01	0.04	-0.05	0.03	-0.04	-0.04	0.04	0.11	0.36	0.23	0.05	0.22	-0.08	0.04	-0.54	-												
Gross Total Assets (Log)	14.06	0.97	-0.08	-0.06	-0.00	-0.11	0.03	-0.10	0.07	0.01	-0.02	-0.22	0.07	-0.02	0.09	0.12	0.02	-0.06	-0.09	0.21	-0.03	-0.11	-0.23	-0.18	-0.02	0.35	-0.42	-0.05	0.19	0.15	-0.13	-0.28	-0.27	0.11	-0.03	-0.30	0.08	-0.07	-											
Deposit Spread Beta	0.77	0.08	0.17	0.13	0.10	0.11	0.00	0.16	-0.02	0.06	0.03	0.10	0.11	-0.02	0.02	0.01	-0.19	-0.15	0.12	-0.26	0.09	-0.12	0.03	0.06	-0.02	0.03	-0.17	0.11	0.01	0.05	0.06	-0.04	-0.09	0.05	0.06	-0.08	-0.07	0.04	0.06	-										
Capital to RWA	14.28	3.65	0.53	0.45	0.24	0.47	0.41	0.22	0.24	0.25	0.15	0.13	0.14	0.23	0.01	-0.07	-0.53	-0.21	-0.12	-0.31	-0.10	-0.11	-0.02	0.10	-0.10	-0.09	-0.10	0.11	-0.06	0.56	-0.10	-0.28	-0.27	0.01	-0.04	-0.23	-0.09	0.09	-0.16	0.11	-									
Duration Mismatch	3.92	1.93	0.24	0.22	0.15	0.17	0.04	0.24	-0.06	-0.07	0.14	-0.09	0.39	0.20	0.05	0.01	-0.25	-0.22	0.22	-0.35	-0.07	-0.11	-0.07	-0.03	-0.02	-0.04	-0.25	0.25	-0.07	0.06	-0.13	-0.26	-0.24	-0.12	-0.08	-0.27	-0.12	-0.04	0.04	0.24	0.20	-								
Income Gap	10.42	13.42	-0.27	-0.23	-0.17	-0.19	-0.03	-0.24	-0.02	0.04	0.00	-0.12	-0.20	-0.11	0.01	0.05	0.29	0.14	-0.12	0.46	-0.05	0.01	-0.11	0.01	-0.09	0.32	-0.44	-0.04	0.14	0.05	0.14	-0.06	-0.17	0.16	0.13	-0.18	-0.05	0.11	0.30	-0.13	-0.22	-0.47	-							
Loan Growth	2.00	2.86	-0.21	-0.18	-0.09	-0.20	-0.21	-0.06	-0.22	-0.04	-0.08	-0.08	-0.00	-0.07	0.04	0.08	0.22	0.08	0.04	0.15	0.03	0.02	-0.06	-0.02	-0.03	0.04	-0.02	-0.05	0.01	-0.02	0.14	0.20	0.15	0.03	-0.04	0.13	-0.08	0.16	0.21	-0.06	-0.25	-0.05	0.15	-						
Deposit Markup	1.56	0.61	0.14	0.02	0.20	-0.02	-0.04	0.05	-0.03	-0.07	-0.01	-0.13	0.19	0.06	0.05	0.03	-0.15	-0.15	-0.03	-0.01	0.03	-0.07	-0.09	-0.05	-0.02	0.19	-0.27	0.02	0.08	0.10	0.07	-0.14	-0.23	-0.07	-0.25	-0.22	-0.06	0.22	0.26	0.14	0.03	0.19	0.04	0.07	-					
Deposit Market Power	0.10	0.08	0.04	0.05	0.01	0.04	0.01	0.05	0.01	-0.00	0.06	0.05	0.02	-0.01	0.00	-0.01	-0.05	-0.07	-0.07	-0.13	0.14	0.39	0.04	0.05	-0.02	-0.11	0.18	-0.03	-0.02	0.05	0.06	0.07	0.04	0.03	0.02	0.04	-0.03	0.14	-0.14	-0.02	0.10	-0.02	-0.12	-0.03	-0.02	-				
Dep. Volatility	1.23	0.99	-0.07	-0.06	-0.03	-0.05	-0.11	0.01	-0.13	-0.09	-0.05	-0.08	0.09	0.04	0.02	0.06	0.06	-0.04	-0.01	0.11	0.00	0.01	-0.38	-0.09	-0.20	-0.05	0.00	-0.10	0.23	-0.05	-0.01	0.13	0.17	0.11	0.04	0.15	0.10	-0.02	0.10	-0.10	-0.11	-0.03	0.09	0.16	0.06	-0.03	-			
Credit Markup	1.94	0.50	0.11	0.07	0.05	0.06	0.09	0.02	0.12	0.02	0.03	-0.04	0.06	-0.02	-0.05	-0.07	-0.09	-0.05	-0.11	-0.01	0.02	0.05	-0.01	0.04	-0.04	0.21	-0.30	-0.00	0.04	0.18	0.09	-0.28	-0.41	0.17	-0.11	-0.39	-0.13	0.40	0.14	0.03	0.19	0.02	0.16	0.01	0.36	0.05	-0.03	-		
Leverage Ratio	9.30	1.90	0.01	0.01	0.01	0.04	0.13	-0.09	0.12	0.09	0.04	-0.03	-0.09	0.02	-0.01	-0.08	-0.02	0.17	-0.10	-0.04	-0.11	-0.03	-0.01	0.02	-0.02	-0.02	-0.07	0.08	-0.16	0.80	0.14	-0.15	-0.27	-0.04	-0.03	-0.22	-0.06	0.15	-0.08	0.01	0.72	0.03	0.03	-0.14	-0.01	0.05	-0.10	0.18	-	
Noncurrent Loans	1.48	1.74	0.01	0.08	-0.06	0.11	0.20	-0.06	0.26	-0.02	0.04	-0.03	-0.04	0.09	-0.00	-0.06	-0.08	0.13	-0.03	-0.10	-0.14	-0.11	-0.00	-0.05	0.04	-0.07	0.11	0.00	-0.06	0.08	-0.05	-0.11	-0.10	-0.03	0.11	-0.05	0.54	-0.46	0.01	0.01	0.14	-0.01	-0.15	-0.28	-0.12	-0.03	-0.00	-0.14	0.09	-
Z score	17.41	17.41	0.03	-0.02	0.08	-0.05	-0.12	0.06	-0.13	-0.02	-0.02	0.03	0.05	-0.04	-0.02	-0.02	0.01	-0.05	0.04	-0.02	0.05	0.03	0.01	-0.01	0.02	0.06	-0.07	0.01	0.04	-0.01	0.06	0.05	0.01	-0.06	-0.19	-0.02	-0.26	0.31	0.04	0.06	-0.01	0.07	0.04	0.11	0.19	0.02	-0.06	0.19	-0.01	-0.31	-

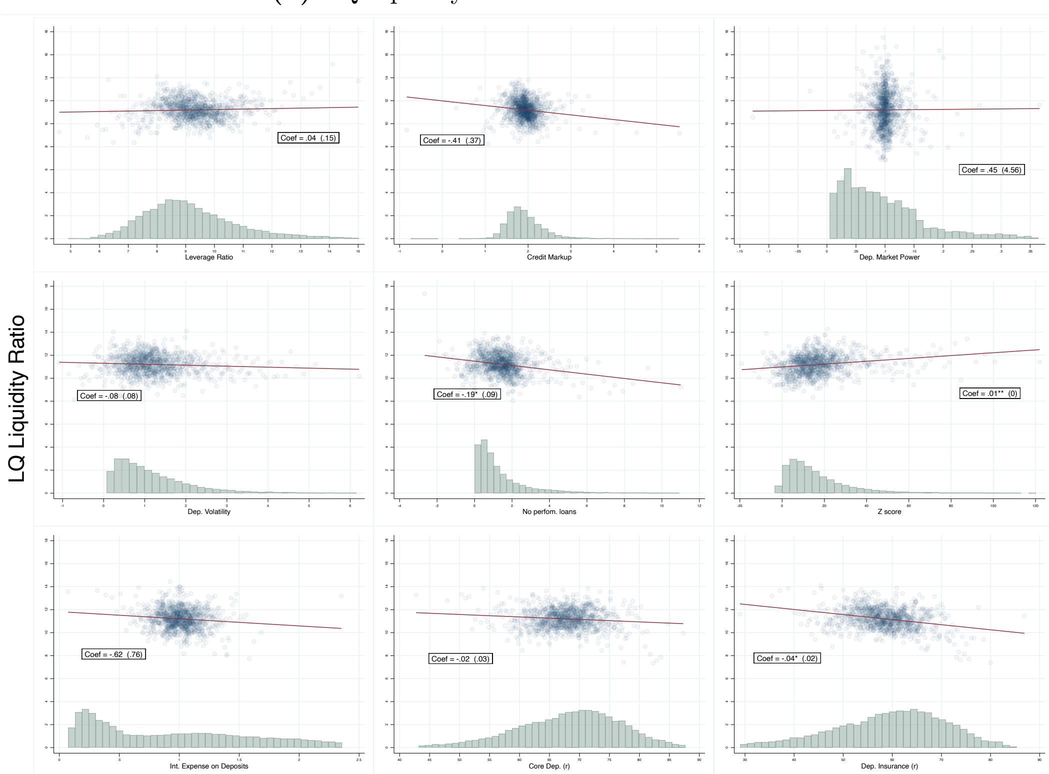
Notes: This table contains information about the in-sample linear Pearson's correlation coefficients between multiple banks' characteristics.

Figure 30: Correlations with respect to Other Banks' Characteristics (Controlling for bank and time fixed effects)

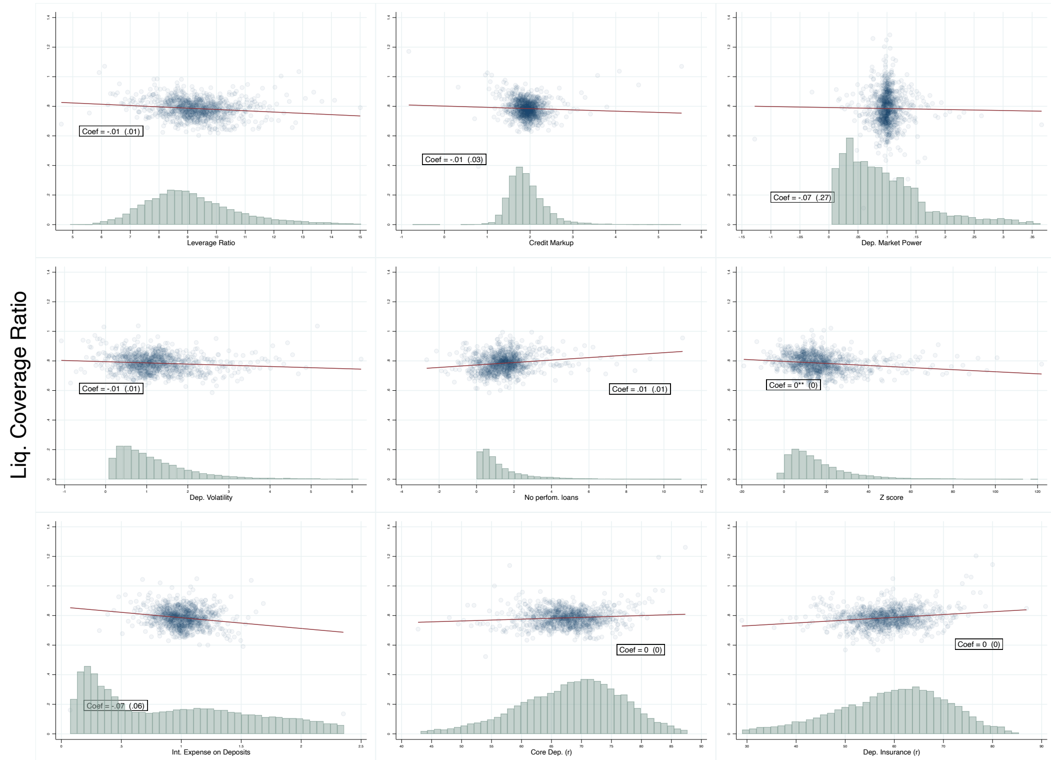
(a) HQ liquidity and Banks' Characteristics



(b) LQ liquidity and Banks' Characteristics



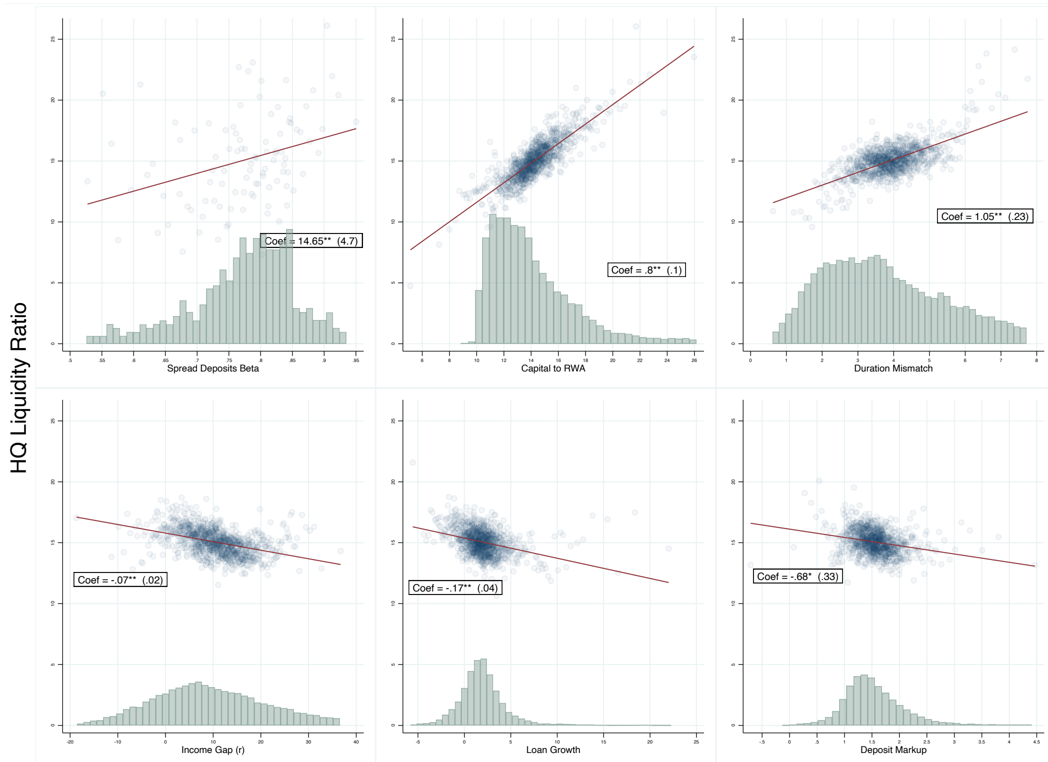
(c) LCR and Banks' Characteristics



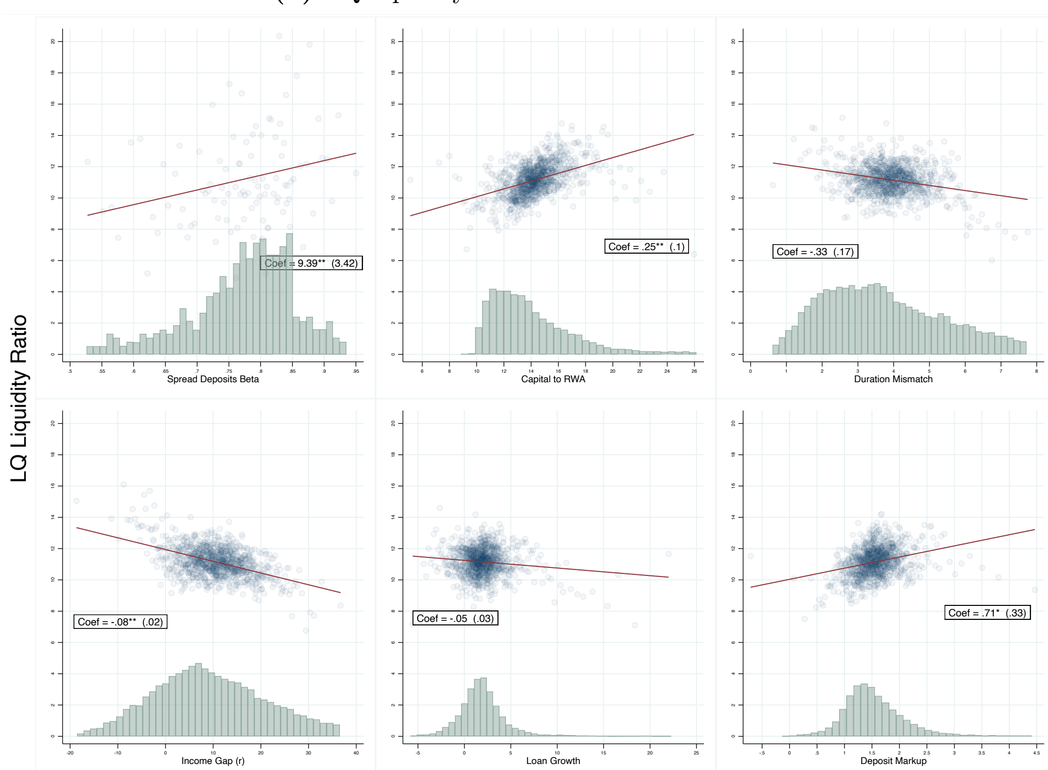
Notes: **a)** To prepare the data, the x-axis and y-axis variables were residualized using bank and quarter-fixed effects. Subsequently, the sample was divided into 1000 equally sized bins based on the residualized x-variable. The Spread Deposit Betas, however, were not residualized, and the data was divided into 100 bins. For each bin, the unweighted average of the x-axis and y-axis variables was calculated, and the mean of each variable was added back to the corresponding residual. Spread Deposit Betas are not residualized, and data was divided into 100 bins. **b)** The resulting graph provides a visual representation of the underlying distribution of the x-variable.

Figure 31: Correlations Controlling for Other Variables

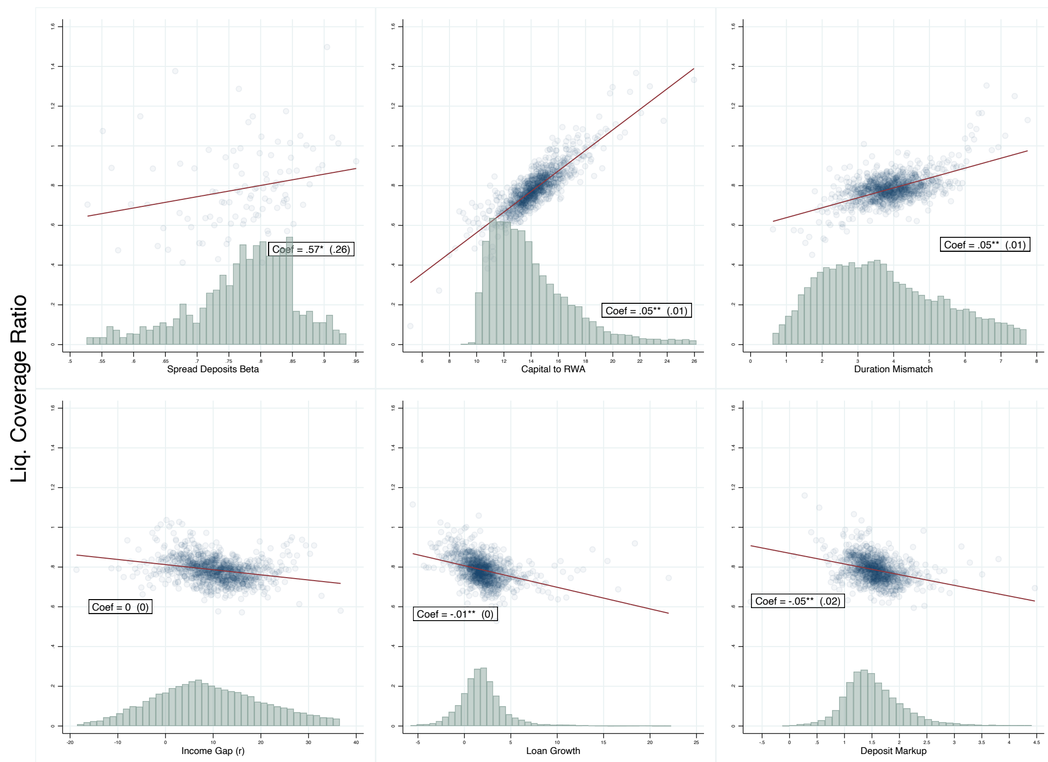
(a) HQ liquidity and Banks' Characteristics



(b) LQ liquidity and Banks' Characteristics



(c) LCR and Banks' Characteristics



Notes: **a)** To prepare the data, the x-axis and y-axis variables were residualized using bank-FE, quarter-FE, and the remaining variable in the graph. Subsequently, the sample was divided into 1000 equally sized bins based on the residualized x-variable. For each bin, the unweighted average of the x-axis and y-axis variables was calculated, and the mean of each variable was added back to the corresponding residual. **b)** The resulting graph provides a visual representation of the underlying distribution of the x-variable.

D Alternative Specifications

D.1 Demand-Supply

Due to the nature of the data, the heterogeneity in monetary policy transmission captured by the γ^h coefficients in (1) are equilibrium realizations. In other words, the quantitative relevance of the coefficient can be attributed to the interaction term's role in influencing supply and demand factors.

In an attempt to quantify the magnitude of demand and supply responses, I propose an estimation exercise that consists of exploiting the predictions of the deposit channel by directly controlling for banks' market power in deposit markets. The underlying intuition is that supply effects are expected to be more relevant for banks with higher monopoly power.

To control for the effect of policy-driven changes in the supply of deposits, I extend specification (1) in a triple-interaction fashion as follows.

$$\Delta_h Y_{i,t+h} = \left(\eta_0^h + \eta_1^h \beta_i^{Spread}\right) mp_t LR_{i,t-1} + \Gamma^h mp_t X_{i,t-1} + \Psi^h Z_{i,t-1} + f_i^h + f_{t+h}^h + u_{i,t+h}^h \quad (12)$$

where the beta spreads β_i^{Spread} is a proxy of the bank-specific deposits' supply sensitivity to interest rate fluctuations[82].

Intuitively, high-beta-banks have low deposits' supply sensitivity relative to low-beta-banks. Therefore, η_1^h represents a triple interaction parameter that accounts for the sensitivity of deposit supply to interest rate fluctuations. It quantifies how much more or less responsive the supply of high-beta banks is to interest rate shocks compared to low-beta banks. η_0^h is expected to capture any changes in outcome-Y not explained by this sensitivity.[83].

When η_1^h takes on positive values, it signifies that high-beta banks, positioned 1sd above the mean of the liquidity distribution, experience lower outcome-Y relative to low-beta banks,

[82]This is obtained following Drechsler, Savov, and Schnabl (2017). The higher the beta, the less monopoly power a bank owns; therefore, lower supply-side shifts are expected. Their results are replicated in Appendix B.4.3.

[83]The term $mp_t\beta_i$ is included in the vector X_i, and its corresponding parameter captures the deposit channel prediction: In response to tightening monetary policy, low-beta banks increase their deposit spreads by contracting more deposit supply.

which are also positioned 1sd above the mean of the liquidity distribution. These differences are attributed to supply-driven factors affecting outcome-Y. In other terms, a non-zero η_1^h implies that high-beta banks, despite being in a similar liquidity position as low-beta banks, have less stable deposit flows in response to interest rate shocks, which can be attributed to factors combining their liquidity management strategies and their monopolistic power.

Other identification strategies were also considered. For instance, Drechsler, Savov, and Schnabl (2017) go around this issue by estimating the changes in deposit rates as dependent variables in a separate regression. They argue that the effect is supply-driven because, in response to changes in the level of the Fed funds rate, deposit spreads increase and quantities decrease. However, I lack access to the deposit rate database.

D.2 Accounting for Hedging

To explore the difference between the source-of-last resort and the change in price effect, I propose an alternative exercise that consists of controlling directly for bank-specific interest rate exposure. The underlying intuition is that banks with higher exposure to interest rate fluctuations (measured by a higher net income beta) are more vulnerable to changes in security prices; therefore, banks with high exposure must experience larger deposit outflows.

The regression specification follows a triple interaction approach:

$$\Delta_h Y_{i,t+h} = \left(\eta_2^h + \eta_3^h|\beta_i^{nim}|\right) mp_t LR_{i,t-1} + \Gamma^h mp_t X_{i,t-1} + \Psi^h Z_{i,t-1} + f_i^h + f_{t+h}^h + u_{i,t+h}^h \quad (13)$$

To measure interest rate risk exposure, I use the absolute value of net interest rate beta (β_i^{NIM})[84]. β_i^{NIM} equal zero indicates that the bank perfectly matches its interest rate income and expense fluctuations, implying low exposure to interest rates. Positive or negative β_i^{NIM} indicate a degree of interest rate exposure, the reason why I include this as an absolute value.

The coefficient η_2^h captures part of the conditional effect of liquidity, which is not explained by the actual exposure to interest rate risks. Consider a bank-i such that $\beta_i^{nim} \neq 0$. The

[84] Equivalent to the difference between the interest rate sensitivity of income and expenses ($\beta_i^{INC} - \beta_i^{EXP}$). These variables are estimated using Drechsler, Savov, and Schnabl (2021)'s methodology. Their results are replicated in Appendix B.4.3

deposit growth of this bank might change because its interest risk exposure induces exposing depositors to changes in security prices. On the contrary, in a bank-i such that β_i^{nim} is close to zero, changes in security prices are not supposed to affect banks' profits. The coefficient η_3^h measures the conditional effect of monetary policy because banks cannot fully hedge interest rate risk and might be potentially more affected by securities price fluctuations.

D.3 Comment on Lending Opportunities

The magnitude of the γ^h coefficients in (1) capture the total conditional effect of monetary policy on deposits (direct and indirect effects). Estimating the direct/causal effect of monetary policy on deposits faces a well-known identification challenge arising from the impact of monetary policy on banks' lending opportunities. The argument is that monetary policy indirectly influences deposit supply as banks adjust it based on their current lending opportunities, which, to some extent, are also determined by monetary policy.

To address this issue, the literature adopts two strategies: A) within-bank estimations, comparing branches of the same bank to control for lending opportunities. B) Within-county estimations, which include time-county fixed effects for better control over local market opportunities (See Drechsler, Savov, and Schnabl (2017)). However, it's worth noting that data from Call Reports about the geographical location may not fully represent a bank's presence across the entire US territory, as it only includes the location of the main office. In contrast, banks may have multiple branches across the country.

E Robustness Exercises: Benchmark Specification

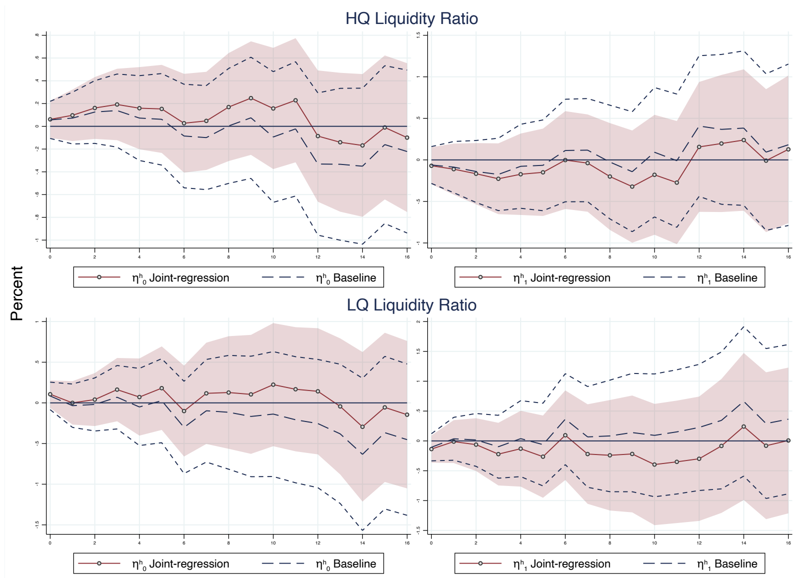
E.1 Deposits

This section collects the results from all Robustness Excercise described in Section 5.2.

E.1.1 Results on Alternative Specifications

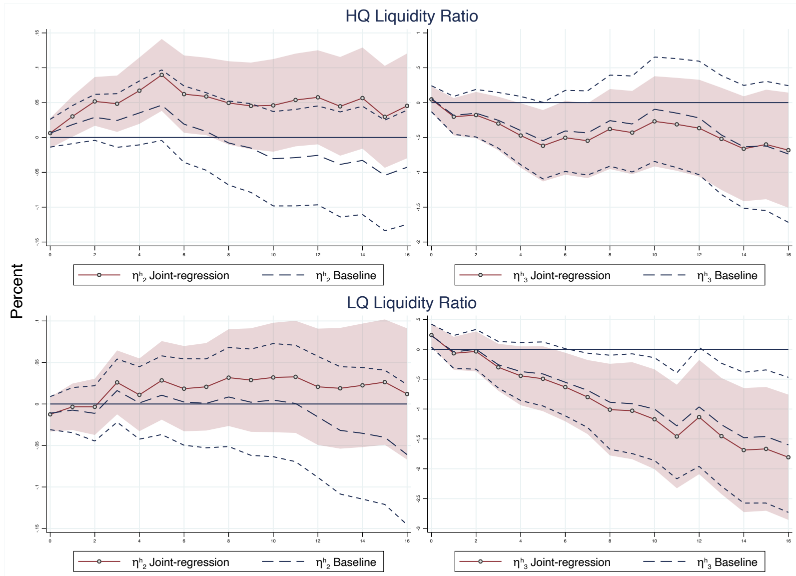
This subsection collects results based on specifications described in section D.

Figure 32: Monetary Tightening Shock Conditional on Liquidity: Effect on Total Domestic Deposit Flows(Accounting for Supply-Demand Effects)



Notes: The graph displays the results for η_0^h and η_1^h obtained from specification (12). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

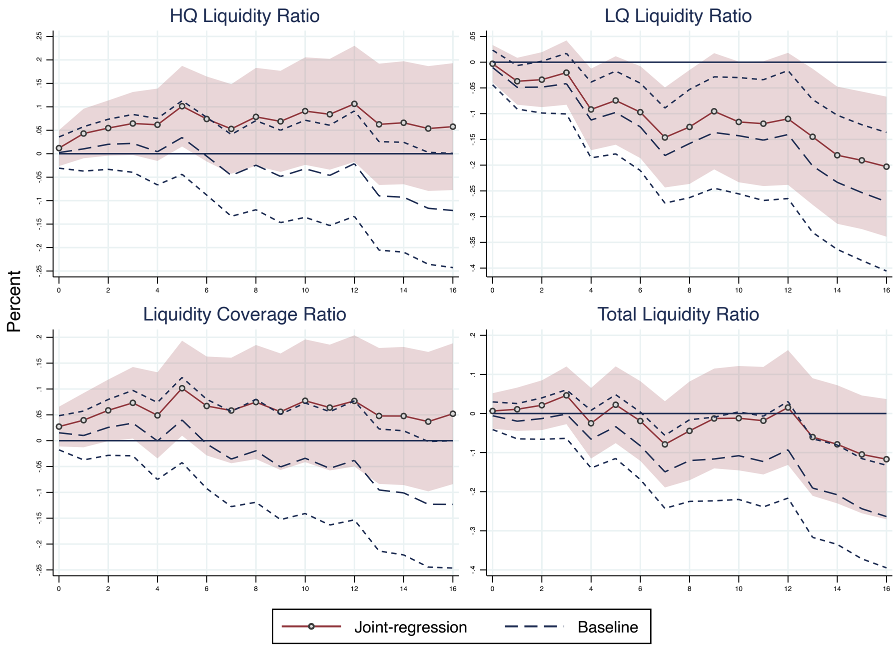
Figure 33: Monetary Tightening Shock Conditional on Liquidity: Effect on Total Domestic Deposit Flows(Accounting for Hedging)



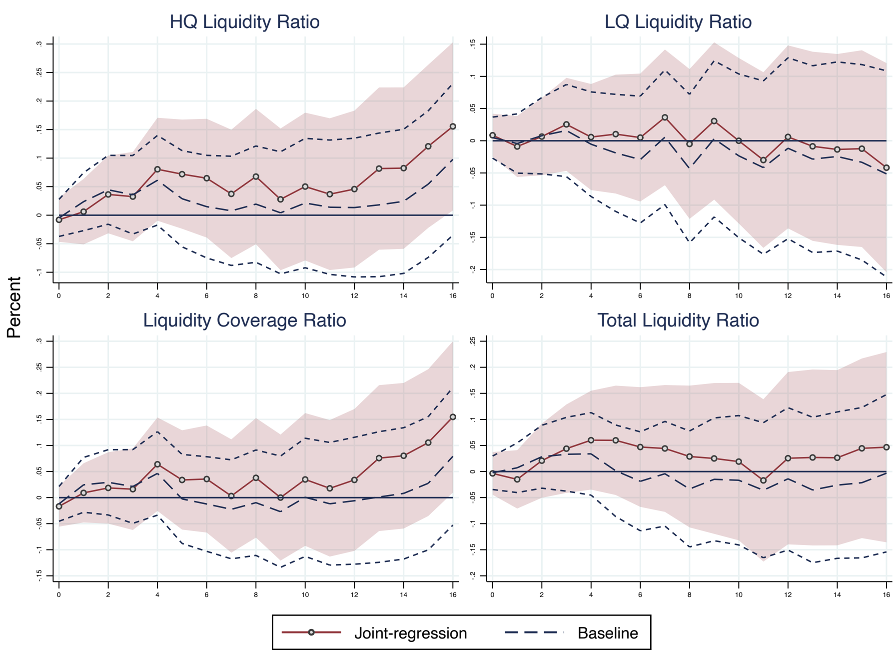
Notes: The graph displays the results for η_2^h and η_3^h obtained from specification (13). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

E.1.2 Different Deposit Accounts

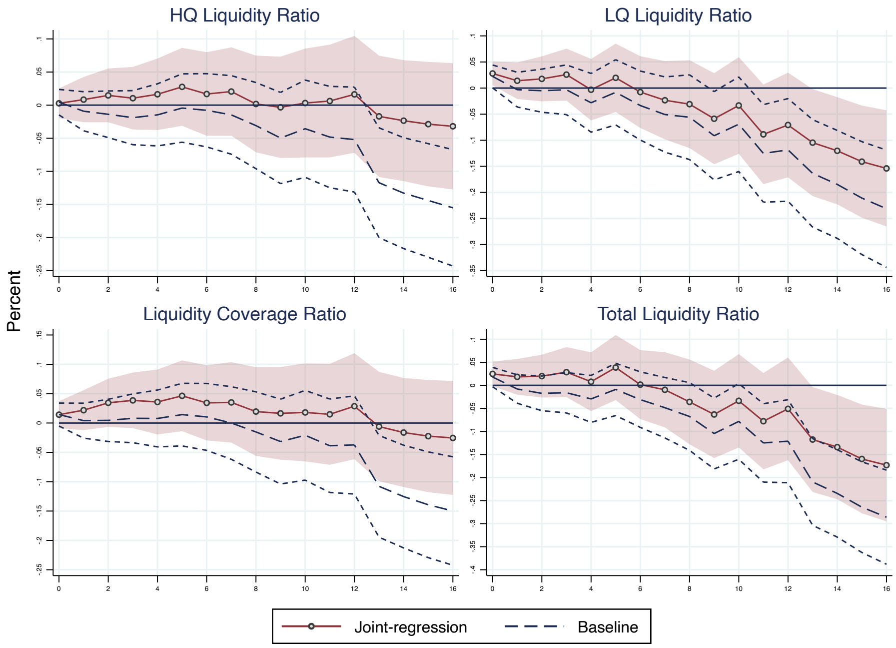
Figure 34: Monetary Tightening Shock Conditional on Liquidity: Effect on Different Deposit Accounts (Baseline)



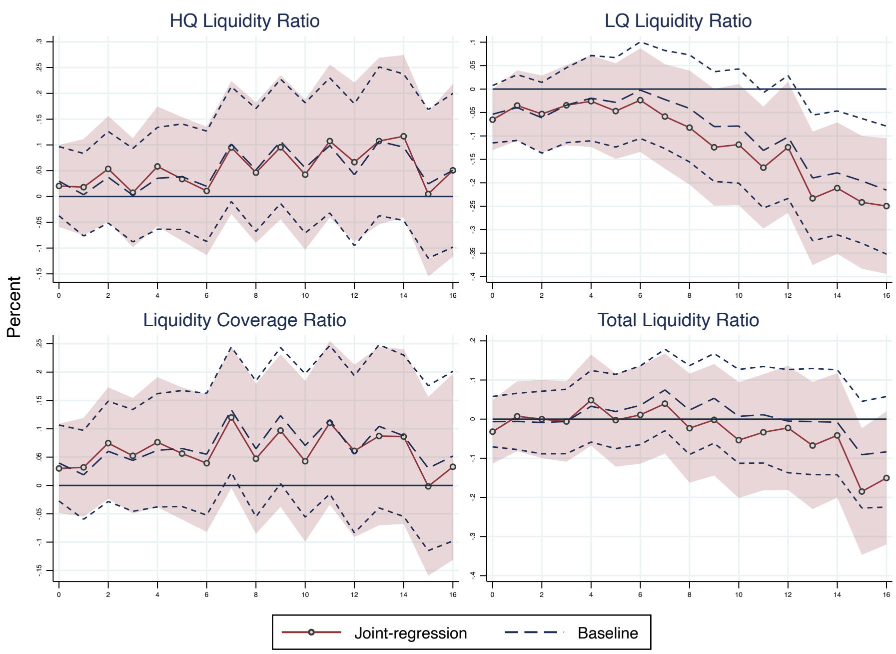
(a) No Transaction Money Market Deposits Accounts



(b) No Transaction Other Saving Accounts



(c) No Transaction Time Deposits Accounts



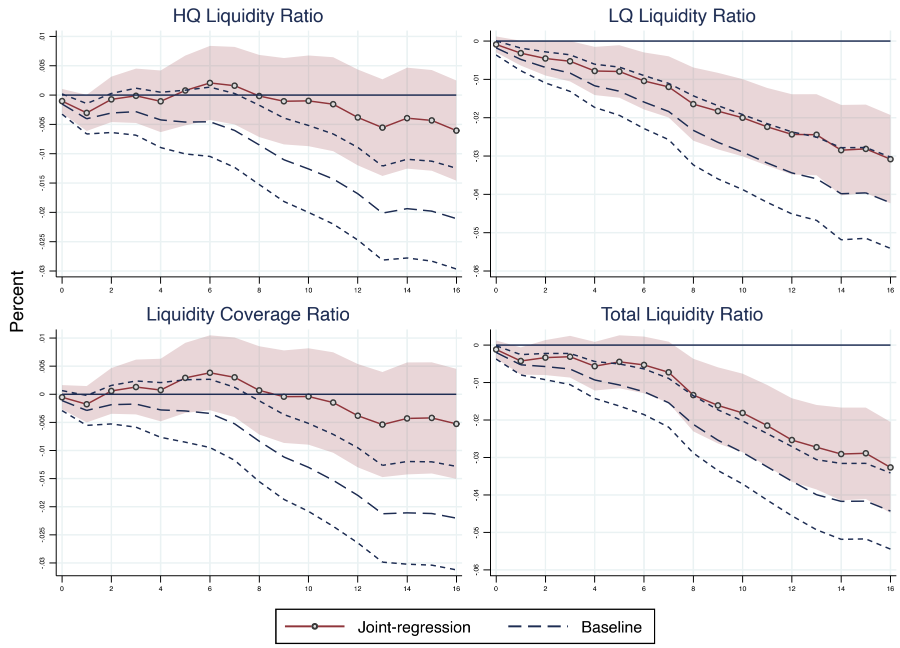
(d) Demand Deposits

Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

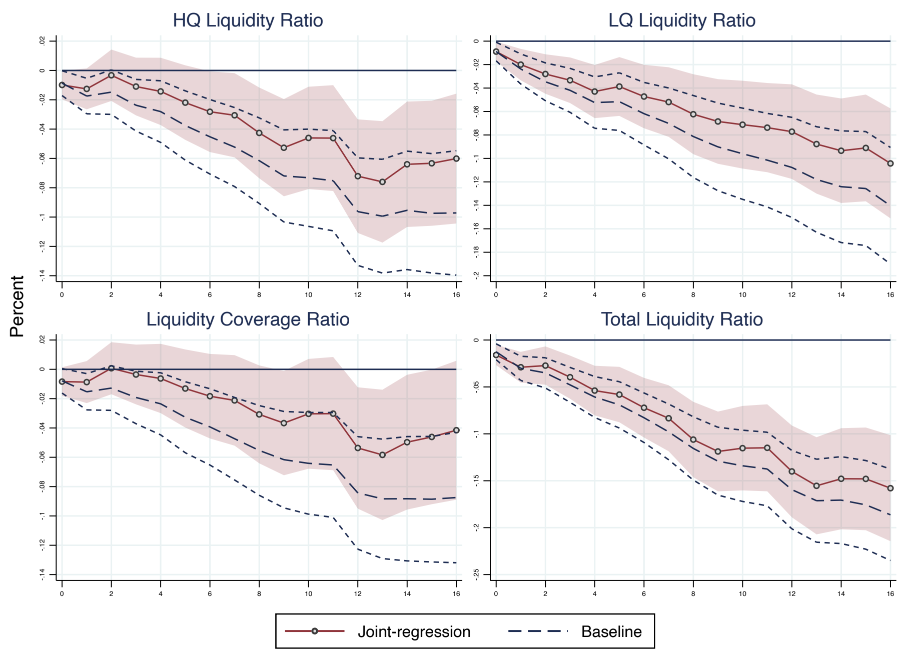
E.1.3 Alternative Monetary Shocks

Figure 35: Monetary Tightening Shock Conditional on Liquidity: Effects on Total Deposit Flows (Baseline)

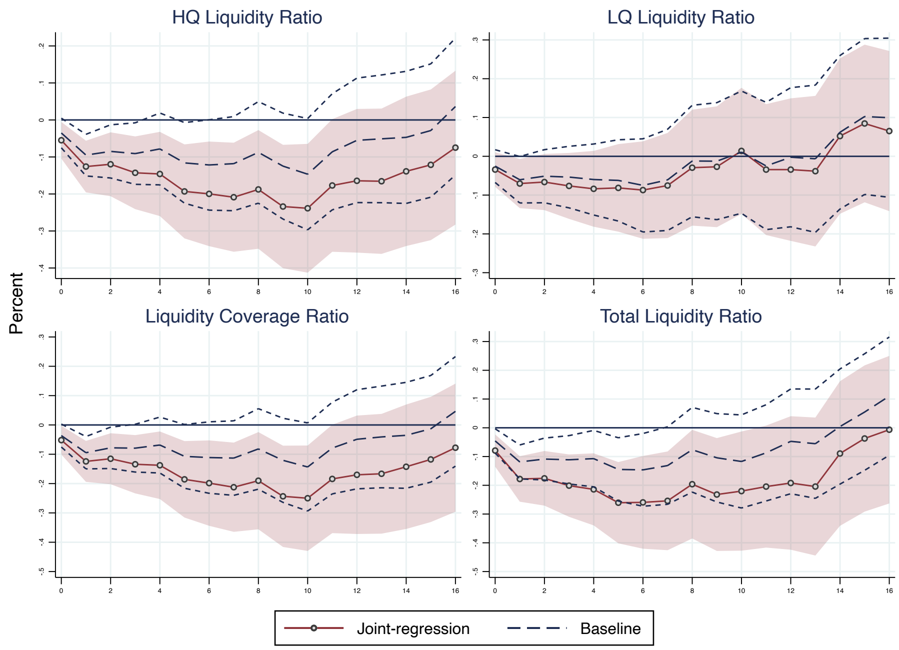
(a) Δ Fed Funds Rate



(b) Shocks from Bu, Rogers, and W. Wu (2021)



(c) Shocks from Acosta (2022)



Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

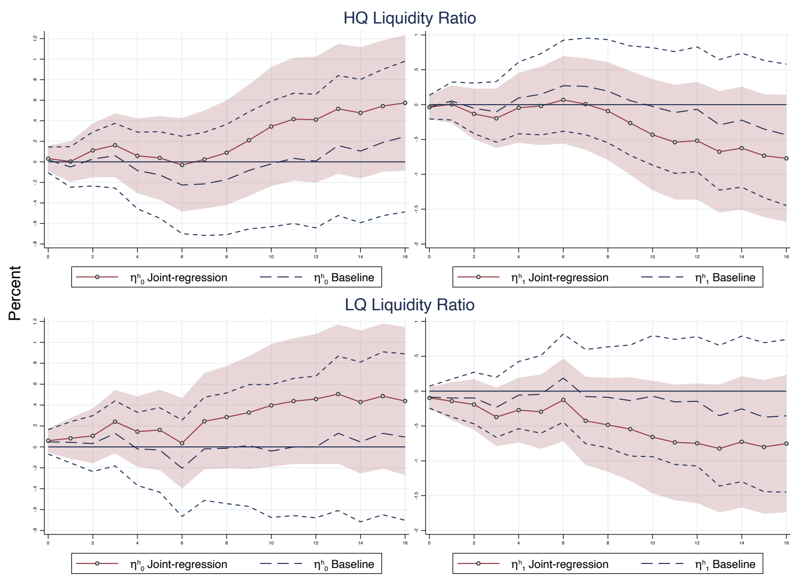
E.2 Loans

This section collects the results from all Robustness Excercise described in Section 6.2.

E.2.1 Results on Alternative Specifications

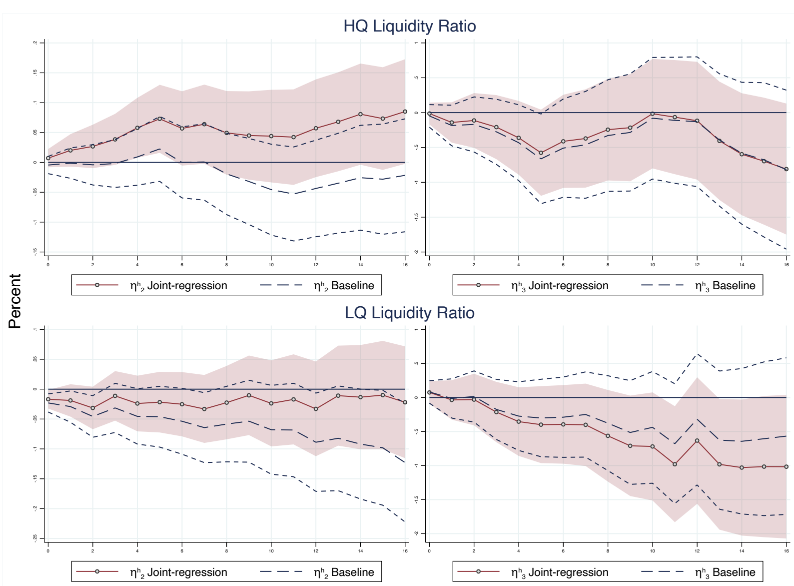
This subsection collects results based on specifications described in Section D.

Figure 36: Monetary Tightening Shock Conditional on Liquidity: Effect on Total Loans Growth(Accounting for Supply-Demand Effects)



Notes: The graph displays the results for η_0^h and η_1^h obtained from specification (12). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

Figure 37: Monetary Tightening Shock Conditional on Liquidity: Effect on Total Domestic Deposit Flows(Accounting for Hedging)

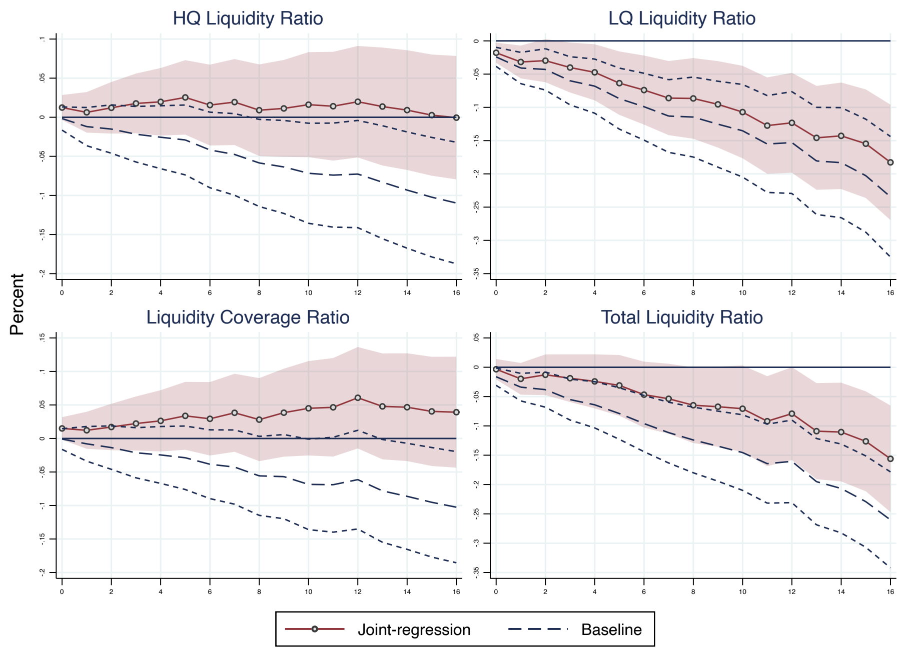


Notes: The graph displays the results for η_2^h and η_3^h obtained from specification (13). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

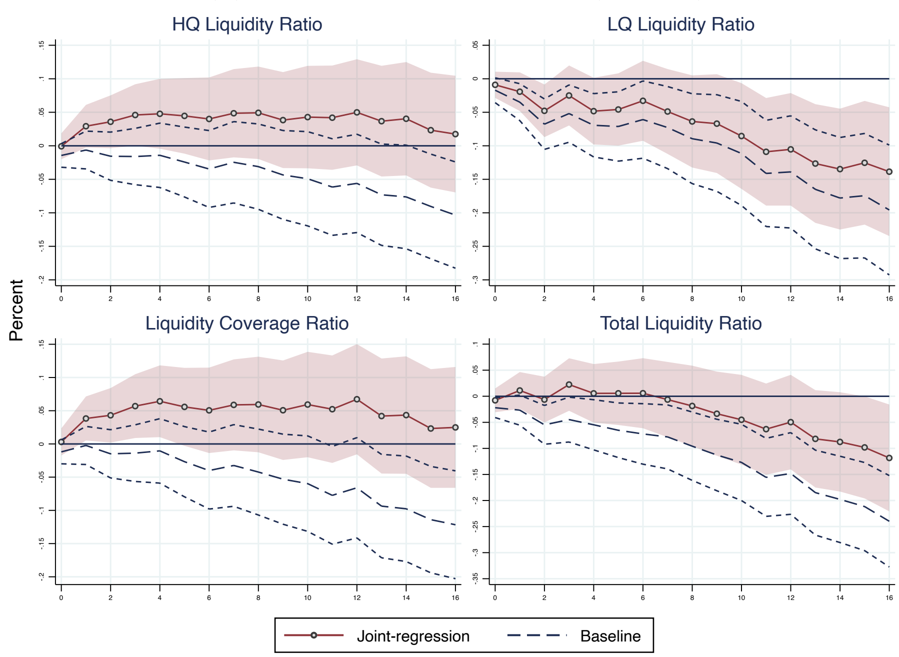
E.2.2 Compositional Effects

Figure 38: Monetary Tightening Shock Conditional on Liquidity:

(a) Effect on C&I Loans (Baseline)



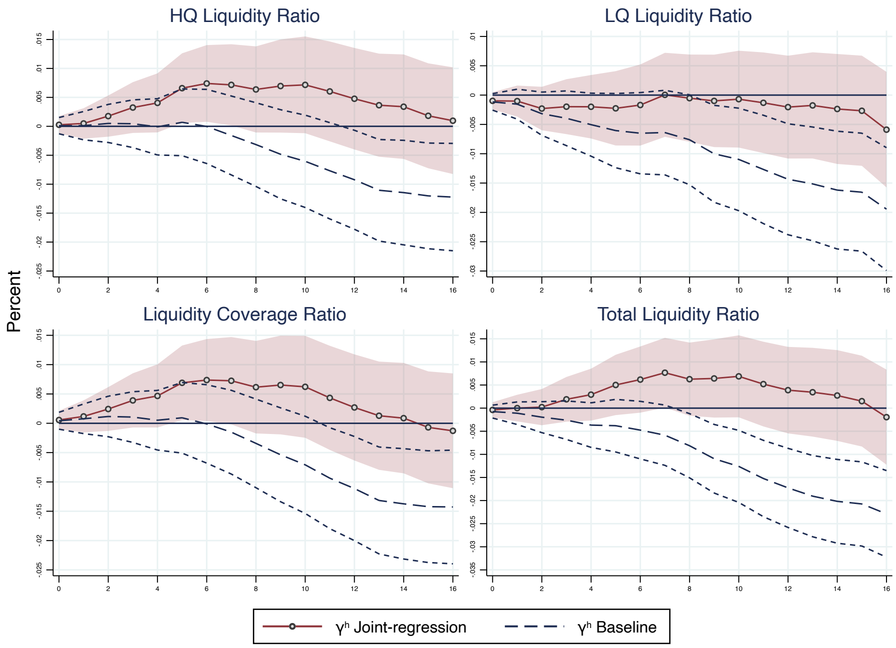
(b) Effect on Real Estate Loans (Baseline)



Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

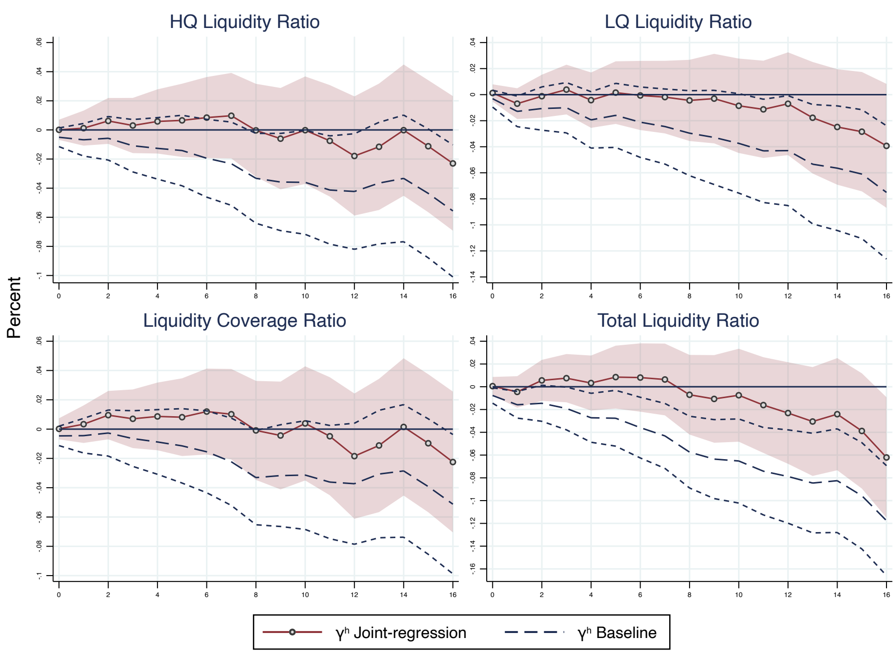
E.2.3 Alternative Monetary Shocks

Figure 39: Monetary Tightening Shock Conditional on Liquidity: Effects on Total Loans Growth (Baseline)

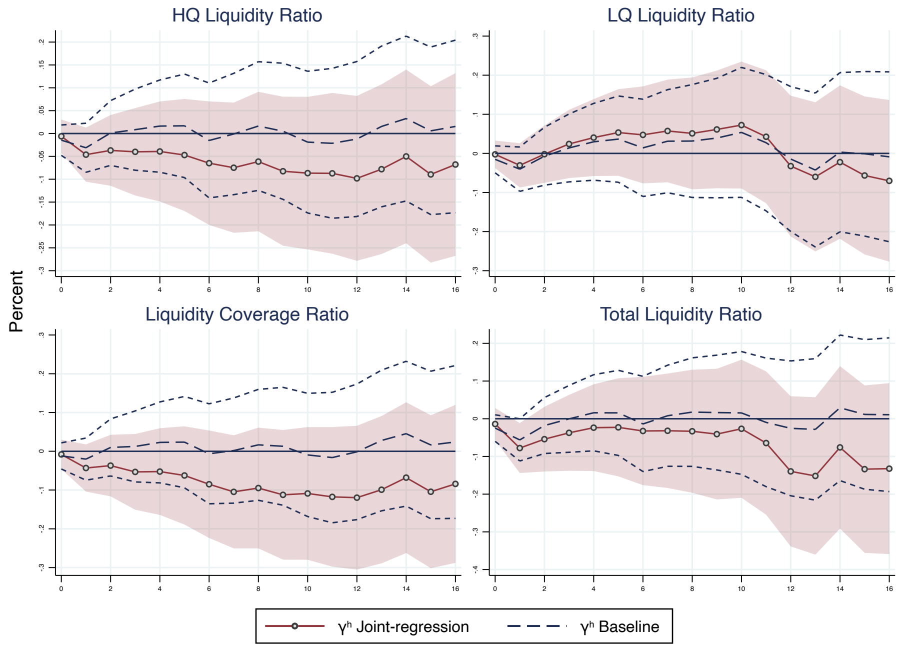


(a) Δ Fed Funds Rate

(b) Shocks from Bu, Rogers, and W. Wu (2021)



(c) Shocks from Acosta (2022)



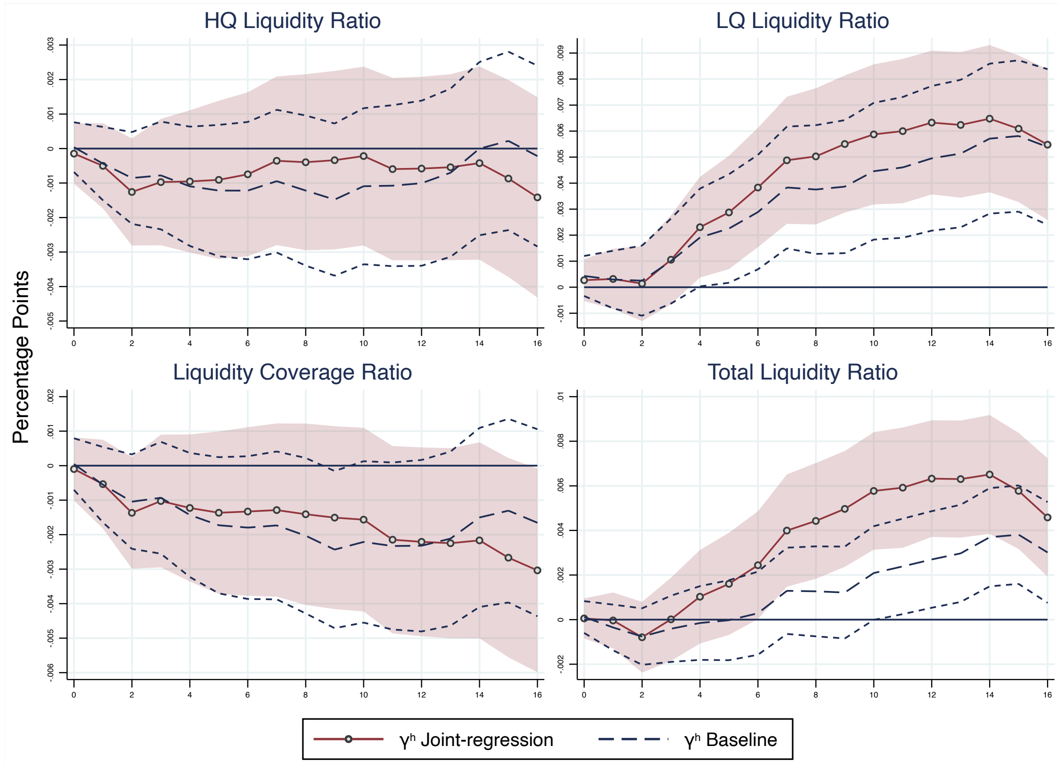
Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

E.3 Liquidity Creation

This section collects the results from all Robustness Excercise described in Section 7.2.

E.3.1 Alternative Monetary Shocks

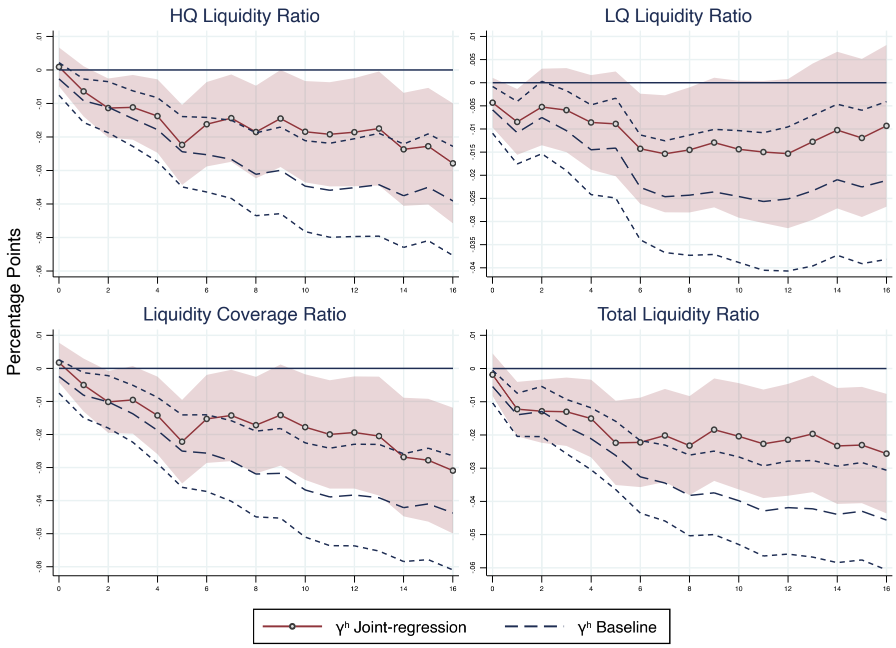
Figure 40: Δ Fed Funds Rate



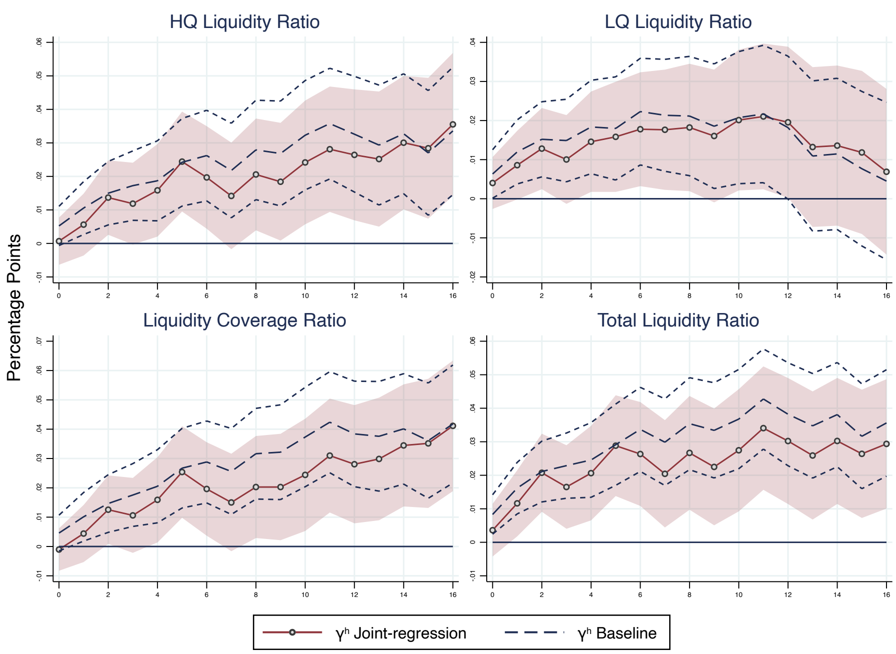
Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

E.3.2 Component of the liquidity creation

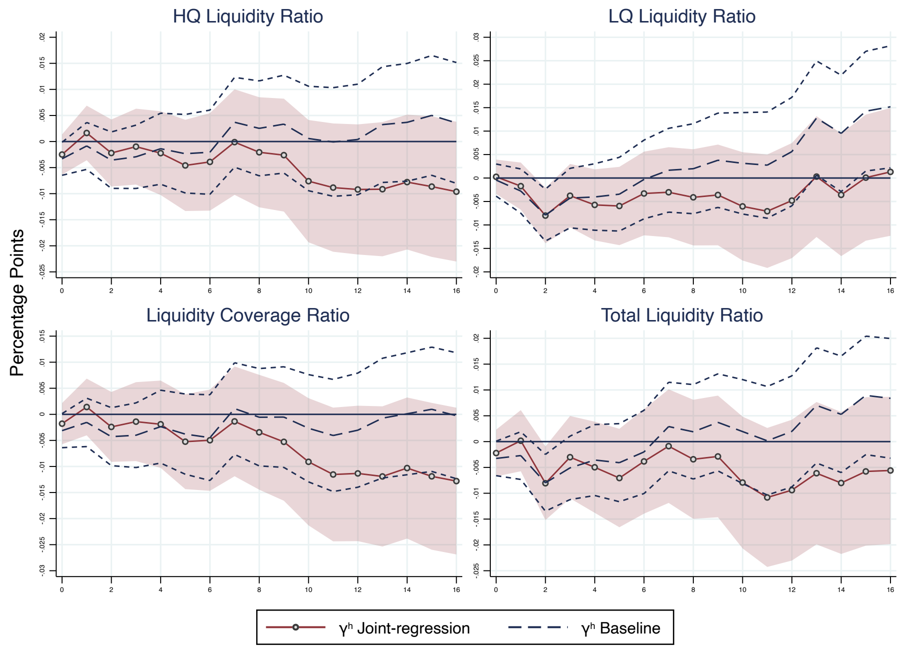
Figure 41: Monetary Tightening Shock Conditional on Liquidity: Effect on Liquidity Creation (Baseline)



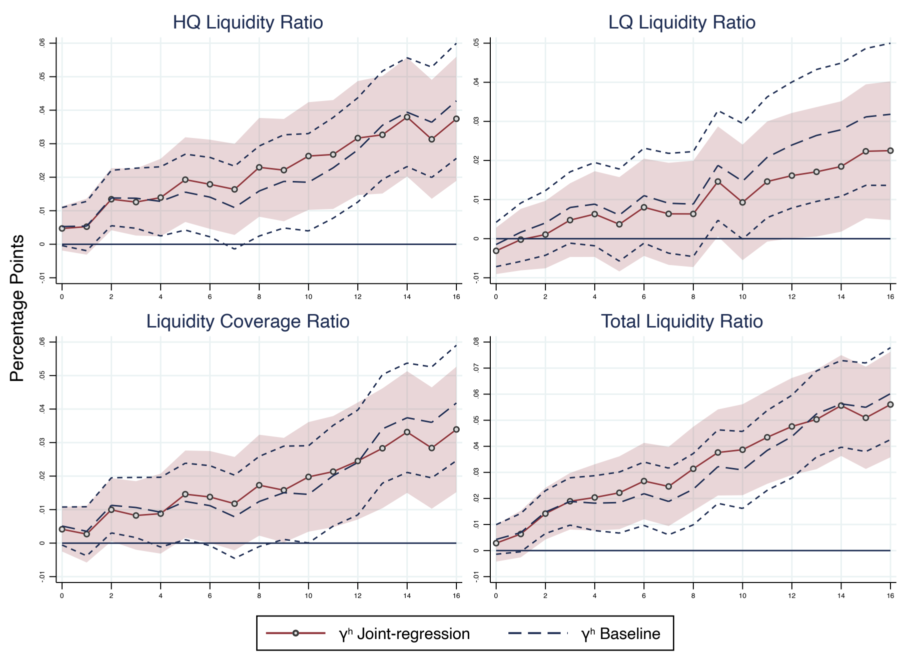
(a) Effect on Illiquid Assets



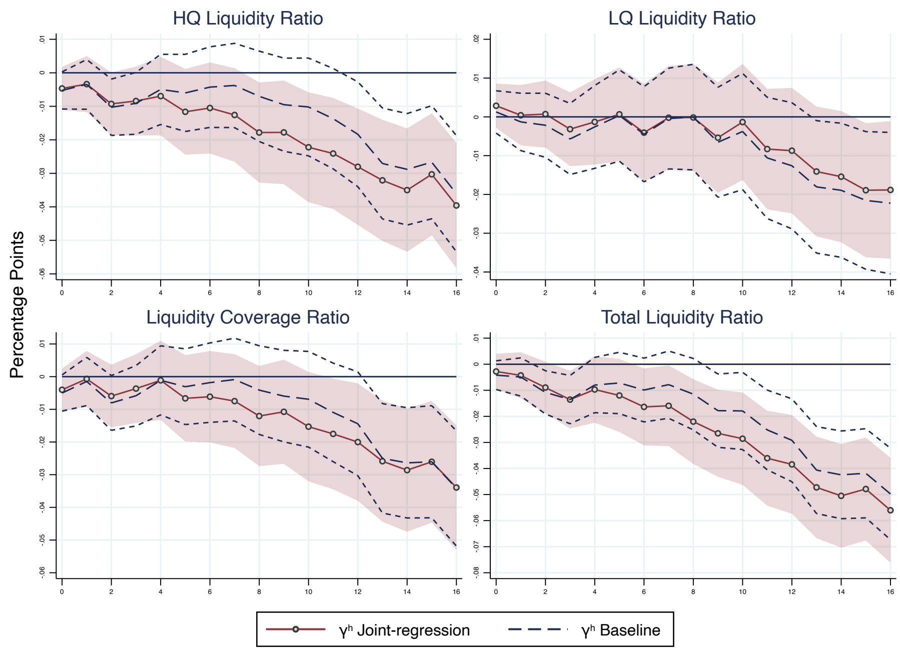
(b) Effect on Liquid Assets



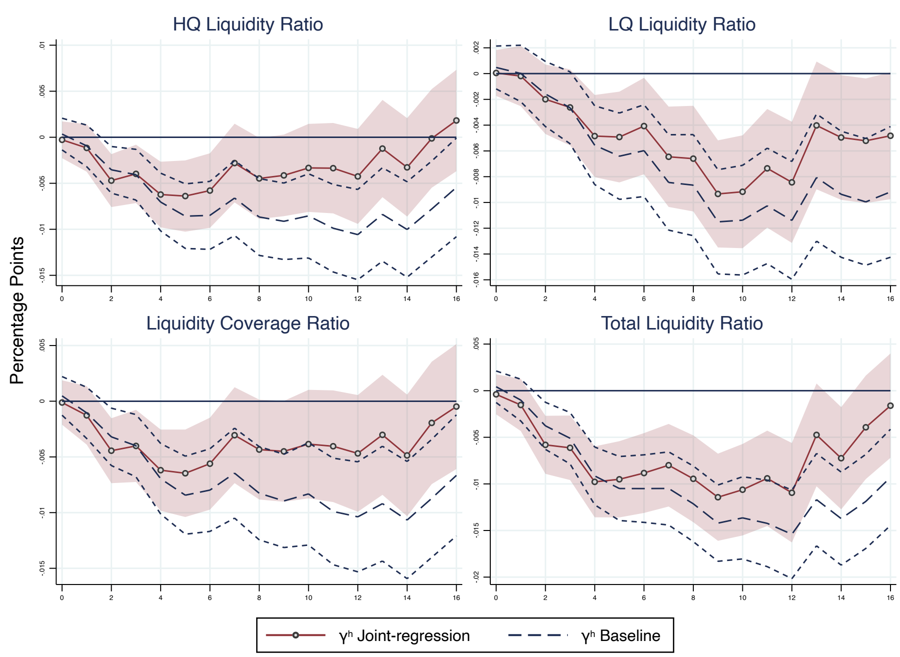
(c) Effect on Semi-liquid Assets



(d) Effect on Liquid Liabilities



(e) Effect on Semi-liquid Liabilities



(f) Effect on Illiquid Liabilities

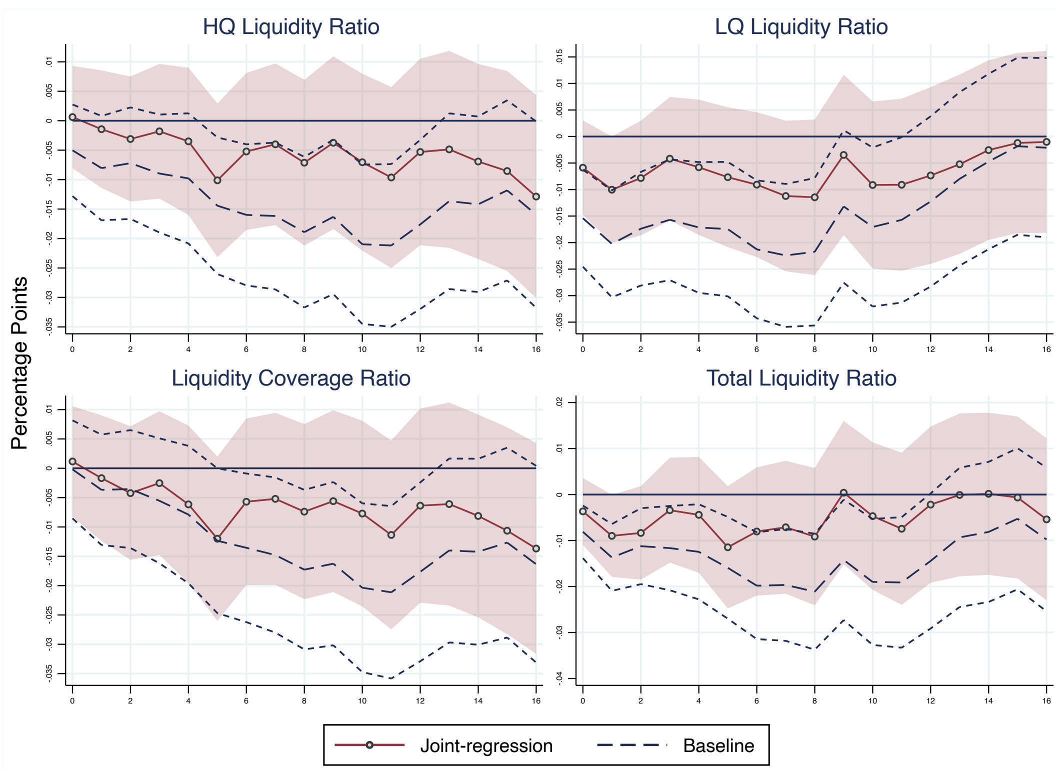
Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

E.3.3 Excluding HQ-liquid Assets from the liquidity creation measure

This alternative measurement does not penalize banks for investing part of their liabilities in HQ-liquid assets at the reference period $t-1$. As a result, the measured amount of liquidity creation is higher for all banks, and this increase is greatest for banks that hold more HQ-liquid assets. The results suggest that findings are robust to excluding HQLA from the reference period.

Alternatively, I reestimate equation (1) replacing the dependent variable by $\Delta_h \widetilde{LIQR}_{i,t+h} \equiv LIQR_{i,t+h} - \widetilde{LIQR}_{i,t-1}$ where $\widetilde{LIQR}_{i,t-1}$ excludes all liquid assets (high and low quality). Instead of affecting banks with significant HQ assets, this measurement will generally affect all banks.

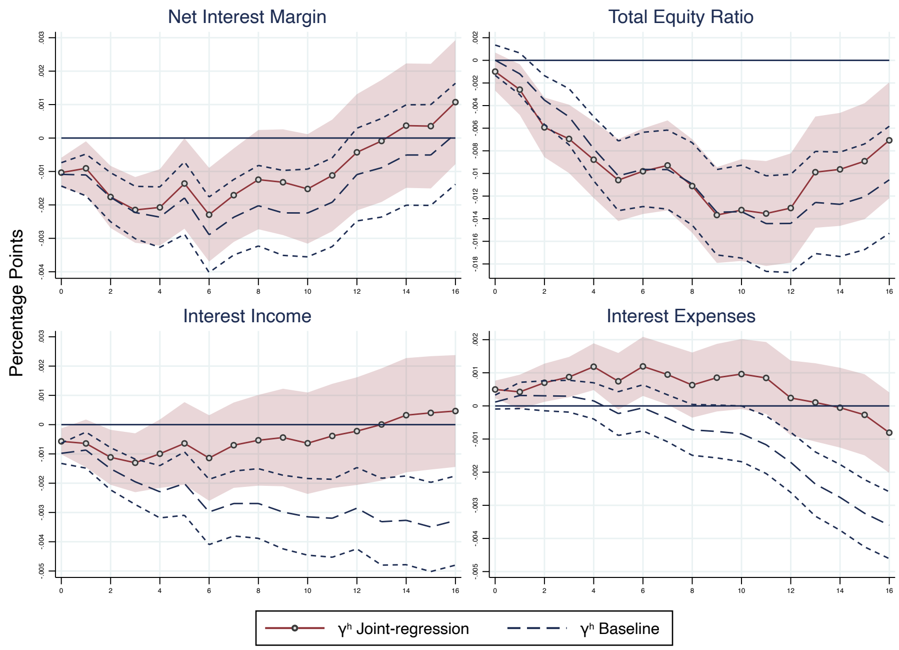
Figure 42: Removing Liquid Assets



Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

E.4 Profitability

Figure 43: Monetary Tightening Shock Conditional on Total Liquidity: Effect on Profit Margins (Baseline)

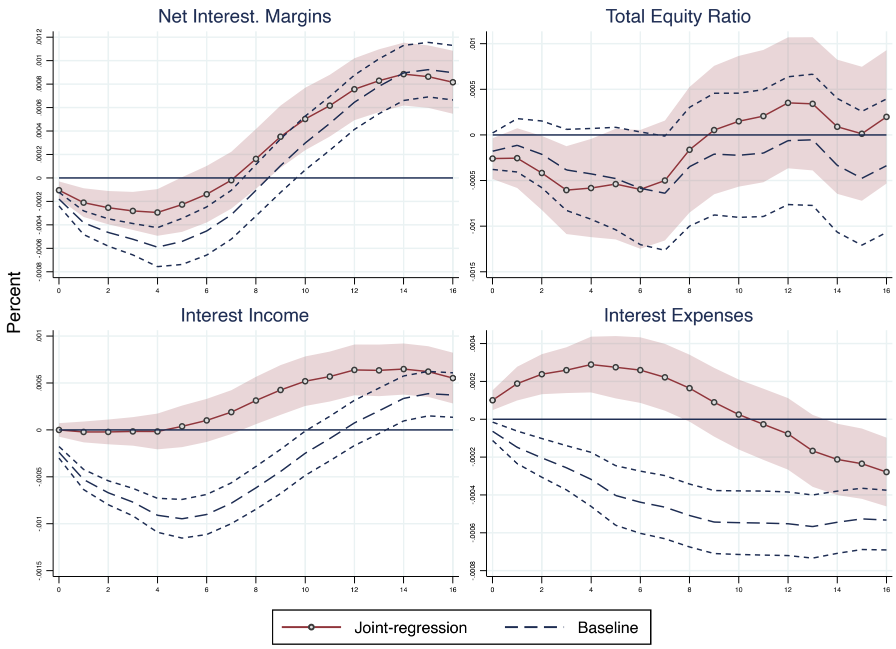


Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

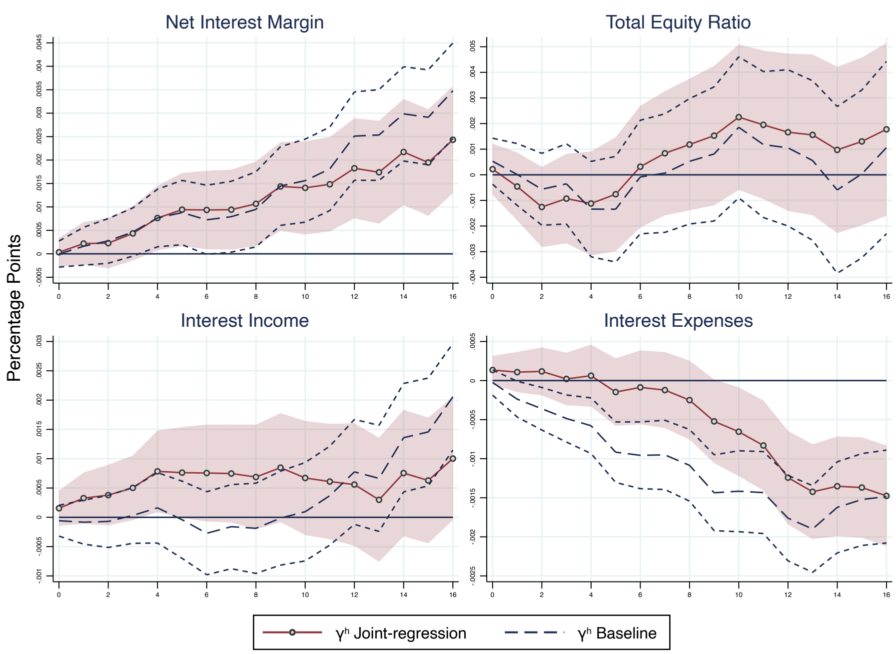
E.4.1 Alternative Monetary Shocks

Figure 44: Monetary Tightening Shock Conditional on HQ-Liquidity: Effects on Profit Margins (Baseline)

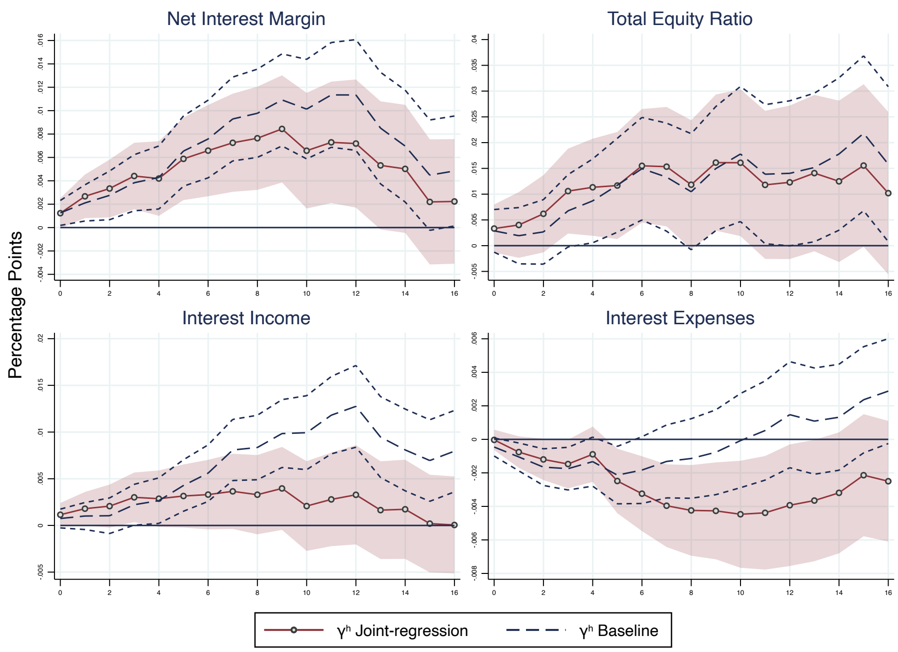
(a) Δ Fed Funds Rate



(b) Shocks from Bu, Rogers, and W. Wu (2021)



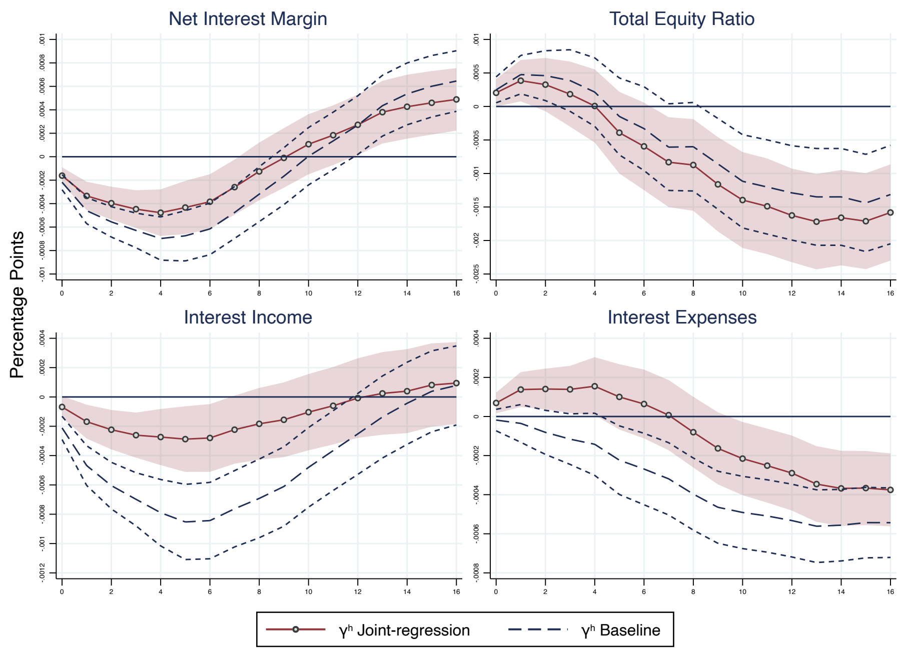
(c) Shocks from Acosta (2022)



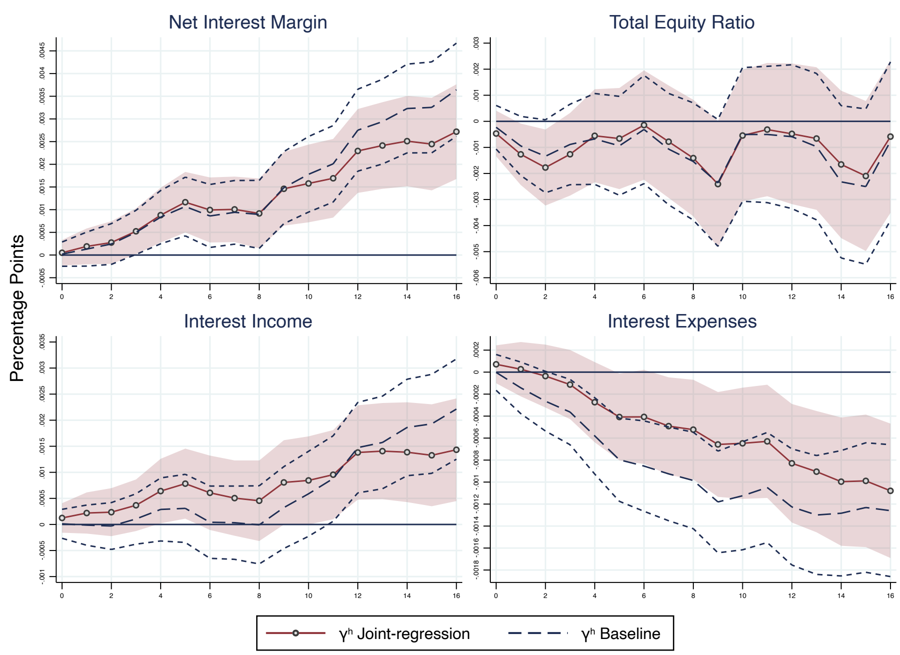
Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

Figure 45: Monetary Tightening Shock Conditional on LQ-Liquidity: Effects on Profit Margins (Baseline)

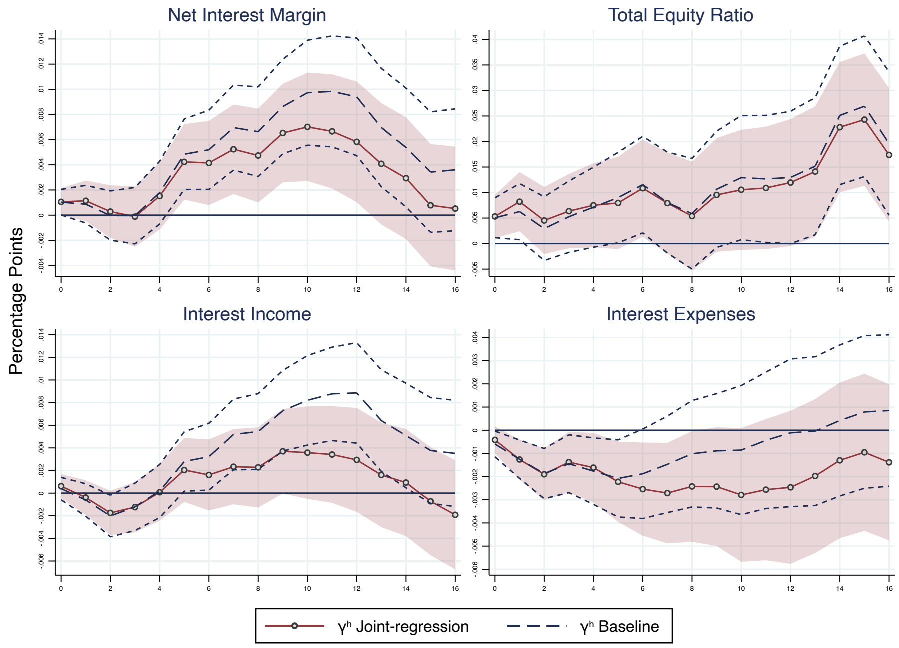
(a) Δ Fed Funds Rate



(b) Shocks from Bu, Rogers, and W. Wu (2021)



(c) Shocks from Acosta (2022)



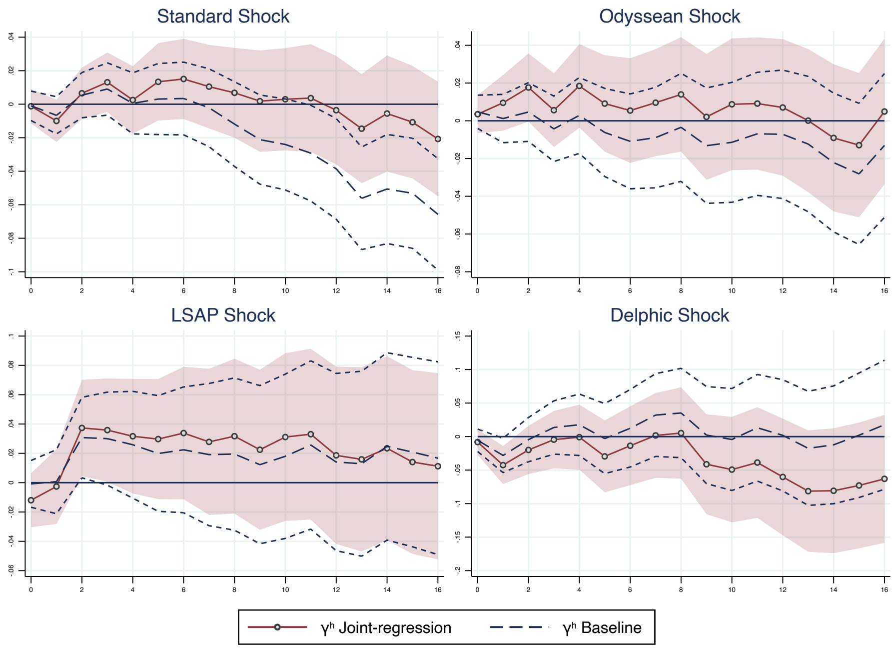
Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

F Unconventional Monetary Policy Shocks

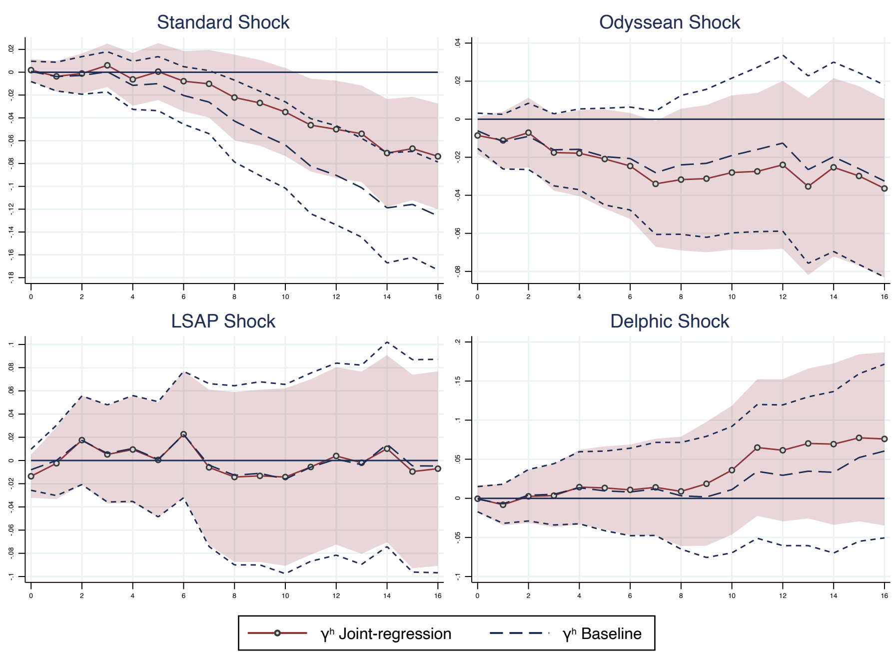
To disentangle the nature of monetary policy shocks, Jarociński (2021) exploits characteristics of the distribution of financial market reactions to FOMC announcements. Intuitively, there is a high chance that only a small subset of the structural shocks drives the significant market reaction to an FOMC announcement (fat-tailed shocks). By detecting the unique patterns of responses characterizing individual shocks, he can categorize shocks between conventional and unconventional shocks.

F.1 Results

Figure 46: Monetary Tightening Conditional on HQ-Liquidity: Effect on Total Deposit Growth (Baseline using Unconventional Shocks)



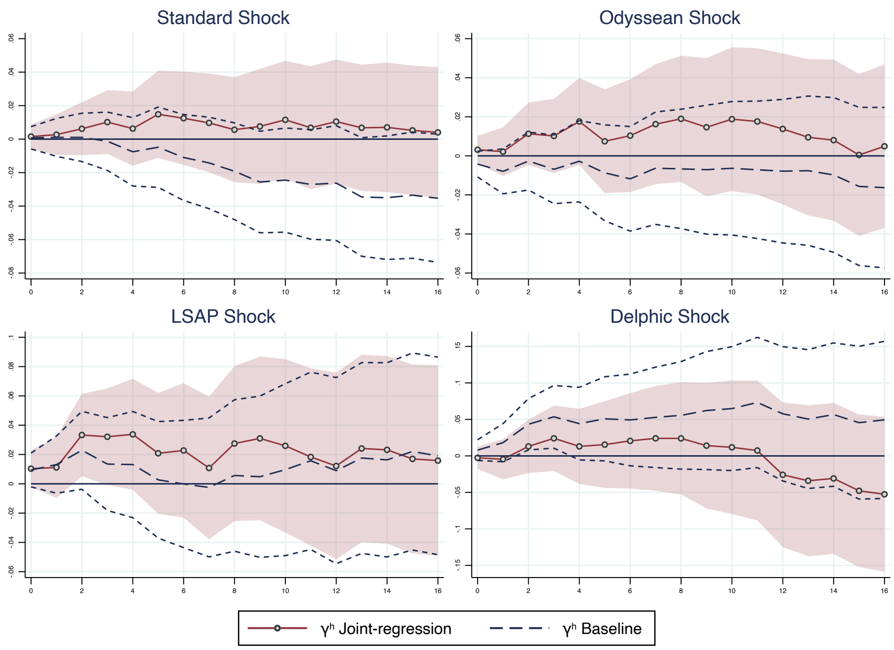
(a) Heterogenaity Induced by HQ liquidity



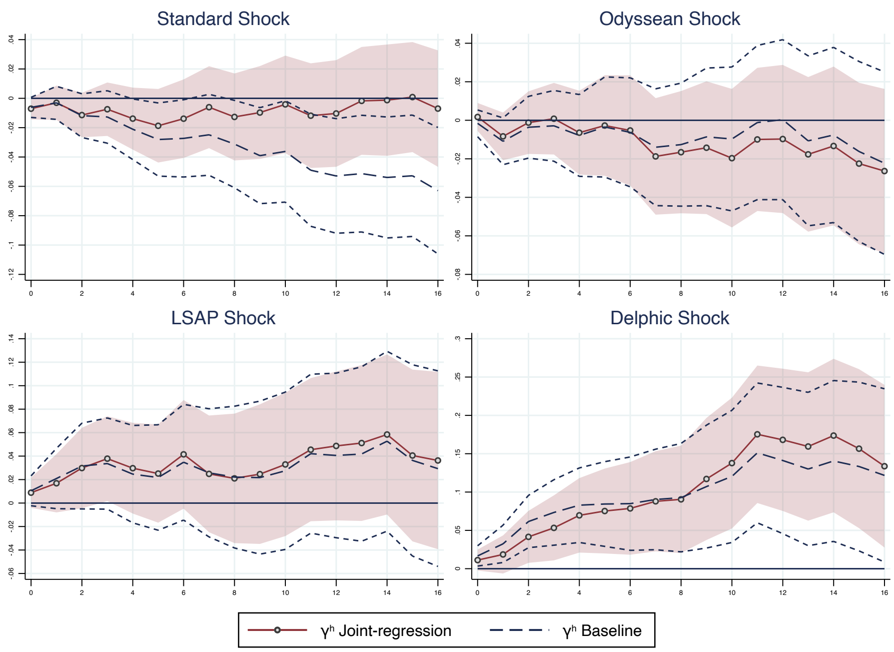
(b) Heterogenaity Induced by LQ liquidity

Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

Figure 47: Monetary Tightening Conditional on Liquidity: Effect on Total Loan Growth (Baseline using Unconventional Shocks)



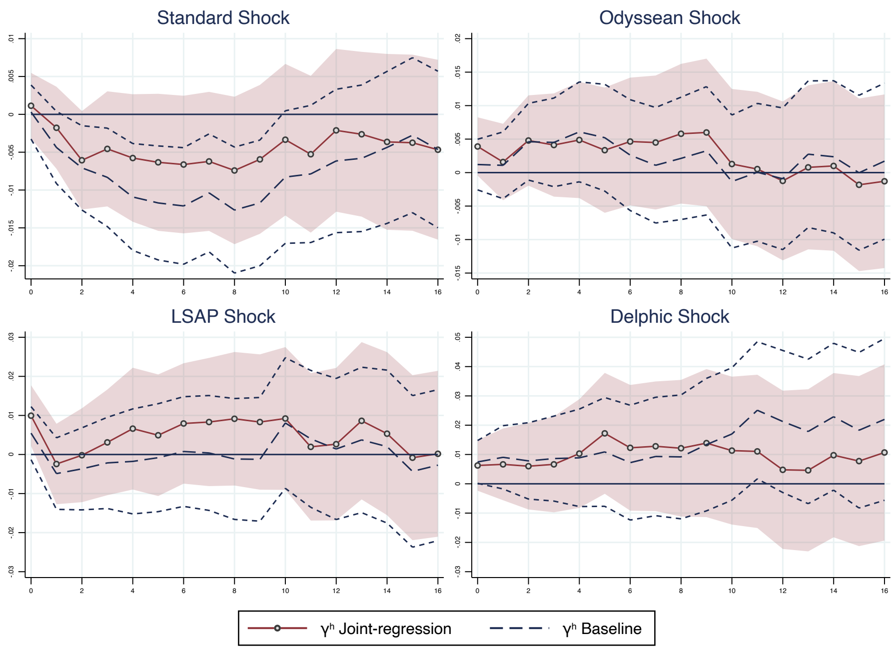
(a) Heterogenaity Induced by HQ liquidity



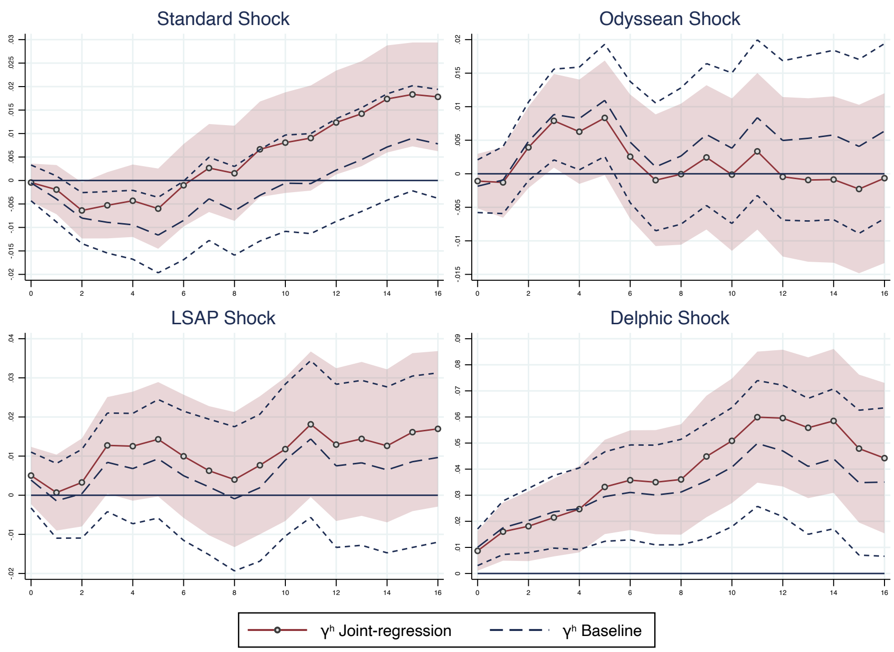
(b) Heterogenaity Induced by LQ liquidity

Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

Figure 48: Monetary Tightening Conditional on Liquidity: Effect on Liquidity Creation (Baseline using Unconventional Shocks)



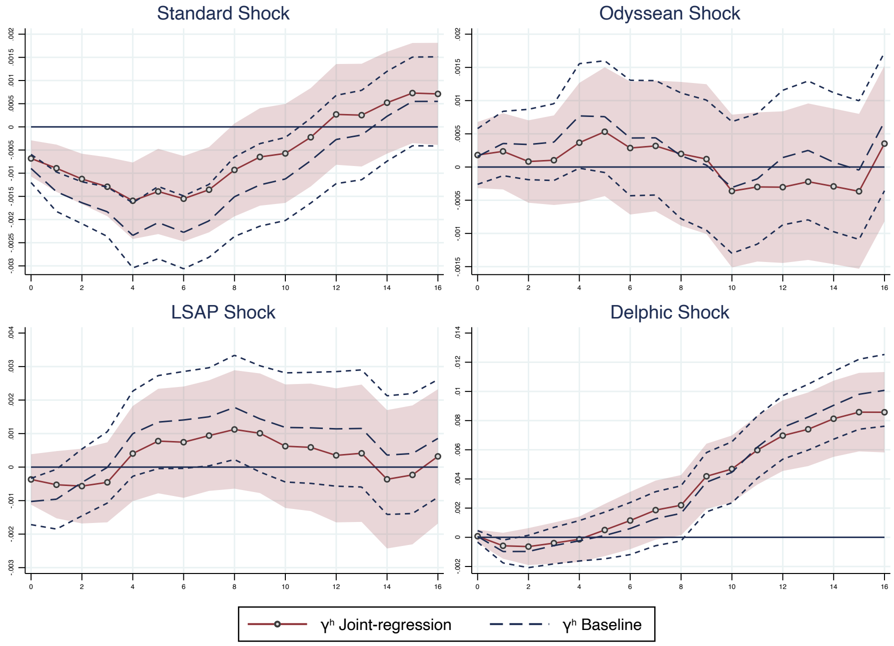
(a) Heterogenaity Induced by HQ liquidity



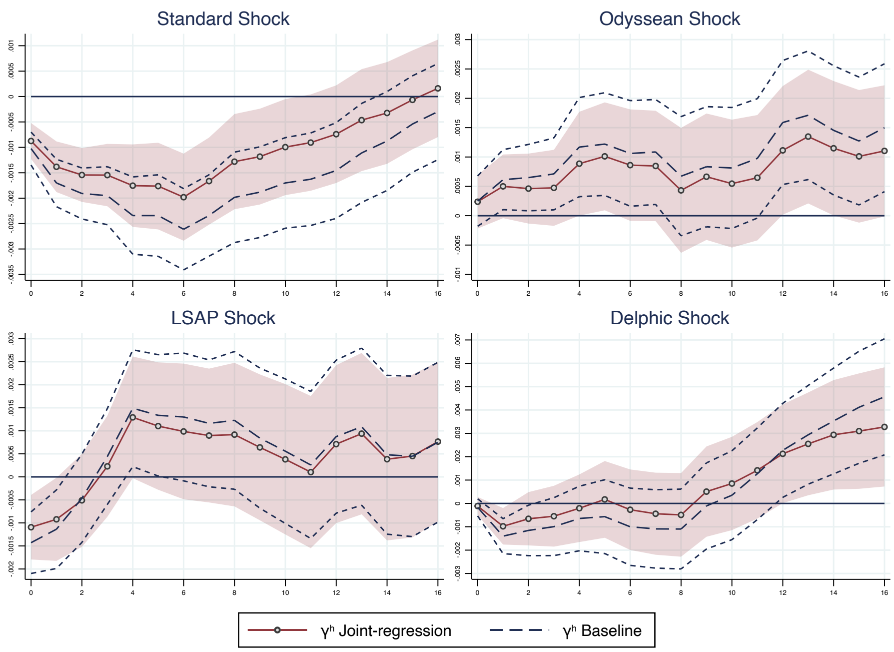
(b) Heterogenaity Induced by LQ liquidity

Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

Figure 49: Monetary Tightening Conditional on Liquidity: Effect on Interest Rate Margins (Baseline using Unconventional Shocks)



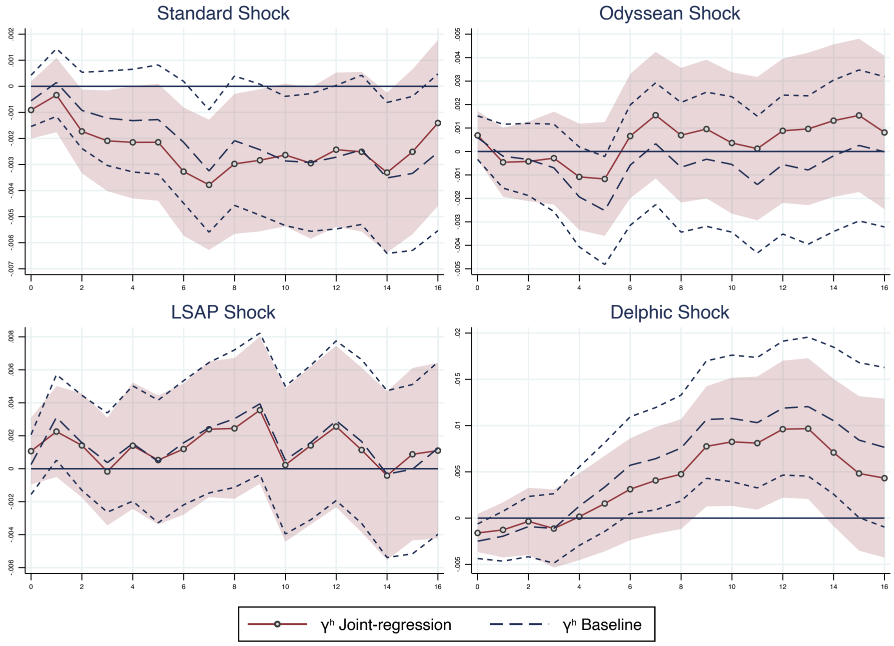
(a) Heterogenaity Induced by HQ liquidity



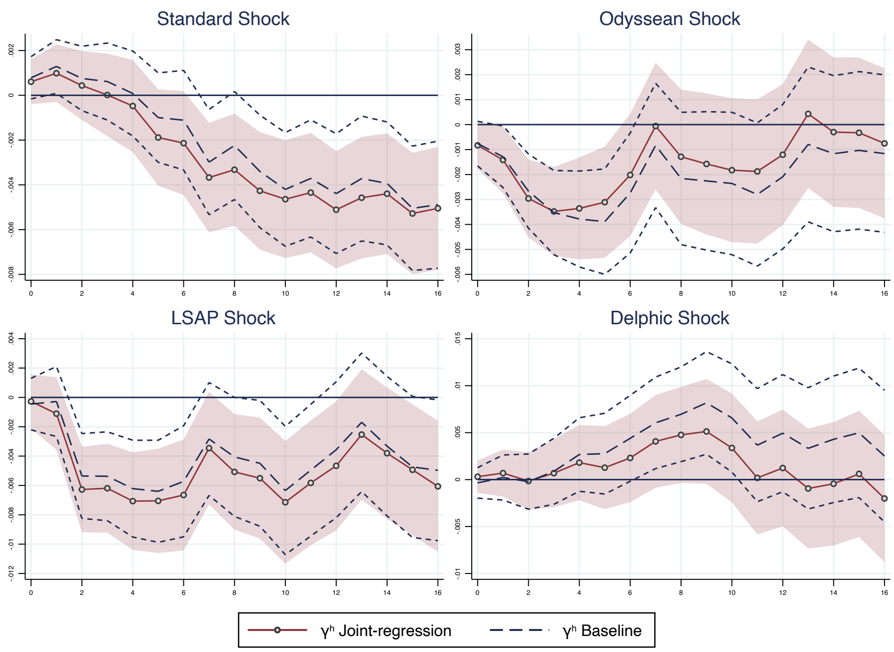
(b) Heterogenaity Induced by LQ liquidity

Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

Figure 50: Monetary Tightening Conditional on Liquidity: Effect on Total Equity Ratio (Baseline using Unconventional Shocks)



(a) Heterogenaity Induced by HQ liquidity



(b) Heterogenaity Induced by LQ liquidity

Notes: The graph displays the results for γ^h obtained from specification (1). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

G Robustness Exercises: Investigating Permanent Heterogeneity in Monetary Policy Transmission and Addressing Endogeneity Concerns

G.1 Controlling for Within Bank Liquidity Variation

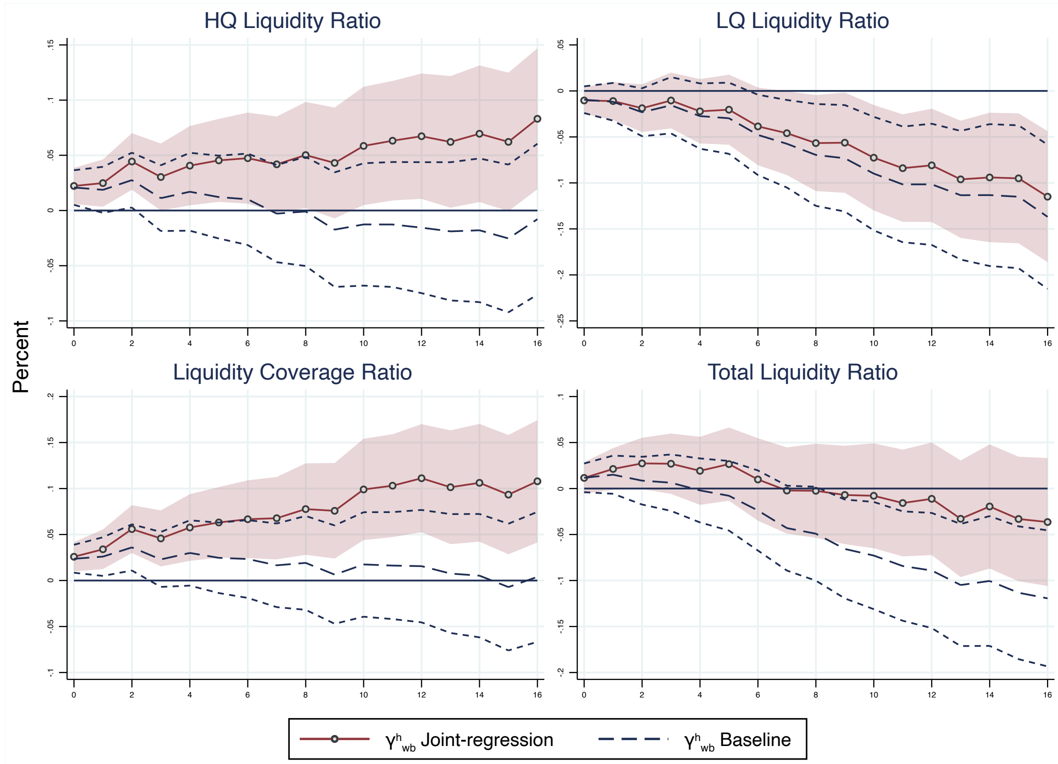
G.1.1 Effect on Deposit Flows

Figure 51 displays the estimates of γ^h_{wb} in specification (4), where the dependent variable is the logarithmic change in total deposits. Once considering the impact of persistent heterogeneity in liquidity ratios, the exercise highlights the following results.

First, when examining the joint-regression estimates, those banks having more than usual HQ liquidity ratios before the monetary shock[85] exhibit more significant deposit growth rates. This observation aligns with the findings presented in Figure 4, which demonstrate how HQ liquidity aids banks in stabilizing their deposits during periods of monetary tightening. The primary difference lies in the fact that when I account for the removal of permanent heterogeneity in HQ liquidity, the magnitudes of these effects are amplified, and their impact appears to be more enduring over time.

[85] Banks positioned one standard deviation above the mean of the distribution of within-bank changes in HQ liquidity ratios

Figure 51: Monetary Tightening Shock Conditional on Liquidity: Effect on Total Domestic Deposit Flows (Within Variation)



Notes: The graph displays the results for γ^h_{wb} obtained from specification (4). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

Second, the dynamics concerning heterogeneity induced by differences in LQ liquidity mirror almost exactly the ones in Figure 4, paper 2. That is, LQ liquidity destabilizes more deposit flows in response to monetary shocks. Once again, removing permanent differences in LQ liquidity ratios increases the absolute value of the parameters. Finally, looking at the dynamics induced by total liquidity, the positive stabilization effect of HQ liquidity seems to dominate the negative effect of LQ liquidity.

Overall, the results closely align with those discussed in Section 5. However, one notable difference is that when we control for a source of permanent heterogeneity in monetary policy, the coefficients' magnitudes increase and the stabilizing influence of HQ liquidity becomes more pronounced.

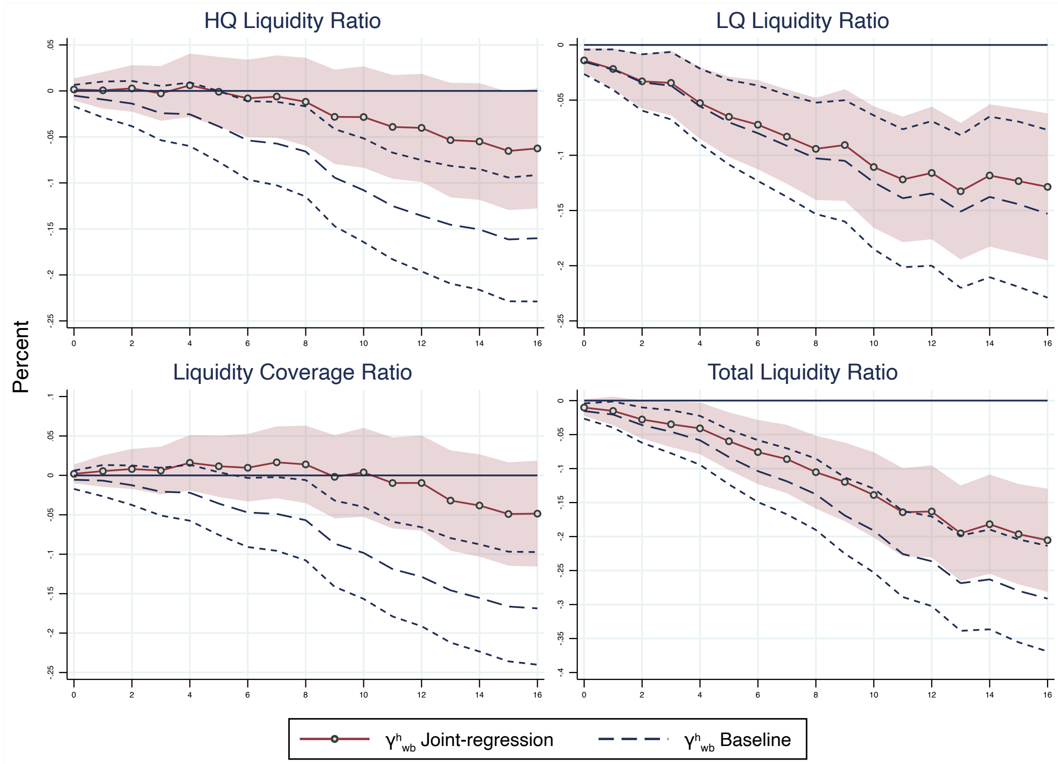
G.1.2 Effect on Loans Growth

Figure 52 displays the estimates of γ^{h}_{wb} in specification (4), where the dependent variable is the logarithmic change in total loans. The exercise highlights the following equilibrium conditions.

First, when examining the joint-regression estimates, those banks having more than usual HQ liquidity ratios before the monetary shock do not exhibit significant differences regarding loan growth rates. Like evidence presented in Figure 7, HQ liquidity does not amplify the decrease in loans as suggested by the baseline point estimates. Once controlling for income and duration gaps, HQ liquidity does not seem to have differential effects during monetary cycles.

Second, banks having more than usual LQ liquidity ratios before the monetary shock experience significantly lower loan growth rates, mirroring almost exactly the results in Figure 7. Coefficients fall around the same magnitudes, implying that four years after a monetary shock that induces a 1bp increase in the Fed fund future rate, banks with higher LQ ratios experience weaker loan growth of around -0.15%.

Figure 52: Monetary Tightening Shock Conditional on Liquidity: Effect on Total Loans Growth (Within Variation)



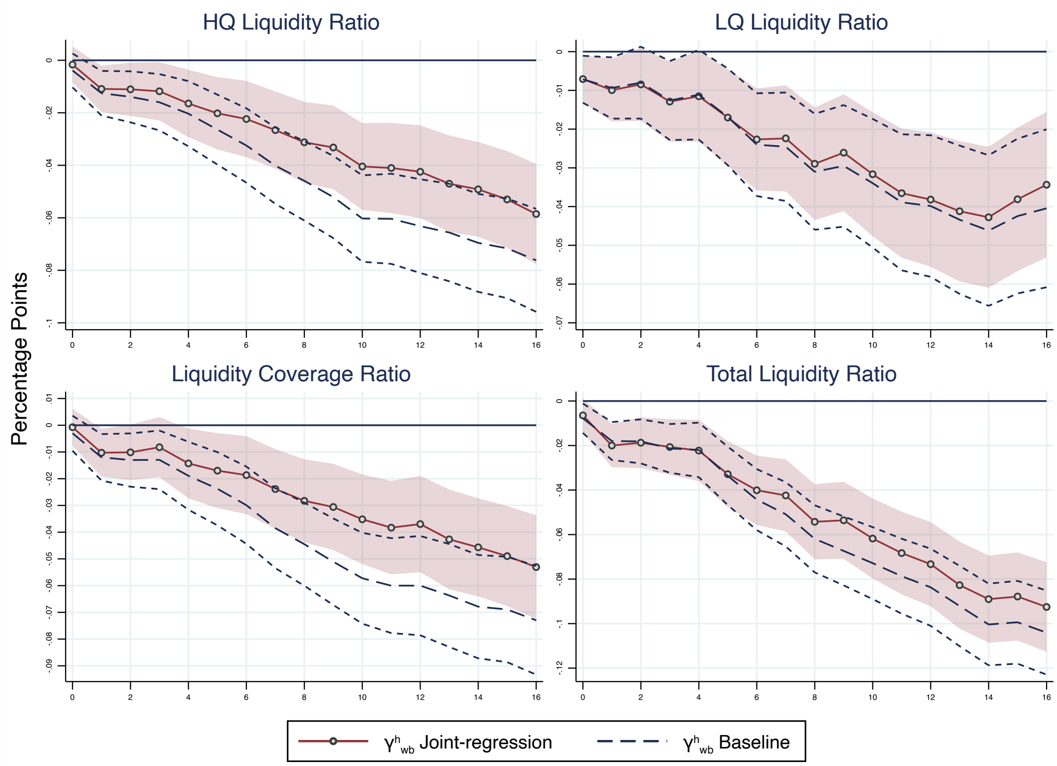
Notes: The graph displays the results for γ^h_{wb} obtained from specification (4). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

Overall, these dynamics follow relatively close to the ones in 6, paper 2. Remarkably, the heterogeneity identified here is more precisely estimated (narrower confidence intervals), indicating that permanent heterogeneity in responsiveness is quantitatively relevant in the sample.

G.1.3 Effect on Liquidity Creation

Figure 53 displays the estimates of γ^h_{wb} in specification (4). The findings are in line with the results presented in Figure 9, which showed that a bank with a liquidity ratio one standard deviation above its average creates less liquidity following a monetary tightening shock. What's particularly noteworthy is that the differences in the effects are more pronounced, persist over longer time horizons, and are statistically significant. This pattern holds for all four liquidity measures, suggesting that having higher ex-ante liquidity does not necessarily grant banks a greater ability to generate liquidity during periods of monetary tightening.

Figure 53: Monetary Tightening Shock Conditional on Liquidity: Effect on Liquidity Creation (Within Variation)



Notes: The graph displays the results for γ^h_{wb} obtained from specification (4). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

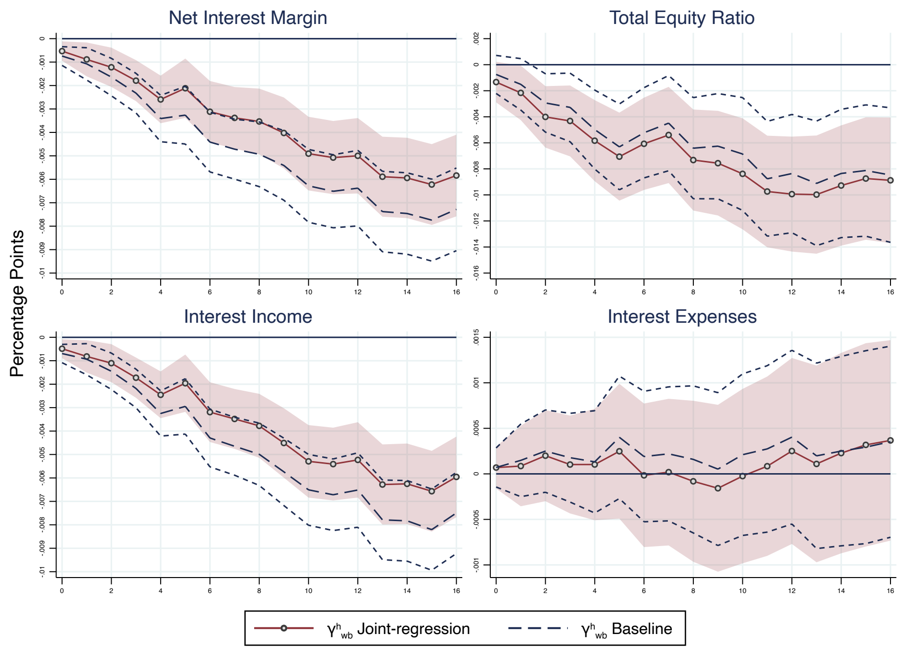
G.1.4 Effect on Profit Margins

Figure 54 displays the estimates of γ^h_{wb} in specification (4), focusing on HQ liquidity (Panel a) and LQ liquidity (Panel b). The exercise highlights significant differences compared to the results in Section 8, paper 2.

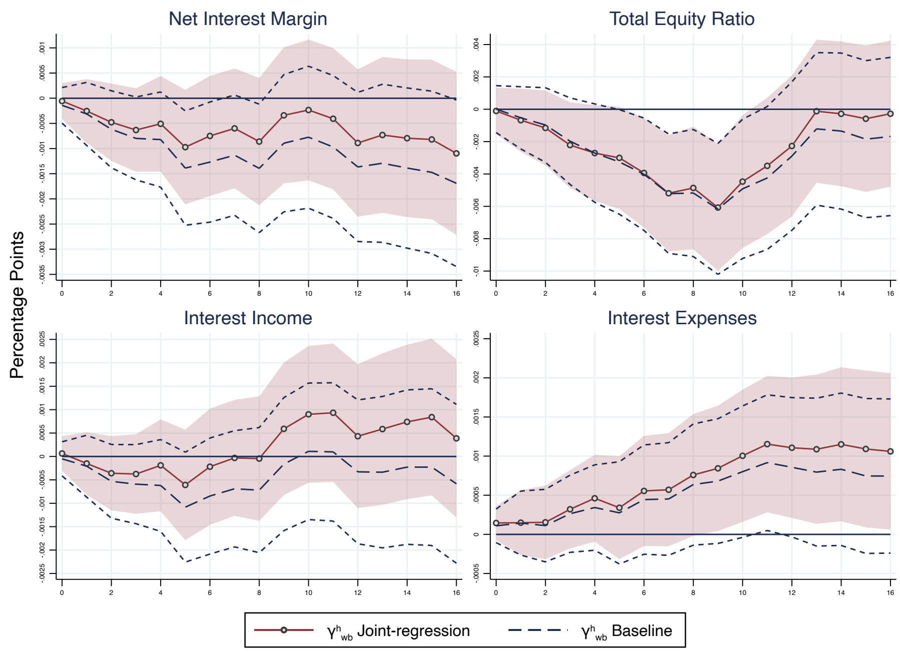
First, it remains true that higher liquidity ratios are associated with lower net interest income in response to a monetary tightening shock. However, this result persists over an even longer horizon and is statistically significantly different from zero.

Focusing on the point estimates from the joint regression, net interest margins of banks standing one standard deviation above the HQ-liquidity distribution are about 0.006 percentage points lower in response to the monetary shock. These differences are primarily explained by the dynamics of policy-induced variations in interest rate income. In contrast, heterogeneity in interest expenses is not observed. Furthermore, the book value of banks' capital as a percentage of total assets drops by about 0.01 percentage points in response to the same monetary shock. Overall, after eliminating permanent heterogeneity in the transmission channel, the adverse impact of HQ liquidity on profit margins and equity appears to be larger and persists for a longer duration.

Figure 54: Monetary Tightening Conditional on Liquidity: Effect on Profit Margins (Within Variation)



(a) Heterogenaity Induced by HQ Liquidity



(b) Heterogenaity Induced by LQ Liquidity

Notes: The graph displays the results for γ_{wb}^{h} obtained from specification (4). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

G.2 Controlling for Permanent Adjustments in Liquidity Ratios

G.2.1 Results

Figures 55 to 58 summarize the γ^h_{SLP} estimates from the OLS estimation of (6). For brevity, I only present the estimation results for the log change in total deposits and loans, the change in liquidity creation ratios, the change in profit margins, and the change in equity ratios, respectively. The estimated dynamics do not fully match those observed in previous papers[86]; however, the main conclusions remain virtually unchanged compared to the OLS regression in paper 2.

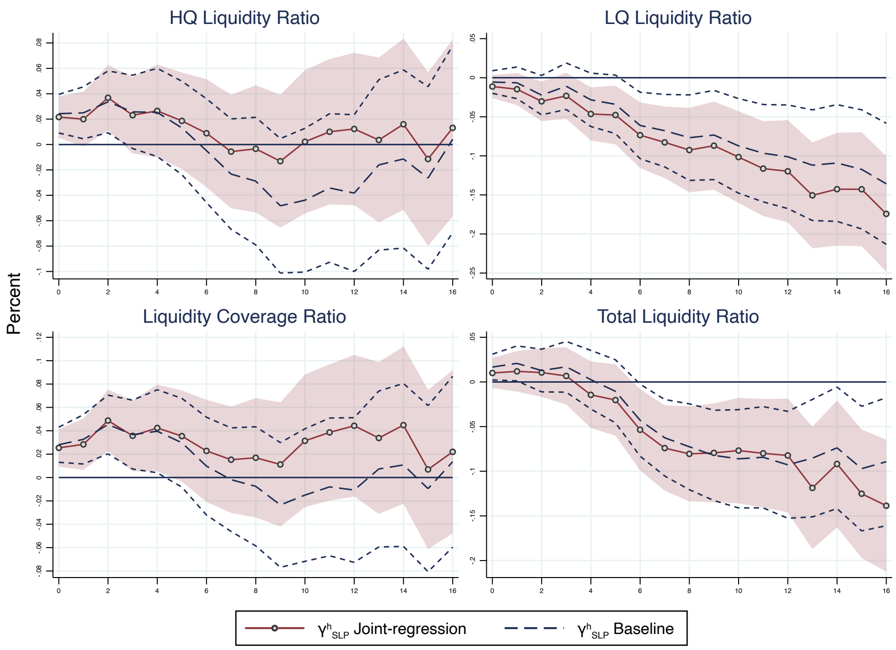
First, HQ liquidity stabilizes deposit flows at short-term horizons, between 0 and 6 quarters. While in the middle- and long-term horizons, LQ liquidity negatively and permanently affects deposit growth (fig. 55). Overall, it is still the case that high liquid asset holdings are associated with lower deposit growth after a contractionary monetary policy shock.

Secondly, banks with larger liquidity ratios –of any type– tend to experience lower loan growth during monetary tightening cycles (fig. 56). This finding aligns with the predictions made in Bluedorn, Bowdler, and Koch (2017). However, when considering joint-regression estimates, liquidity appears to have no differential effect on loan growth. In other words, factors such as income and duration gaps, which capture banks' exposure to interest rate risk, seem to absorb the negative impact of liquidity. This observation is consistent with the evidence in Kashyap, Rajan, and Stein (2002). Similar results if looking at a bank's capacity to create liquidity (fig. 57). From the joint-regression point estimates, liquidity seems to play no role in the transmission channel.

Finally, larger HQ- and LQ liquidity ratios harm banks' profitability (fig. 58). Remarkably, banks with higher HQ liquidity ratios permanently experience lower net interest rate margins.

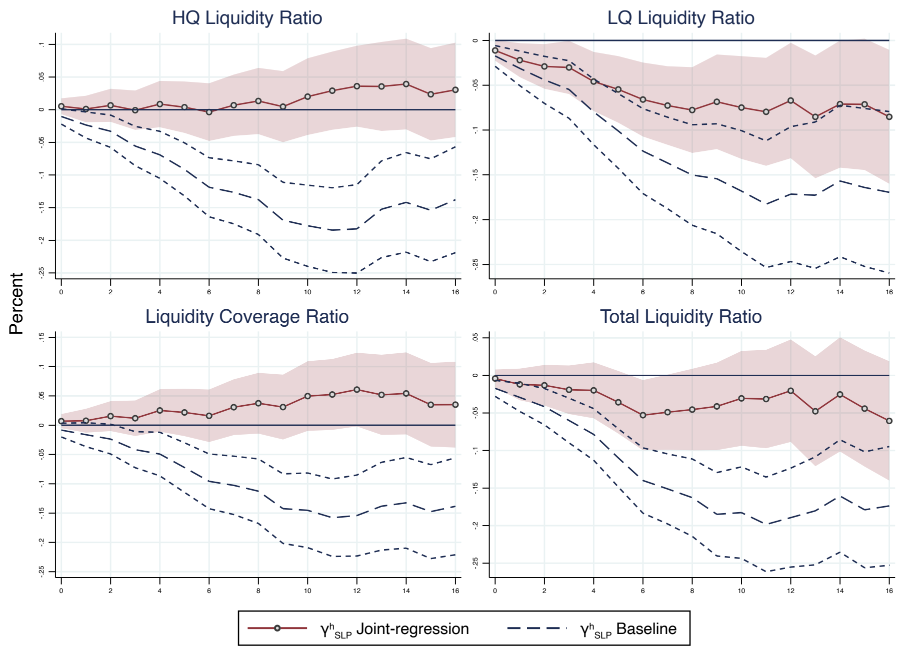
[86]The magnitudes of the coefficients remain within the range estimated in paper 2, while confidence intervals are wider in the joint-regressions.

Figure 55: Monetary Tightening Shock Conditional on Liquidity: Effect on Total Domestic Deposit Flows (State-dependent LP)



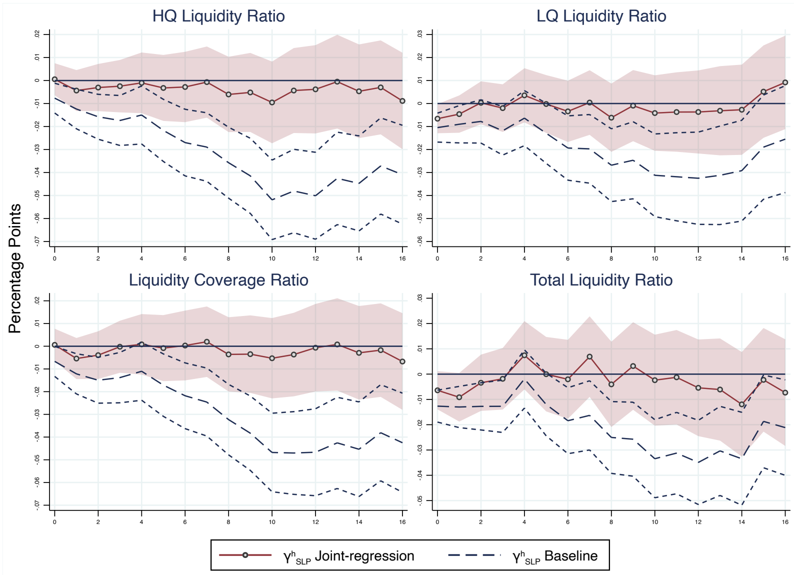
Notes: The graph displays the results for γ^h_{SLP} obtained from specification (6). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

Figure 56: Monetary Tightening Shock Conditional on Liquidity: Effect on Total Loans Growth (State-dependent LP)



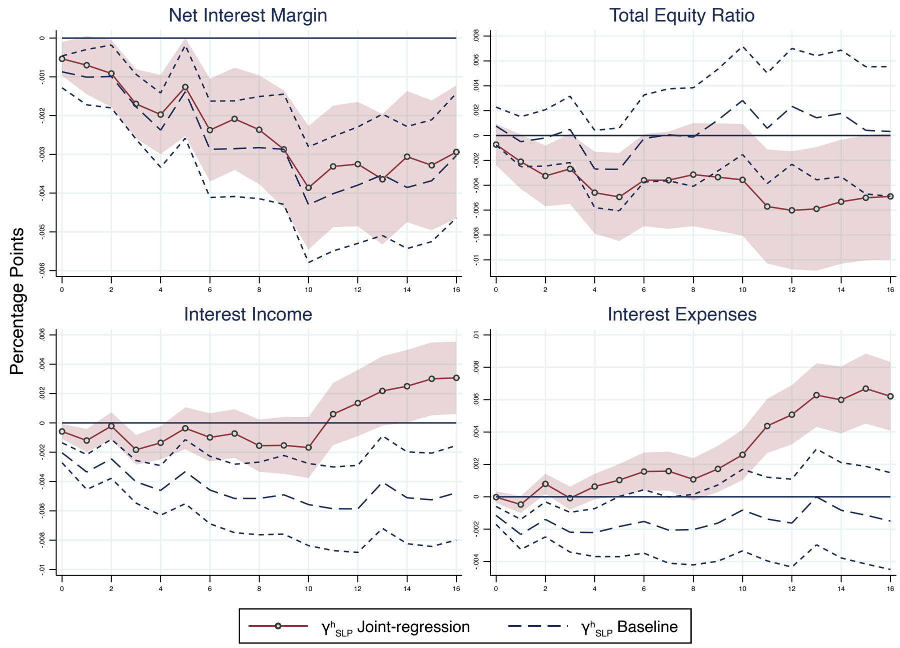
Notes: The graph displays the results for γ^h_{SLP} obtained from specification (6). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

Figure 57: Monetary Tightening Shock Conditional on Liquidity: Effect on Liquidity Creation (State-dependent LP)

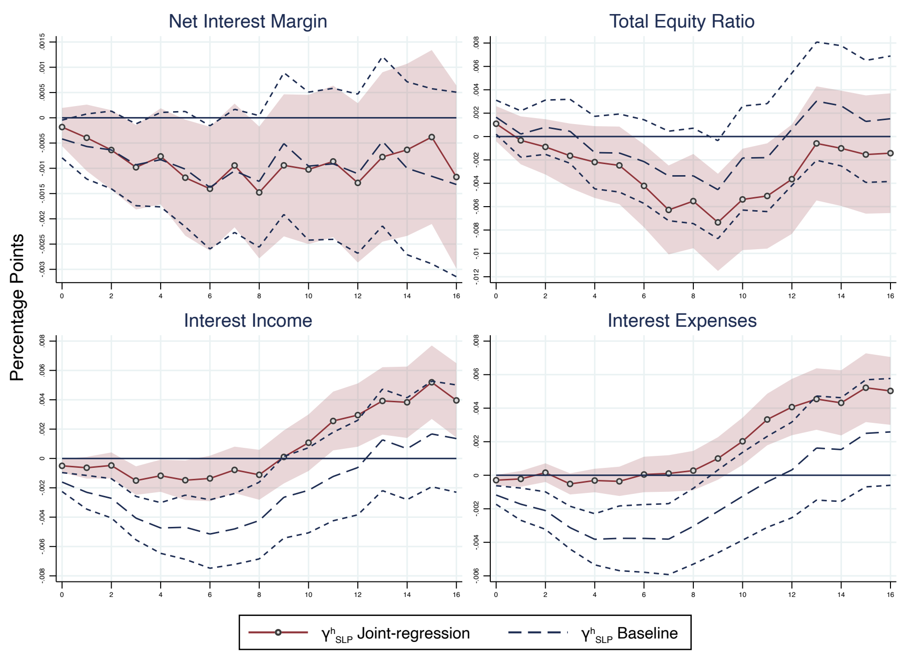


Notes: The graph displays the results for γ^h_{SLP} obtained from specification (6). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

Figure 58: Monetary Tightening Shock Conditional on Liquidity: (State-dependent LP)



(a) HQ Liquidity Portfolio

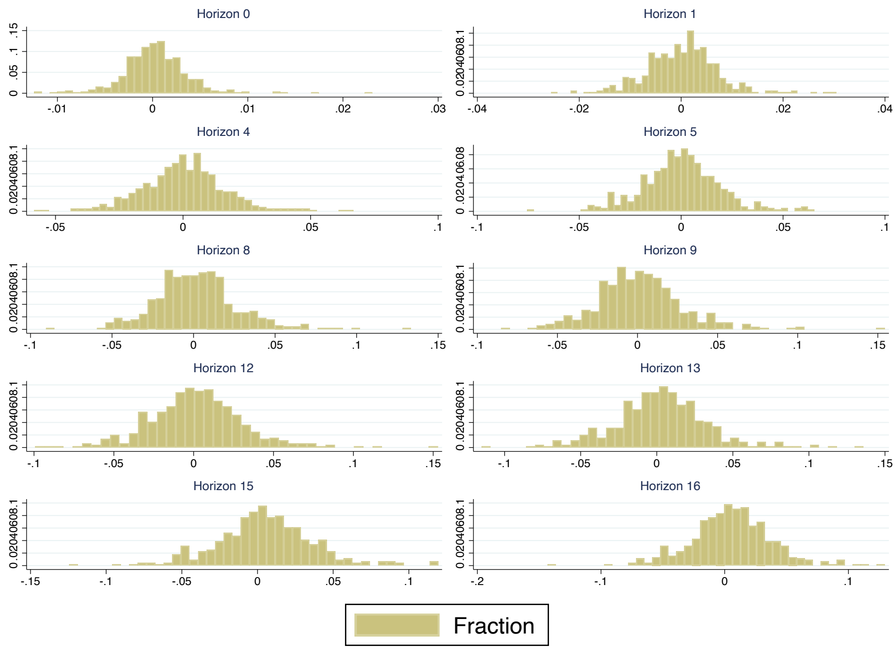


(b) LQ Liquidity Portfolio

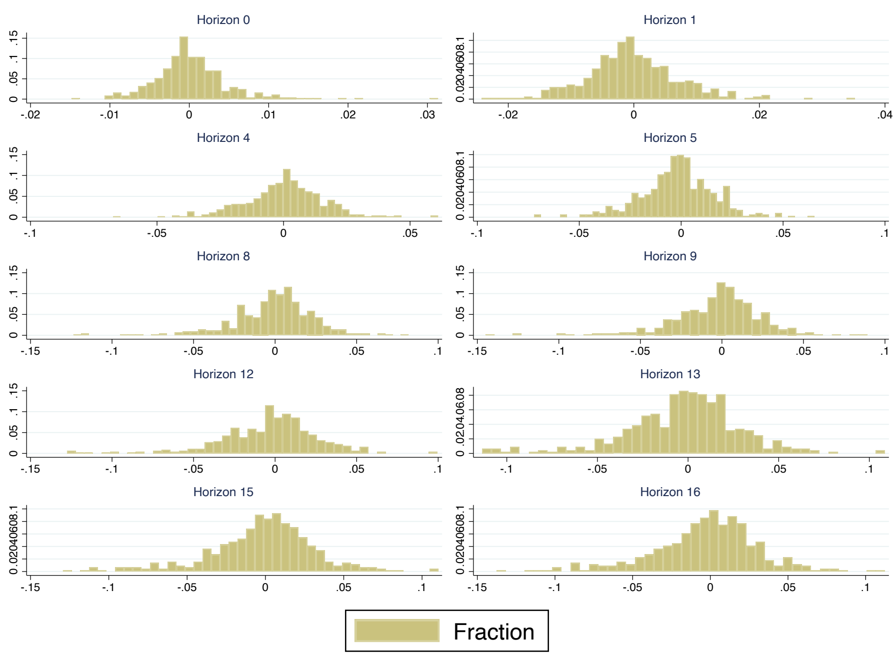
Notes: The graph displays the results for γ^h_{SLP} obtained from specification (6). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

G.2.2 Descriptive Statistics Stage I

Figure 59: Heterogeneity in the Response of Liquidity Ratios to Monetary Shocks



(a) HQ Liquidity Portfolio

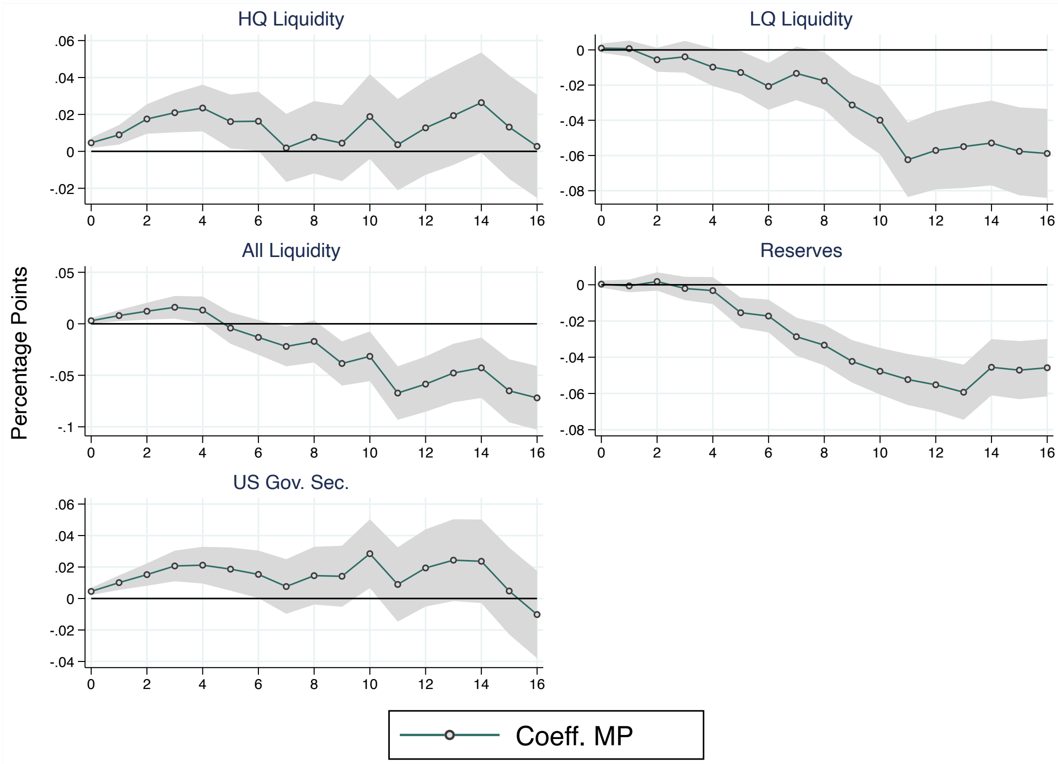


(b) LQ Liquidity Portfolio

Notes: The graph shows the distribution of the coefficient Θ_i^h from specification (5) for horizons $h = \{0, 1, 4, 5, 8, 9, 12, 13, 15, 16\}$. This coefficient proxies the average response of liquidity ratios to monetary shocks for different horizons. The monetary shock is the baseline series from Jarociński and Karadi (2020).

$$\Delta_h LR^j_{i,t+h} = f^h_i + \theta^h mp_t + \Gamma^h mp_t \widetilde{X}_{i,t-1} + \Psi^h B_{i,t-1} + \varphi^h A_{t-1} + \epsilon^h_{i,t+h} \tag{14}$$

Figure 60: Unconditional Effect of Monetary Tightening Shocks into Liquidity Ratios



Notes: The graph shows estimated coefficients θ^h from specification (14). It represents the average response of the sample to monetary tightening shocks.

G.3 Consequences of Endogeneity - Reverse Causality

G.3.1 Results

Figures 61 to 65 summarize the γ_{iv}^{h} estimates from the 2SLS estimation of (8). For brevity, I only present the estimation results for the log change in total deposits and loans, the change in liquidity creation ratios, the change in net interest rate margins, and the change in equity ratios, respectively[87].

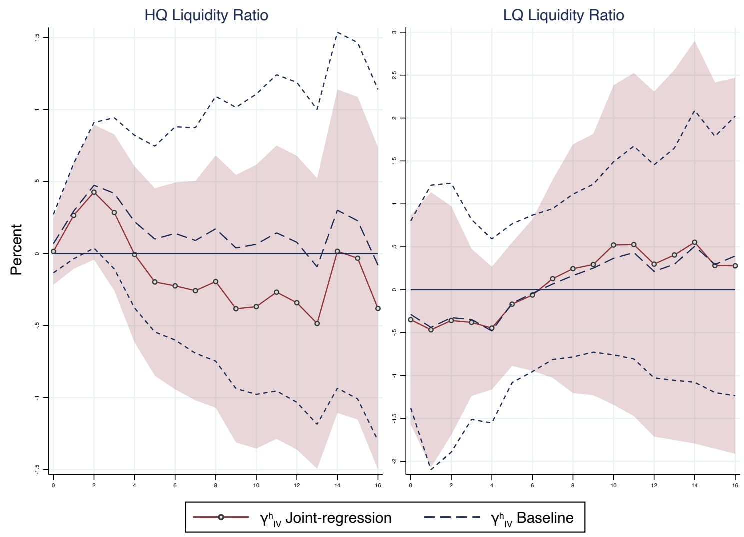
Regarding HQ liquidity, the IV estimates largely align with the previous findings. When examining the short-term effects (between 0 and 8 quarters after the shock), the conclusions are similar to those obtained in the OLS regression. Higher HQ liquidity ratios continue to exhibit a stabilizing effect on deposit outflows and loan growth. However, they also correspond to lower profit margins, although this effect does not directly translate into equity. Interestingly, the impact on liquidity creation is opposite to the evidence presented in paper 2 and Section 10.1.1.

In contrast, the effects of LQ liquidity in the IV approach are more nuanced. Previous evidence in paper 2 suggested that LQ liquidity played a destabilizing role in the transmission mechanism. However, the IV results present a less clear-cut picture.

Two key takeaways emerge from this exercise. First, the magnitudes of the point estimates obtained in the IV approach fall within the ranges estimated in previous sections. However, it's important to note that the confidence intervals in the IV approach tend to be larger. This can be attributed to the low cross-sectional heterogeneity in the instruments, as seen in Figure 66. This observation indicates that the variations in liquidity ratios across banks are predominantly driven by the banks' endogenous, with exogenous responses playing a minor role. One potential interpretation of this finding is that the Bartik instruments might not be the most effective tools for instrumenting liquidity ratios.

[87]The implications of using the IV approach for other outcome variables-Y are available upon request.

Figure 61: Monetary Tightening Shock Conditional on Liquidity: Effect on Total Domestic Deposit Flows (Bartik-IV)



Notes: The graph displays the results for γ_{iv}^{h} obtained from specification (8). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

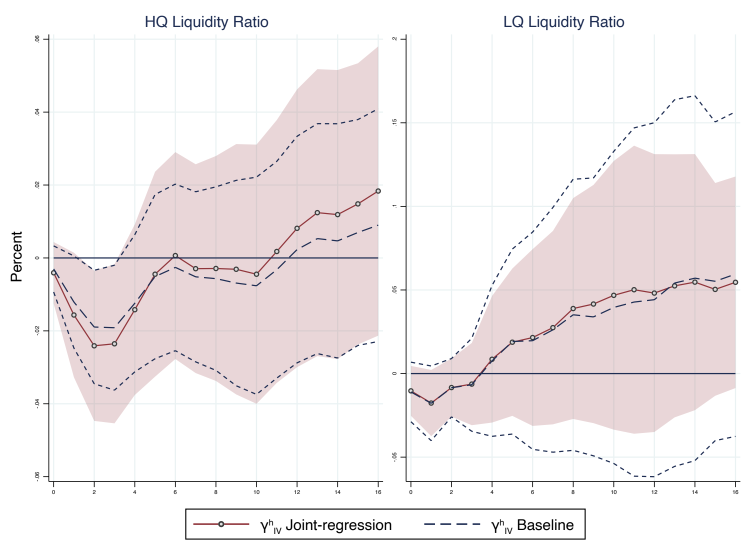
Figure 62: Monetary Tightening Shock Conditional on Liquidity: Effect on Total Loans Growth (Bartik-IV)

Notes: The graph displays the results for γ_{iv}^{h} obtained from specification (8). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

Figure 63: Monetary Tightening Shock Conditional on Liquidity: Effect on Liquidity Creation (Bartik-IV)

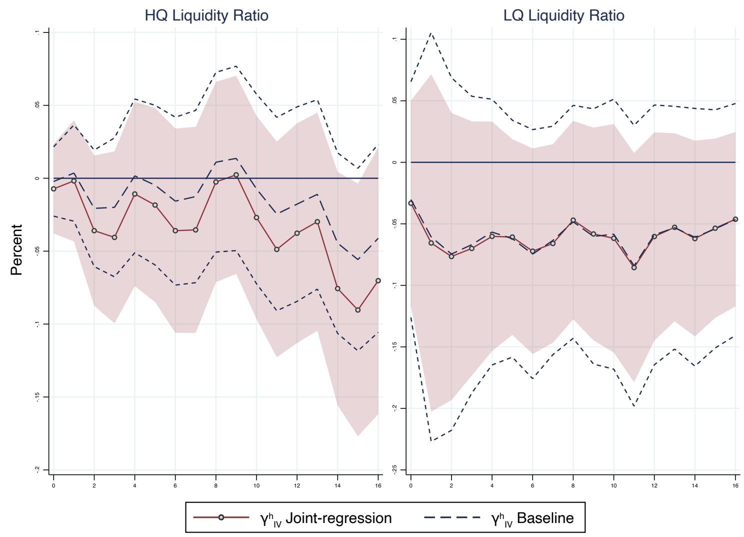
Notes: The graph displays the results for γ_{iv}^h obtained from specification (8). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

Figure 64: Monetary Tightening Shock Conditional on Liquidity: Effect on Net Interes Margins (Bartik-IV)



Notes: The graph displays the results for γ_{iv}^h obtained from specification (8). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

Figure 65: Monetary Tightening Shock Conditional on Liquidity: Effect on Equity Value (Bartik-IV)



Notes: The graph displays the results for γ_{iv}^{h} obtained from specification (8). The solid lines represent the joint-regression estimates, which incorporate control variables. Confidence intervals at 90% are constructed based on Newey-West robust standard errors to account for correlation within banks and within quarters.

G.3.2 Bartik's Instruments

This subsection provides the foundational understanding of the Bartik approach. The Bartik approach in this study is used to decompose the cross-sectional heterogeneity in liquidity ratios $LR_{i,t-1}$ (the treatment variation) between a (plausibly) exogenous component and an endogenous component. The objective is to build instruments that capture the cross-sectional heterogeneity of high- and low-quality liquidity ratios explained by exogenous factors.

To decompose the liquidity ratios, the method suggests focusing on the individual components of each liquidity category, named asset-$a \in LR^j$. These categories are summarized in paper 2 Appendix B.2. Based on these categories, the dollar value of each asset-a is disaggregated between a) a bank-specific portfolio share of asset-a and b) a bank-specific accumulation of asset-a. The decomposition begins with the following identity[88].

$$\frac{\Delta LR_{i,t}}{LR_{i,t-1}} \equiv \sum_{a \in LR} w_{i,t-1}^{a} \times \tilde{g}_{i,t}^{a} \tag{15}$$

[88]See Appendix G.1.

where $w^a_{i,t}$ is the bank-specific share of asset-a in the liquidity category (LR-portfolio), and $\tilde{g}^a_{i,t}$ is the rate of growth of a specific asset-a from $t-1$ to t, relative to the rate of growth in total assets (LR-trend). It is noteworthy that (15) is a decomposition for the changes in liquidity ratios.

Following Breuer (2021), identity (15) can be rewritten as follows

$$\frac{\Delta LR_{i,t}}{LR_{i,t-1}} = \sum_{a \in LR} w^a_i \tilde{g}^a_t + (w^a_{i,t-1} - w^a_i)\tilde{g}^a_t + (\tilde{g}^a_{i,t} - \tilde{g}^a_t)w^a_i + (w^a_{i,t-1} - w^a_i)(g^a_{i,t} - \tilde{g}^a_t) \tag{16}$$

In equation (16), the term $(w^a_{i,t-1} - w^a_i)$ accounts for the variations in the rate of growth of liquidity ratios across banks in quarter t resulting from the endogenous changes in a bank's portfolio shares. The term $(\tilde{g}^a_{i,t} - \tilde{g}^a_t)$ accounts for the variations in changes of liquidity ratios across banks in quarter t due to endogenous bank-specific trends. The remaining term $w^a_i \tilde{g}^a_t$ corresponds to Bartik's since it is the (more plausible) exogenous component explaining the heterogeneity of interest.

$$z^{BTK}_{i,t} \equiv \sum_{a \in LR} w^a_i \tilde{g}^a_t \tag{17}$$

The instrument is composed of two elements. w^a_i is the *predetermined* share of asset-a in banks' portfolio of LR-liquidity, which captures bank-specific portfolio composition (stationary allocation). While $\tilde{g}^a_t$ is the *aggregate change* of asset-a from $t-1$ to t relative to total assets, which captures asset-specific common trends in the banking system (aggregate shocks). The interaction of both terms ($z^{BTK}_{i,t}$) accounts for a fraction of the cross-sectional heterogeneity in the relative growth rate of liquidity in quarter t explained by exogenous factors. This is because, by construction, $z^{BTK}_{i,t}$ is orthogonal to banks' endogenous changes in the portfolio composition and endogenous changes in the rate of accumulation of assets.

Measurement Procedure I build one instrument $z^j_{i,t}$ for each of the liquidity categories of interest, where j corresponds to the liquidity categories: high- or low-quality. Since the procedure is the same for each liquidity category, I omit index j to simplify the notation. The computation of each component in $z_{i,t}$ goes as follows:

1. **Bank-specific predetermined portfolio composition (w^a_i):** Measured as the

share of liquid asset type-a in the liquidity portfolio-j for bank-i. Following the literature, the predetermined quarter corresponds to 2013q2 as the reference date since this date is a referent in other related works (e.g., Ihrig et al., 2017).

2. **Common time-varying component ($\tilde{g}^a_{i,t}$):** Measured as the aggregate rate gorwth of asset-a relative[89] to aggregate total assets by size group.

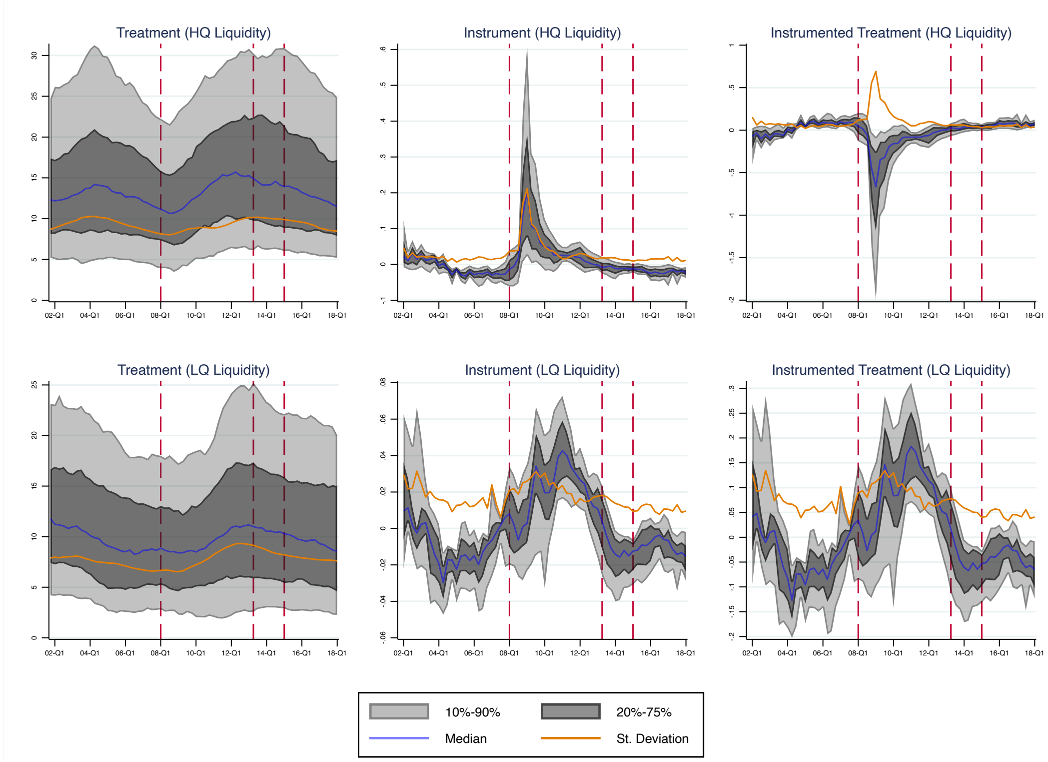
The instrument's characteristics and components are left in Section G.3.3.

G.3.3 Descriptive Statistics on the Bartik's Instruments

Heterogeneity in the Instruments Does the instrumented treatment still provide enough variation across banks? Figure 66 presents cross-sectional heterogeneity of the liquidity ratios (Column 1), their instruments (Column 2), and the instrumented treatment (Column 3). Heterogeneity in Bartik's instruments (Column 2) indicates that asset-specific aggregate shocks affect total liquidity ratios differently. Intuitively, a bank with a predetermined portfolio allocation responds differently to asset-specific aggregate shocks.

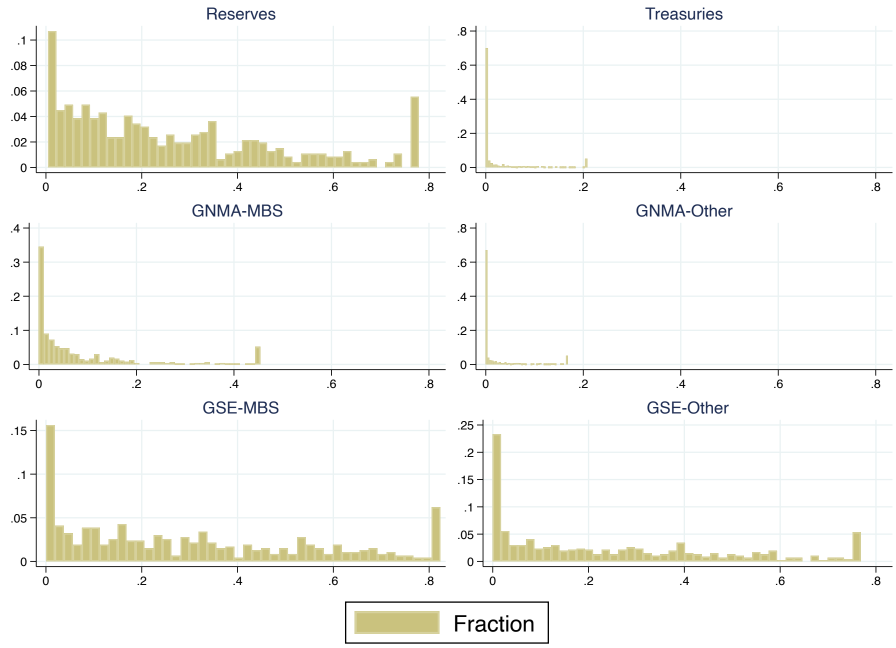
[89] See a related mathematical expression in equation (G.1).

Figure 66: Heterogeneity in Treatment, Instrument and Instrumented Treatment

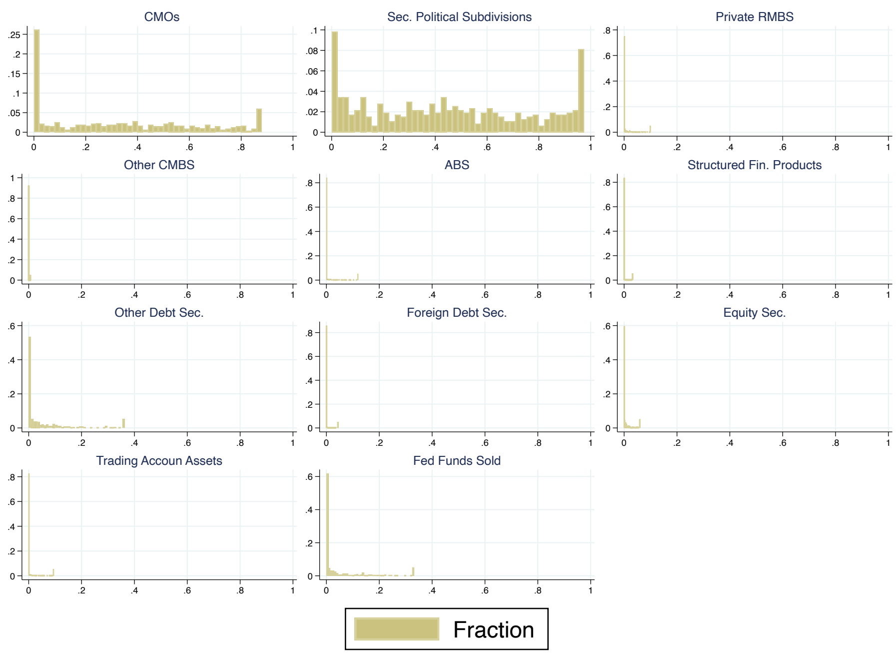


Notes: The graph shows the evolution of the 10, 25, 50, 75, and 90 percentiles and the standard deviation across No-LCR commercial banks for 2001q4-2018q1. Column 1 represents the liquidity ratios $LR^j_{i,t}$. Column 2 represents the Bartik instrument $z^j_{i,t}$ where the predetermined portfolio shares correspond to 2013q2. Column 3 is obtained regressing $LR^j_{i,t}$ on $z^j_{i,t}$ and bank- quarter-fixed effects. Vertical dashed lines indicate 2008q4, 2013q2, and 2015q1.

Figure 67: Cross Sectional Heterogeneity in Predetermined Shares of Assets in 2013q2



(a) HQ Liquid Assets



(b) HQ Liquid Assets

Notes: This figure depicts the predetermined shares of assets-a (w_i^a). The quarter of reference is 2013q2.

Relevance Condition In line with the standard instrumental variable approach, a necessary condition for the validity of the instrument is that $\mathbb{E}\left[LR_{i,t}^{j} \cdot z_{i,t}^{j}|f_i, f_t\right] \neq 0$ Following

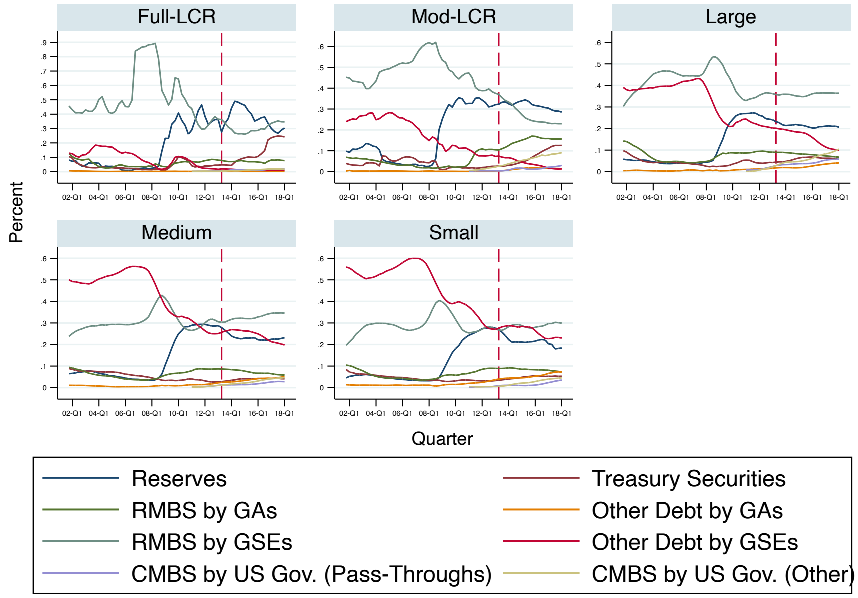
Breuer (2021), this condition essentially requires:

Degree of persistence in the pre-determined shares: Figure 68 depicts the evolution of the portfolio shares for each asset type[90].

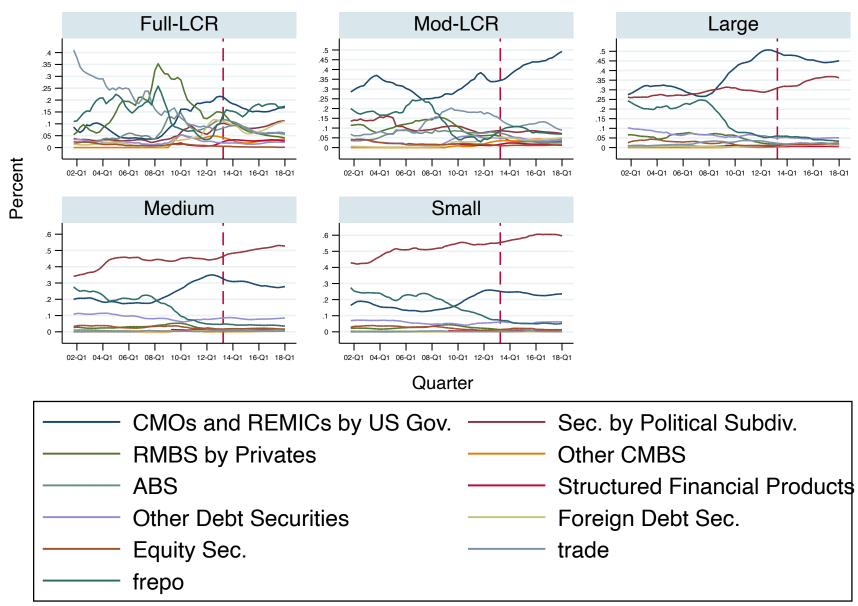
Commonality in the trend across units: Figure 69 depicts the cross-sectional heterogeneity in the growth rate of each asset-a (relative to the growth of total assets). Similarly, the common trend must predict the trend observed in individual units.

[90]In particular, the pre-determined shares must predict the actual shares during the sample period for the Bartik instrument to be relevant. Literature suggests not adjusting for limited persistence or commonality using the actual instead of the predetermined shares as the right-hand-side variation.

Figure 68: Time Series of the Liquidity Portfolio Shares by Bank Size



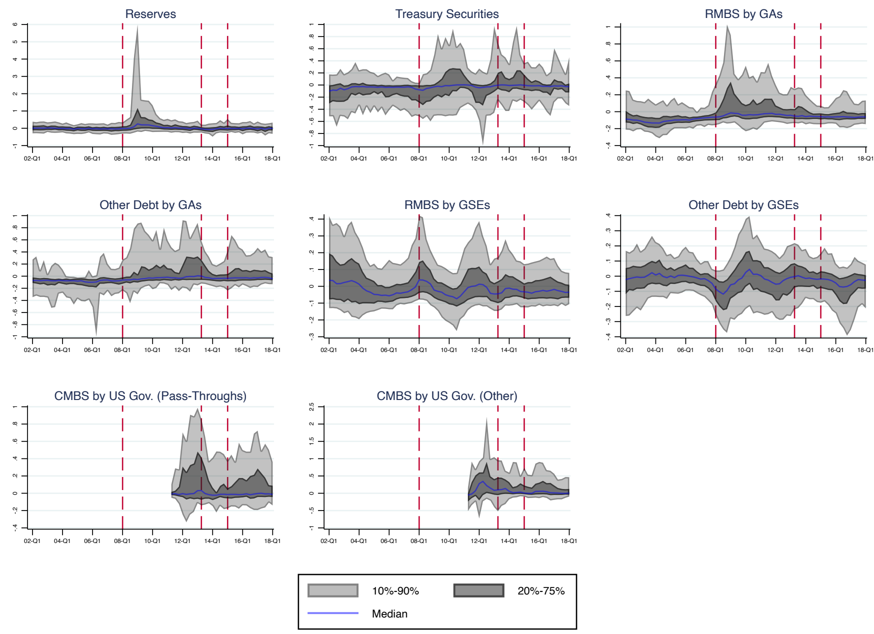
(a) HQ Liquidity Portfolio



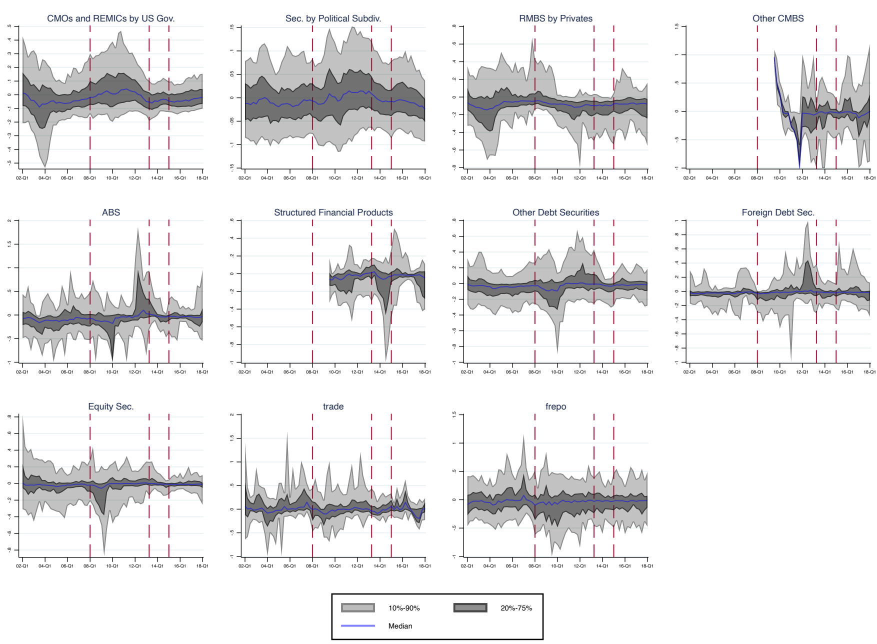
(b) LQ Liquidity Portfolio

Notes:

Figure 69: Cross-sectional Heterogeneity in Relative Growth Rates



(a) HQ Liquidity Portfolio



(b) LQ Liquidity Portfolio

Notes:

Bartik Decomposition for Liquidity Ratios

Proof G.1 (Bartik Decomposition for Liquidity Ratios) *The treatment variation corresponds to the different liquidity ratios $j = \{HQLA, LQLA\}$. A decomposition for changes in liquidity ratios goes as follows:*

$$\frac{LA^j_{i,t}}{GTA_{i,t}} \equiv LR^j_{i,t} = \sum_{a \in LA^j} \frac{a_{i,t}}{GTA_{i,t}}$$

Subtracting $LR^j_{i,t-1}$,

$$\begin{aligned}
LR^j_{i,t} - LR^j_{i,t-1} &= \sum_{a \in LA^j} \frac{a_{i,t}}{GTA_{i,t}} - \frac{a_{i,t-1}}{GTA_{i,t-1}} \\
\Delta LR^j_{i,t} &= \sum_{a \in LA^j} \frac{a_{i,t}}{GTA_{i,t}} - \frac{a_{i,t-1}}{GTA_{i,t-1}} \frac{GTA_{i,t}}{GTA_{i,t}} \\
&= \sum_{a \in LA^j} \left[a_{i,t} - a_{i,t-1}(1 + g^{GTA}_{i,t})\right] \frac{1}{GTA_{i,t}} \\
&= \sum_{a \in LA^j} \left[a_{i,t} - a_{i,t-1} - a_{i,t-1} g^{GTA}_{i,t}\right] \frac{1}{GTA_{i,t}} \\
&= \sum_{a \in LA^j} \left[a_{i,t-1} g^a_{i,t} - a_{i,t-1} g^{GTA}_{i,t}\right] \frac{1}{GTA_{i,t}} \\
&= \sum_{a \in LA^j} \left[a_{i,t-1} \left(g^a_{i,t} - g^{GTA}_{i,t}\right)\right] \frac{1}{GTA_{i,t}}
\end{aligned}$$

Dividing by $LR^j_{i,t-1}$,

$$\begin{aligned}
\frac{\Delta LR^j_{i,t}}{LR^j_{i,t-1}} &= \frac{GTA_{i,t-1}}{LA^j_{i,t-1}} \sum_{a \in LA^j} \left[a_{i,t-1} \left(g^a_{i,t} - g^{GTA}_{i,t}\right)\right] \frac{1}{GTA_{i,t}} \\
&= \sum_{a \in HQ} \frac{a_{i,t-1}}{LA^j_{i,t-1}} \frac{g^a_{i,t} - g^{GTA}_{i,t}}{1 + g^{GTA}_{i,t}} \\
&= \sum_{a \in LA^j} w^a_{i,t-1} \times \left(\frac{g^a_{i,t} - g^{GTA}_{i,t}}{1 + g^{GTA}_{i,t}}\right) \\
&= \sum_{a \in LA^j} w^a_{i,t-1} \times \tilde{g}^a_{i,t}
\end{aligned}$$

where $\frac{g^a_{i,t} - g^{GTA}_{i,t}}{1 + g^{GTA}_{i,t}}$ is the rate of growth of asset-a relative to the rate of growth of total assets.

References

[1] Viral V. Acharya, Hyun Song Shin, and Tanju Yorulmazer. "Crisis Resolution and Bank Liquidity". en. In: *Review of Financial Studies* 24.6 (June 2011), pp. 2166–2205. ISSN: 0893-9454, 1465-7368. DOI: 10.1093/rfs/hhq073.

[2] Miguel Acosta. "The Perceived Causes of Monetary Policy Surprises". en. In: (2022).

[3] Gara Afonso et al. "Monetary Policy Implementation with an Ample Supply of Reserves". en. In: *SSRN Electronic Journal* (2020). ISSN: 1556-5068. DOI: 10.2139/ssrn.3524621.

[4] Pierre-Richard Agénor and Karim El Aynaoui. "Excess liquidity, bank pricing rules, and monetary policy". en. In: *Journal of Banking & Finance* 34.5 (May 2010), pp. 923–933. ISSN: 03784266. DOI: 10.1016/j.jbankfin.2009.10.003.

[5] Ryan N. Banerjee and Hitoshi Mio. "The impact of liquidity regulation on banks". en. In: *Journal of Financial Intermediation* 35 (July 2018), pp. 30–44. ISSN: 10429573. DOI: 10.1016/j.jfi.2017.05.008.

[6] Juliane Begenau, Monika Piazzesi, and Martin Schneider. *Banks' Risk Exposures*. en. Tech. rep. w21334. Cambridge, MA: National Bureau of Economic Research, July 2015, w21334.

[7] Hamid Beladi et al. "Liquidity creation and funding ability during the interbank lending crunch". en. In: *International Review of Financial Analysis* 67 (Jan. 2020), p. 101433. ISSN: 10575219. DOI: 10.1016/j.irfa.2019.101433.

[8] Marco Bellifemine, Rustam Jamilov, and Tommaso Monacelli. "Monetary Policy with Heterogeneous Banks". en. In: (2022).

[9] Allen Berger and Christa Bouwman. "Bank Liquidity Creation". en. In: *Review of Financial Studies* 22.9 (Sept. 2009), pp. 3779–3837. ISSN: 0893-9454, 1465-7368. DOI: 10.1093/rfs/hhn104.

[10] Allen Berger and Christa Bouwman. "Bank liquidity creation, monetary policy, and financial crises". en. In: *Journal of Financial Stability* 30 (June 2017), pp. 139–155. ISSN: 15723089. DOI: 10.1016/j.jfs.2017.05.001.

[11] Allen Berger, Christa Bouwman, et al. "Bank liquidity creation following regulatory interventions and capital support". en. In: *Journal of Financial Intermediation* 26 (Apr. 2016), pp. 115–141. ISSN: 10429573. DOI: 10.1016/j.jfi.2016.01.001.

[12] Allen Berger, Omrane Guedhami, et al. "Economic policy uncertainty and bank liquidity hoarding". en. In: *Journal of Financial Intermediation* 49 (Jan. 2022), p. 100893. ISSN: 10429573. DOI: 10.1016/j.jfi.2020.100893.

[13] Allen Berger and John Sedunov. "Bank liquidity creation and real economic output". en. In: *Journal of Banking & Finance* 81 (Aug. 2017), pp. 1–19. ISSN: 03784266. DOI: 10.1016/j.jbankfin.2017.04.005.

[14] Ben Bernanke. "The New Tools of Monetary Policy". en. In: *American Economic Review* 110.4 (2020), pp. 943–983. ISSN: 0002-8282. DOI: 10.1257/aer.110.4.943.

[15] Ben Bernanke and Mark Gertler. "Agency Costs, Net Worth, and Business Fluctuations". In: *The American Economic Review* 79.1 (1989), pp. 14–31.

[16] Ben Bernanke and Mark Gertler. "Inside the Black Box: The Credit Channel of Monetary Policy Transmission". en. In: (1995).

[17] Ben Bernanke, Mark Gertler, and Simon Gilchrist. "The Financial Accelerator in a Quantitative Business Cycle Framework". In: *Handbook of Macroeconomics in: J. B. Taylor & M. Woodford (ed.)* 1st ed. Vol. 1. 1999, pp. 1341–1393.

[18] Javier Bianchi and Saki Bigio. "Banks, Liquidity Management, and Monetary Policy". en. In: *Econometrica* 90.1 (2022), pp. 391–454. ISSN: 0012-9682. DOI: 10.3982/ECTA16599.

[19] BIS. "Liquidity Coverage Ratio: High-quality liquid assets (LCR30)." en. In: *Basel Committee on Banking Supervision* (2019), p. 26.

[20] John C Bluedorn, Christopher Bowdler, and Christoffer Koch. "Heterogeneous Bank Lending Responses to Monetary Policy: New Evidence from a Real-Time Identification". en. In: *International Journal of Central Banking* 13.1 (2017). DOI: 10.24149/wp1404.

[21] Frédéric Boissay and Russell Cooper. "The Collateral Composition Channel". en. In: *American Economic Journal: Macroeconomics* 12.1 (Jan. 2020), pp. 41–75. ISSN: 1945-7707, 1945-7715. DOI: 10.1257/mac.20170097.

[22] Matthias Breuer. "Bartik Instruments: An Applied Introduction". en. In: *Journal of Financial Reporting, forthcoming* (2021). DOI: 10.2139/ssrn.3786229.

[23] Chunya Bu, John Rogers, and Wenbin Wu. "A unified measure of Fed monetary policy shocks". en. In: *Journal of Monetary Economics* 118 (Mar. 2021), pp. 331–349. ISSN: 03043932. DOI: 10.1016/j.jmoneco.2020.11.002.

[24] Michael Choi and Guillaume Rocheteau. "A Model of Retail Banking and the Deposits Channel of Monetary Policy". en. In: *Journal of Monetary Economics* (July 2023), S0304393223000831. ISSN: 03043932. DOI: 10.1016/j.jmoneco.2023.06.010.

[25] James S. Cloyne, Òscar Jordà, and Alan M. Taylor. "State-Dependent Local Projections: Understanding Impulse Response Heterogeneity". en. In: *Federal Reserve Bank of San Francisco, Working Paper Series* 2023.05 (Feb. 2023), pp. 01–58. DOI: 10.24148/wp2023-05.

[26] Sergio Correia. "A Feasible Estimator for Linear Models with Multi-Way Fixed Effects". en. In: *Working Paper* (2017), p. 19.

[27] Piotr Danisewicz et al. "The real effects of banking supervision: Evidence from enforcement actions". en. In: *Journal of Financial Intermediation* 35 (July 2018), pp. 86–101. ISSN: 10429573. DOI: 10.1016/j.jfi.2016.10.003.

[28] Denis Davydov, Zuzana Fungáčová, and Laurent Weill. "Cyclicality of bank liquidity creation". en. In: *Journal of International Financial Markets, Institutions and Money* 55 (July 2018), pp. 81–93. ISSN: 10424431. DOI: 10.1016/j.intfin.2018.02.014.

[29] Denis Davydov, Sami Vähämaa, and Sara Yasar. "Bank liquidity creation and systemic risk". en. In: *Journal of Banking & Finance* 123 (Feb. 2021), p. 106031. ISSN: 03784266. DOI: 10.1016/j.jbankfin.2020.106031.

[30] Manthos D. Delis, Iftekhar Hasan, and Nikolaos Mylonidis. "The Risk-Taking Channel of Monetary Policy in the U.S.: Evidence from Corporate Loan Data: MONEY, CREDIT AND BANKING". en. In: *Journal of Money, Credit and Banking* 49.1 (Feb. 2017), pp. 187–213. ISSN: 00222879. DOI: 10.1111/jmcb.12372.

[31] Marco Di Maggio et al. "Interest Rate Pass-Through: Mortgage Rates, Household Consumption, and Voluntary Deleveraging". en. In: *American Economic Review* 107.11 (Nov. 2017), pp. 3550–3588. ISSN: 0002-8282. DOI: 10.1257/aer.20141313.

[32] Sebastian Di Tella and Pablo Kurlat. "Why Are Banks Exposed to Monetary Policy?" en. In: *American Economic Journal: Macroeconomics* 13.4 (Oct. 2021), pp. 295–340. ISSN: 1945-7707, 1945-7715. DOI: 10.1257/mac.20180379.

[33] Douglas W. Diamond and Philip H. Dybvig. "Bank Runs, Deposit Insurance, and Liquidity". en. In: *Journal of Political Economy* 91.3 (1983), p. 19.

[34] Piti Disyata. "The Bank Lending Channel Revisited". In: *Journal of money, Credit and Banking* (2011). DOI: 10.1111/j.1538-4616.2011.00394.x.

[35] Itamar Drechsler, Alexi Savov, and Philipp Schnabl. "Banking on Deposits: Maturity Transformation without Interest Rate Risk". en. In: *The Journal of Finance* 76.3 (June 2021), pp. 1091–1143. ISSN: 0022-1082, 1540-6261. DOI: 10.1111/jofi.13013.

[36] Itamar Drechsler, Alexi Savov, and Philipp Schnabl. "The Deposits Channel of Monetary Policy". en. In: *The Quarterly Journal of Economics* 132.4 (Nov. 2017), pp. 1819–1876. ISSN: 0033-5533, 1531-4650. DOI: 10.1093/qje/qjx019.

[37] Itamar Drechsler, Alexi Savov, and Philipp Schnabl. "Why do banks invest in MBS?" en. In: (2023).

[38] Itamar Drechsler, Alexi Savov, Philipp Schnabl, and Olivier Wang. *Banking on Uninsured Deposits*. en. Tech. rep. w31138. Cambridge, MA: National Bureau of Economic Research, Apr. 2023, w31138.

[39] William B. English, Skander J. Van Den Heuvel, and Egon Zakrajšek. "Interest rate risk and bank equity valuations". en. In: *Journal of Monetary Economics* 98 (Oct. 2018), pp. 80–97. ISSN: 03043932. DOI: 10.1016/j.jmoneco.2018.04.010.

[40] Joshua J. Evans and Mamiza Haq. "Does bank capital reduce liquidity creation?" en. In: *Global Finance Journal* (Apr. 2021), p. 100640. ISSN: 10440283. DOI: 10.1016/j.gfj.2021.100640.

[41] Zuzana Fungacova, Rima Turk, and Laurent Weill. "High liquidity creation and bank failures". en. In: *Journal of Financial Stability* 57 (Dec. 2021), p. 100937. ISSN: 15723089. DOI: 10.1016/j.jfs.2021.100937.

[42] Anderson Gareth and Cesa-Bianchi Ambrogio. "Crossing the Credit Channel: Credit Spreads and Firm Heterogeneity". In: *IMF Working Paper* WP/20/267 (Dec. 2020).

[43] Pedro Gete and Michael Reher. “Mortgage Securitization and Shadow Bank Lending”. en. In: *The Review of Financial Studies* 34.5 (Apr. 2021). Ed. by Itay Goldstein, pp. 2236–2274. ISSN: 0893-9454, 1465-7368. DOI: 10.1093/rfs/hhaa088.

[44] Isabel Gödl-Hanisch. “Bank Concentration and Monetary Policy Pass-Through”. en. In: (2022).

[45] Matthieu Gomez et al. “Banks’ exposure to interest rate risk and the transmission of monetary policy”. en. In: *Journal of Monetary Economics* 117 (Jan. 2021), pp. 543–570. ISSN: 03043932. DOI: 10.1016/j.jmoneco.2020.03.011.

[46] Valentin Haddad and David Sraer. “The Banking View of Bond Risk Premia”. en. In: *The Journal of Finance* 75.5 (Oct. 2020), pp. 2465–2502. ISSN: 0022-1082, 1540-6261. DOI: 10.1111/jofi.12949.

[47] Edward P. Herbst and Benjamin K. Johannsen. “Bias in Local Projections”. en. In: *Finance and Economics Discussion Series* 2020.010r1 (Jan. 2021), pp. 1–62. ISSN: 19362854. DOI: 10.17016/FEDS.2020.010r1.

[48] Han Hong, Jing-Zhi Huang, and Deming Wu. “The information content of Basel III liquidity risk measures”. en. In: *Journal of Financial Stability* 15 (Dec. 2014), pp. 91–111. ISSN: 15723089. DOI: 10.1016/j.jfs.2014.09.003.

[49] Jane Ihrig et al. “How Have Banks Been Managing the Composition of High-Quality Liquid Assets?” en. In: *Finance and Economics Discussion Series* 2017.092 (Aug. 2017). ISSN: 19362854. DOI: 10.17016/FEDS.2017.092.

[50] Marek Jarociński. “Estimating the Fed’s Unconventional Policy Shocks”. en. In: *SSRN Electronic Journal* (2021). ISSN: 1556-5068. DOI: 10.2139/ssrn.3982819.

[51] Marek Jarociński and Peter Karadi. “Deconstructing Monetary Policy Surprises— The Role of Information Shocks”. en. In: *American Economic Journal: Macroeconomics* 12.2 (Apr. 2020), pp. 1–43. ISSN: 1945-7707, 1945-7715. DOI: 10.1257/mac.20180090.

[52] Priit Jeenas. “Monetary Policy Shocks, Financial Structure, and Firm Activity: A Panel Approach”. en. In: *SSRN Electronic Journal* (2018). ISSN: 1556-5068. DOI: 10.2139/ssrn.3043579.

[53] Òscar Jordà. “Estimation and Inference of Impulse Responses by Local Projections”. en. In: *American Economic Review* 95.1 (Feb. 2005), pp. 161–182. ISSN: 0002-8282. DOI: 10.1257/0002828053828518.

[54] Supriya Kapoor and Oana Peia. “The impact of quantitative easing on liquidity creation”. en. In: *Journal of Banking & Finance* 122 (Jan. 2021), p. 105998. ISSN: 03784266. DOI: 10.1016/j.jbankfin.2020.105998.

[55] Anil K. Kashyap, Raghuram Rajan, and Jeremy C. Stein. “Banks as Liquidity Providers: An Explanation for the Coexistence of Lending and Deposit-taking”. en. In: *The Journal of Finance* 57.1 (Feb. 2002), pp. 33–73. ISSN: 00221082. DOI: 10.1111/1540-6261.00415.

[56] Anil K. Kashyap and Jeremy C. Stein. “What Do a Million Observations on Banks Say About the Transmission of Monetary Policy?” en. In: *American Economic Review* 90.3 (June 2000), pp. 407–428. ISSN: 0002-8282. DOI: 10.1257/aer.90.3.407.

[57] Ruby P. Kishan and Timothy P. Opiela. “Bank Size, Bank Capital, and the Bank Lending Channel”. en. In: *Journal of Money, Credit and Banking* 32.1 (Feb. 2000), p. 121. ISSN: 00222879. DOI: 10.2307/2601095.

[58] John Krainer and Pascal Paul. “Monetary Transmission through Bank Securities Portfolios”. en. In: *Federal Reserve Bank of San Francisco* Working Paper 2023-18 (2023). DOI: 10.24148/wp2023-18.

[59] Lei Li, Elena Loutskina, and Philip E. Strahan. “Deposit market power, funding stability and long-term credit”. en. In: *Journal of Monetary Economics* 138 (Sept. 2023), pp. 14–30. ISSN: 03043932. DOI: 10.1016/j.jmoneco.2023.04.004.

[60] Emi Nakamura and Jón Steinsson. “High-Frequency Identification of Monetary Non-Neutrality: The Information Effect*”. en. In: *The Quarterly Journal of Economics* 133.3 (Aug. 2018), pp. 1283–1330. ISSN: 0033-5533, 1531-4650. DOI: 10.1093/qje/qjy004.

[61] Thach Vu Hong Nguyen et al. “Do stress tests affect bank liquidity creation?” en. In: *Journal of Corporate Finance* 64 (Oct. 2020), p. 101622. ISSN: 09291199. DOI: 10.1016/j.jcorpfin.2020.101622.

[62] Pablo Ottonello and Thomas Winberry. "Financial Heterogeneity and the Investment Channel of Monetary Policy". en. In: *Econometrica* 88.6 (2020), pp. 2473–2502. ISSN: 0012-9682. DOI: 10.3982/ECTA15949.

[63] Pascal Paul. "Banks, maturity transformation, and monetary policy". en. In: *Journal of Financial Intermediation* 53 (Jan. 2023), p. 101011. ISSN: 10429573. DOI: 10.1016/j.jfi.2022.101011.

[64] Peter Paz. "Bank Capitalization heterogeneity and monetary policy". In: *Working Paper Series Banco de España*. Documentos de Trabajo. N.º 2234 (2022). DOI: 10.2139/ssrn.4252563.

[65] Alberto Polo. "Imperfect pass-through to deposit rates and monetary policy transmission". en. In: *SSRN Electronic Journal* (2021). ISSN: 1556-5068. DOI: 10.2139/ssrn.3900542.

[66] William Poole. "Commercial Bank Reserve Management in a Stochastic Model: Implications for Monetary Policy". en. In: *The Journal of Finance* (1968).

[67] Arisyi F. Raz, Danny McGowan, and Tianshu Zhao. "The dark side of liquidity regulation: Bank opacity and funding liquidity risk". en. In: *Journal of Financial Intermediation* (Aug. 2022), p. 100990. ISSN: 10429573. DOI: 10.1016/j.jfi.2022.100990.

[68] Daniel Roberts, Asani Sarkar, and Or Shachar. "The Costs and Benefits of Liquidity Regulations". In: (2021).

[69] René Stulz, Alvaro Taboada, and Mathijs van Dijk. "The determinants of liquid asset holdings". In: *NBER WORKING PAPER SERIES*. NBER 30340 (2022).

[70] Suresh M. Sundaresan and Kairong Xiao. "Liquidity Regulation and Banks: Theory and Evidence". en. In: *SSRN Electronic Journal* (2023). ISSN: 1556-5068. DOI: 10.2139/ssrn.4020511.

[71] Skander Van den Heuvel. "Does Bank Capital Matter for Monetary Transmission?" en. In: *Economic Policy Review. Federal Reserve Bank of New York* (2002).

[72] Xingmin Zhang et al. "Bank liquidity creation, network contagion and systemic risk: Evidence from Chinese listed banks". en. In: *Journal of Financial Stability* 53 (Apr. 2021), p. 100844. ISSN: 15723089. DOI: 10.1016/j.jfs.2021.100844.