

# Monetary Policy, Bank Fragility, and the Modern Financial Intermediation

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monetary policy transmission, modern financial intermediation, nonbank intermediation, bank fragility, financial stability, credit reallocation

## Abstract

This article reviews recent research on monetary policy transmission through banks and the broader financial intermediation sector, and its implications for financial stability. Traditional banks remain fragile due to high leverage and maturity transformation, making them vulnerable to interest rate, credit, and liquidity shocks. Meanwhile, the rise of nonbank intermediation—now involved in most lending—has reshaped how credit is originated, funded, and distributed, complicating policy transmission and regulation. We examine evidence on six key adjustment margins of monetary policy transmission through banks and the financial intermediation sector: (a) balance sheet valuation, (b) loan retention, (c) securities holdings, (d) shadow bank lending substitution, (e) deposit substitution, and (f) bank-to-nonbank lending. These channels often reallocate credit in response to monetary and capital shocks rather than just altering its aggregate level, highlighting the need for a system-wide perspective that reflects the adaptive, interconnected nature of modern financial intermediation.

## 1. INTRODUCTION

Banks have traditionally played a central role in credit allocation and the functioning of modern economies. For decades, they have been the dominant institutions channeling savings into productive investments and loans, largely through their unique capacity to engage in relationship lending, screen opaque borrowers, and provide liquidity services (Diamond 1984, Kashyap et al. 2002). The bank balance sheet model of intermediation has also been regarded as a key component of monetary policy transmission (Kashyap & Stein 2000). However, this central role has always coexisted with a structurally fragile funding model. First, banks operate with very high financial leverage compared to nonfinancial firms (Jiang et al. 2020). Second, banks rely on maturity transformation—funding long-term, illiquid loans with short-term liabilities such as deposits. This mismatch makes them inherently vulnerable to liquidity risk, interest rate shocks, and credit losses, all of which can culminate in solvency crises (Diamond & Dybvig 1983, Diamond & Rajan 2001, Goldstein & Pausner 2005, Egan et al. 2017, Davilla & Goldstein 2023, Jiang et al. 2024). These vulnerabilities can also become particularly acute during episodes of monetary tightening (Jiang et al. 2024, 2025). More broadly, macro-financial models emphasize how balance sheet constraints and liquidity frictions can amplify shocks and generate nonlinear dynamics in the financial system (e.g., He & Krishnamurthy 2013, Brunnermeier & Sannikov 2014, Bianchi & Bigio 2022).

At the same time, the institutional structure of credit intermediation has shifted dramatically over the past half-century. While banks were once dominant, the rise of market-based finance and nonbank intermediaries—commonly grouped as shadow banks—has reshaped how credit is originated, funded, and distributed (Buchak et al. 2018, 2025; Jiang et al. 2020). These changes complicate and fundamentally alter the transmission of monetary policy and regulatory interventions through the financial sector (Buchak et al. 2024a,b, 2025).

This article surveys recent work connecting monetary policy, banks, and the broader financial intermediation sector. The literature on banking is vast, and it is not possible to do it full justice here. Instead, we highlight main insights from recent studies, particularly those analyzing the evolving relationship between banks and the nonbanking sector and its implications for monetary policy pass-through and financial stability.

We begin by documenting banks' vulnerabilities, then we examine the shifting composition of the financial system. Next, we explore how the modern margins of financial intermediation—such as loan sales, shadow bank lending substitution, bank debt security holdings, and deposit substitution—affect the transmission of monetary policy and capital shocks.

As the conclusion emphasizes, the financial system has fundamentally changed: Banks no longer dominate credit provision, while loan sales and the rise of shadow banking have introduced new margins of adjustment. Recognizing these substitution and retention margins is essential for understanding the true transmission of monetary policy and the stability of the financial system. We conclude by discussing directions for future research, emphasizing the need to deepen our understanding of how these margins operate across different intermediaries and what they imply for welfare and systemic risk.

## 2. BANKS FRAGILITY: MATURITY TRANSFORMATION AND HIGH FINANCIAL LEVERAGE

Banks are structurally fragile institutions due to two interrelated features of their business model. First, banks operate with high financial leverage—meaning their equity capital constitutes only a small fraction of their total assets. A typical US bank finances roughly 90% of its assets with debt—primarily in the form of deposits—leaving only about 10% funded by equity capital (Jiang et al.

2020). By contrast, nonfinancial businesses maintain a much lower debt-to-asset ratio, averaging around 25–35% over the past two decades (Office of the Comptroller of the Currency 2021). As a result, even a moderate decline in bank asset values can quickly erode the banks' capital base and raise concerns about solvency.

Second, banks routinely engage in maturity transformation by funding long-term loans and assets with short-term callable deposits. Increases in interest rates can raise bank funding costs while at the same time sharply reducing the market value of their fixed-rate assets such as loans and securities, especially when banks—such as many in the United States—hedge little or none of their interest rate exposure (Granja et al. 2024). This maturity mismatch–driven interest rate risk is a classic vulnerability of the banking sector and was a one of the key factors in the widespread insolvencies during the savings and loan crisis of the 1980s.

The mismatch between liquid callable liabilities and long-term assets makes banks also susceptible to runs—episodes in which depositors, fearing for a bank's solvency, withdraw funds en masse. There are two types of such self-fulfilling runs: the classic runs due to illiquid assets, in the spirit of Diamond & Dybvig (1983) and Goldstein & Pauzner (2005),<sup>1</sup> and the solvency runs on bank franchise value induced by higher interest rates or credit losses, in the spirit of Egan et al. (2017) and Jiang et al. (2024).

These fragilities are not unique to traditional banks. Nonbank financial intermediaries—such as nonbank lenders, securitization conduits, and investment funds—can also operate with fairly high financial leverage and are similarly reliant on short-term funding, much of which is often sourced from banks themselves (Jiang et al. 2020, Jiang 2023, Acharya et al. 2025). The collapse of several nonbank mortgage lenders during the global financial crisis of 2008 revealed that maturity mismatch and unstable funding structures can generate run-like dynamics in the nonbank sector as well, posing significant risks to financial stability (e.g., see Gorton 2010).

### 3. BANKS WITHIN THE MODERN FINANCIAL INTERMEDIATION SYSTEM

To understand the role of banks and the impact of monetary policy on financial stability, it is essential to recognize that over the past half-century, the architecture of financial intermediation has undergone a fundamental transformation. Buchak et al. (2025) document how over the past half-century, the traditional model of bank-centered lending has undergone a significant transformation. The share of informationally sensitive lending—i.e., loans held on bank balance sheets—has declined from 55% in the early 1970s to 33% in recent years (**Figure 1a**). At the same time, savers have moved away from deposits, which now represent just 13% of nonfinancial sector financial assets savings, down from 21% (**Figure 1b**). Banks themselves have shifted their balance sheets: In 1970, loans accounted for 70% of bank assets, compared to only 55% today, as more resources are allocated toward securities issued by the originate-to-distribute (OTD) sector (**Figure 1c**).

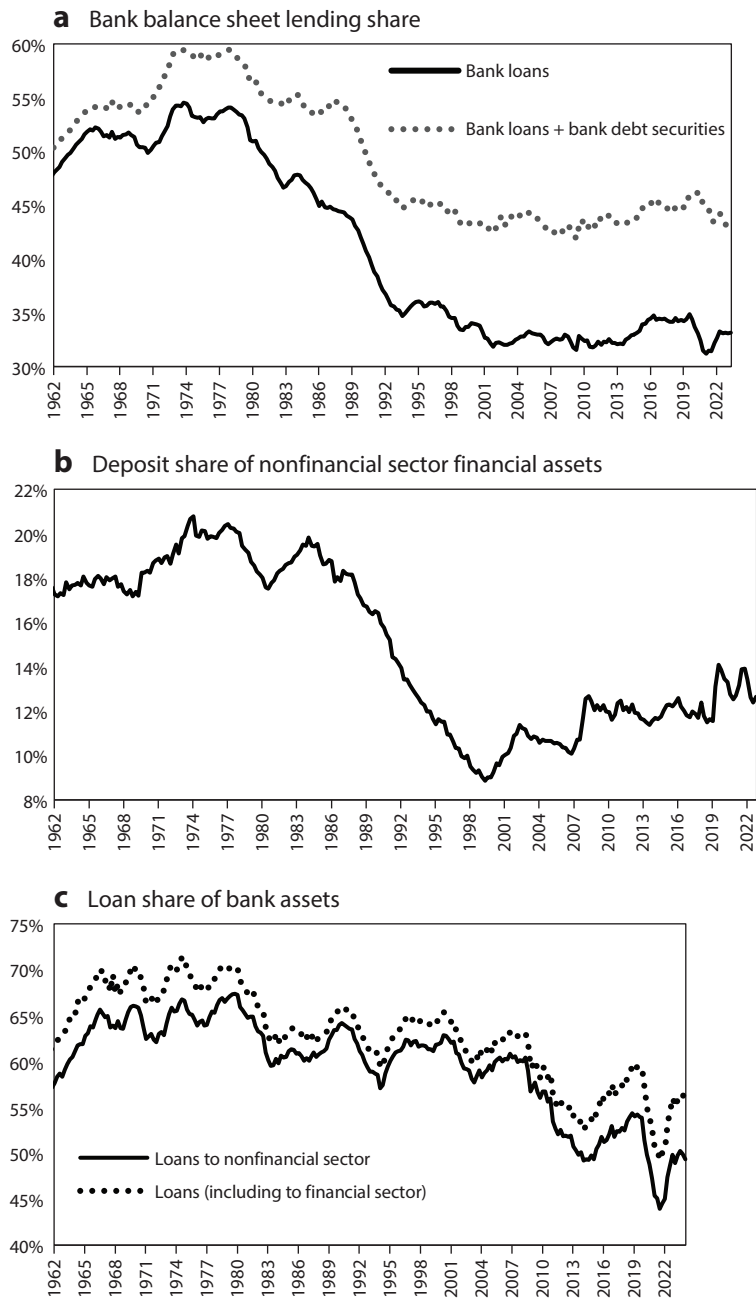
Buchak et al. (2025) indicate that a set of institutional and policy forces underlies this shift. These include (a) advances in financial technology and regulatory changes that facilitated the growth of securitization and debt securities markets, (b) innovations and policy shifts that enabled the expansion of alternative savings vehicles to deposits [e.g., money market funds, debt fund exchange-traded funds (ETFs), and pension funds], (c) changes in bank regulation, and (d) the use of unconventional monetary policy.

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<sup>1</sup>Goldstein & Pauzner (2005) study a modification of Diamond & Dybvig's (1983) model, in which the fundamentals of the economy uniquely determine whether a bank run occurs.

Figure 1

Decline of the traditional bank model of intermediation. This figure reproduces the key trends documenting the decline of the traditional bank business model from Buchak et al. (2025). Panel *a* shows bank balance sheet lending as a share of total outstanding lending to households and nonfinancial businesses, with the dotted line including bank holdings of debt securities that finance credit to these sectors. Panel *b* reports the total bank deposits held by the domestic nonfinancial sector relative to the sector's total financial assets. Panel *c* presents bank loans as a share of total bank assets, where the solid line reflects loans to the nonfinancial sector and the dotted line additionally includes loans to the non-depository financial sector. Figure created using data from the Flow of Funds database curated by the Federal Reserve Bank of St. Louis (<https://fred.stlouisfed.org/categories/32251>).



Beyond competing in the lending and savings markets, banks and nonbank financial intermediaries are also interconnected through two additional and important channels. First, banks serve as major investors in the securities originated by the nonbank sector (Buchak et al. 2025). As the traditional model of bank balance sheet lending has declined, banks have increasingly allocated their assets toward securitized products—such as mortgage-backed securities (MBS) and debt securities—issued by nonbank intermediaries. This has led to a notable rise in the share of securities held on bank balance sheets, effectively linking banks to credit risk intermediated outside their own lending books.

Second, nonbank financial intermediaries often rely on banks for funding. Many shadow banks and investment vehicles finance their operations through lines of credit, repurchase agreements, or other forms of short-term borrowing from the banking sector (Jiang et al. 2020, 2024; Acharya et al. 2025; Chernenko et al. 2025). As a result, stress in one part of the system—whether within banks or nonbanks—can transmit to the other through these balance sheet interdependencies, amplifying systemic vulnerabilities.

#### 4. ADJUSTMENT MARGINS IN THE TRANSMISSION OF MONETARY POLICY IN THE MODERN FINANCIAL INTERMEDIATION SYSTEM

This transformation has produced a financial system in which banks are deeply intertwined with nonbank intermediaries, making it essential—when assessing how monetary policy affects banks and, more broadly, financial stability—to account for their growing interconnectedness and the general equilibrium interactions that bind them. These interconnections imply that monetary policy shocks, whether conventional or unconventional, propagate through a networked financial system, not a segmented one. Understanding the response of this system requires an appreciation of how modern intermediation adjusts along multiple margins.

**Figure 2** provides a stylized representation of the modern US financial intermediation system, adapted from Buchak et al. (2025). It links five key sectors: (a) private borrower sector (households and firms) that demands credit; (b) traditional banks, which transform deposits into loans and securities; (c) shadow banks and OTD lines of traditional banks, which provide loans financed by market-based sources and securitization; (d) the saver sector, which provides funding through deposits, equity, and direct securities purchases; and (e) the central bank, which injects reserves, holds securities, and conducts monetary interventions.

Credit to the economy can flow either through bank balance sheets financed through deposits (traditional model) or, increasingly, through market-based channels (shadow banks, securitization, and securities markets) financed through nonbank saver alternatives (securities intermediated by money market funds, pension funds, ETFs, etc.). The six prominent, though not exhaustive, margins of adjustment listed below shape the way banks and the financial intermediation market more broadly respond to monetary or financial shocks. Beyond these margins, monetary policy can also operate through changes in the composition, maturity, and riskiness of real investment projects, not fully considered here, which alter risk-taking incentives and the allocation of credit across projects and sectors.

##### M1. Balance sheet valuation margin

- Location: traditional bank sector assets (loans, securities, reserves) and liabilities (deposits).
- Mechanism: Monetary policy changes, such as interest rate hikes, can reduce the market value of bank assets, potentially shrinking equity capital, with the opposite effects when rates fall. This margin captures how valuation changes affect banks' equity and capacity to lend.

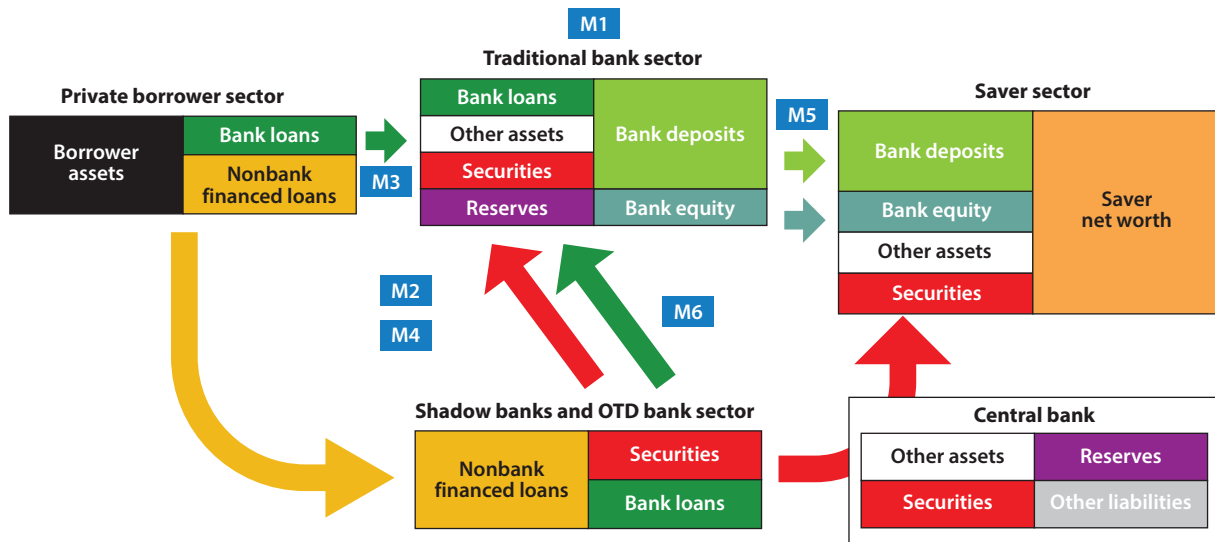


**Figure 2**

Modern financial intermediation framework. This schematic illustrates the flow of credit and funding across borrowers, banks, shadow banks, savers, and the central bank, based on Buchak et al. (2025). It highlights five key sectors: borrowers (households and firms), traditional banks, shadow banks and originate-to-distribute (OTD) business lines of traditional banks, savers, and the central bank. Credit can flow either through bank balance sheets (the traditional model) or, increasingly, through market-based channels (shadow banks, securitization, and securities markets). Monetary and regulatory shocks propagate through six margins of adjustment: bank balance sheet valuation (M1), bank balance sheet loan retention (M2), securities holdings (M3), shadow bank lending substitution (M4), deposit substitution (M5), and bank-to-nonbank lending (M6).

#### M2. Bank balance sheet loan retention margin

- Location: traditional bank balance sheet lending versus loan sales/securitization.
- Mechanism: Banks can either retain loans on balance sheet or sell them into secondary markets. When facing capital shocks, e.g., following a rise in interest rates, banks may sell loans rather than shrink lending outright, shifting risk and credit provision off their balance sheets.

#### M3. Securities holdings margin

- Location: traditional banks' allocation between loans and securities.
- Mechanism: Banks adjust the composition of their assets, reallocating from direct loans to securities (including MBS and corporate bonds). Quantitative easing (QE), liquidity regulation, or changes in interest rate conditions can change banks' securities holdings at the expense of loan origination.

#### M4. Shadow bank lending substitution margin

- Location: nonbank (shadow bank) sector's role in originating loans.
- Mechanism: When banks reduce balance sheet lending (e.g., after capital shocks or tighter regulation), shadow banks step in to originate more standardized, less informationally sensitive loans, partially offsetting the decline in aggregate credit.

#### M5. Deposit substitution margin

- Location: saver sector allocation between bank deposits and alternative assets.

- Mechanism: Savers can substitute away from deposits into money market funds, bond ETFs, or pension funds. For example, higher interest rates can lead to bank deposit outflows that reduce bank lending and push intermediation toward market-based credit.

#### M6. Bank-to-nonbank lending margin

- Location: flow of credit between banks and nonbank financial institutions.
- Mechanism: Banks lend not only to households and firms but also to nonbank intermediaries. As a result, stress in one part of the system—whether in banks or nonbanks—can spill over to the other through these balance sheet interdependencies, amplifying systemic vulnerabilities.

Below, we review each of these margins in greater detail and discuss how they interact with monetary policy.

### 4.1. Bank Balance Sheet Valuation Margin

A first channel through which monetary policy affects bank stability is the bank balance sheet valuation margin, as exemplified by the 2023 regional banking crisis. As discussed in Section 2, banks operate with high financial leverage and engage in maturity transformation—funding themselves with short-term, often demandable liabilities, primarily deposits, while investing in long-term, fixed-rate assets such as loans and securities. When interest rates rise, the market values of assets and liabilities can adjust asymmetrically, putting pressure on bank capital. This vulnerability is amplified by the fact that US banks hedge little, if any, of their interest rate exposure (Granja et al. 2024).

Jiang et al. (2024) develop a conceptual framework and empirical methodology to analyze how changes in interest rates affect the value of US bank assets and bank stability. Their model of solvency runs shows that interest rate increases can trigger self-fulfilling runs by uninsured depositors—even when banks’ assets are fully liquid and banks have strong deposit franchise value in the absence of runs. Their framework identifies banks with longer-duration assets, low capital, and—critically—high uninsured leverage, a concept introduced by Jiang et al. (2020), as most vulnerable. Using their newly developed indicators of bank fragility, they apply this approach to the monetary tightening cycle of 2022 and estimate that higher rates reduced the market value of US banking system assets by up to \$2 trillion (including loan portfolios held to maturity) relative to book values. These losses, combined with high uninsured leverage, have created risk of solvency runs among uninsured depositors in a significant subset of US banks.

Importantly, the erosion of bank equity following monetary tightening can also have second-round effects on credit supply. A traditional bank lending channel (e.g., Kashyap & Stein 2000) shows that, as equity buffers shrink, banks can become more cautious, because of either regulatory capital constraints or heightened internal risk aversion. This can lead to a contraction in new lending, particularly for riskier borrowers. The balance sheet valuation margin thus creates a direct link between interest rate policy, maturity mismatch, franchise strength, and lending capacity, with implications for both financial stability and macroeconomic performance.

In a related work, Amador & Bianchi (2024) present a dynamic general equilibrium model of self-fulfilling bank runs, where banks trade capital in competitive and liquid markets but remain vulnerable to runs due to a loss of creditor confidence. A key distinction of their model, compared to the one by Diamond & Dybvig (1983), is that like in Jiang et al.’s (2024) model, runs can occur even though the bank has access to a liquid market where it can sell its assets. Crucial to the occurrence of runs in Amador & Bianchi’s (2024) model is the existence of a positive spread between the return on capital and the cost of borrowing, which reflects a positive franchise value for the

bank. The inability to leverage due to a run diminishes the bank's value, and if the reduction in the bank's value is substantial enough, the bank becomes vulnerable to a self-fulfilling run. Amador & Bianchi (2024) also show that when a banking crisis is generated by runs, credit easing can reduce the number of defaulting banks and enhance welfare.

In addition to this work, Haddad et al. (2023) and Drechsler et al. (2024) also analyze how solvency bank runs interact with monetary policy. Other relevant contributions in this literature include, among others, studies by Flannery & Sorescu (2023), Crosignani & Prazad (2024), Granja et al. (2024), Koont et al. (2024), Acharya et al. (2025), Jiang et al. (2025), and Cookson et al. (2026).

It is useful to compare the insights of this emerging literature with those of Drechsler et al. (2021), who argue that maturity transformation does not expose banks to interest rate risk. In their view, the deposit franchise enables banks to pay rates that are low and relatively insensitive to market interest rates, thereby eliminating solvency concerns from higher rate-induced losses on bank asset values. However, Jiang et al. (2024) and subsequent work show that this perspective is incomplete, as it overlooks the possibility of depositor runs triggered by rising interest rates—events that, if they occur, can rapidly erode deposit franchise value (if present) and contribute to bank failures. Moreover, even abstracting from run risk and focusing on the “good” no-run equilibrium, DeMarzo et al. (2024) find that, for most US banks, the franchise value declines as interest rates rise, amplifying losses on bank assets. This is also consistent with work by Begenau et al. (2025), who show that banks take on substantial interest rate exposure. Finally, as Jiang et al. (2024) demonstrate, if bank asset values become sufficiently impaired due to higher rates, a fundamental bank insolvency can emerge as a unique equilibrium outcome. Taken together, these findings imply that banks engage in maturity transformation with substantial unhedged exposure to interest rate risk.

Building on these insights, Jiang et al. (2025) examine how banks' vulnerability to higher interest rates—especially when combined with credit losses, such as exposure to distress in commercial real estate—may constrain monetary policy. They find that, in the current environment, interest rate risk poses a greater threat to banks than credit risk, potentially creating a bank stability constraint on monetary policy that limits the scope of policy tightening. Their results underscore the importance of incorporating rising-rate scenarios, including adverse stagflationary conditions, into bank stress testing frameworks.

## **4.2. Bank Balance Sheet Loan Retention Margin**

The second adjustment margin, the balance sheet loan retention margin, captures how banks adjust their business models—shifting between retaining loans on their balance sheets and distributing them through securitization or loan sales—in response to shocks, including changes in monetary policy. This margin can complicate the interpretation of credit market responses to policy changes. As discussed above, rising interest rates can impair bank capital and stability by eroding asset values and increasing run risk. While this might be expected to trigger a sharp contraction in lending, the actual decline in lending may be much smaller if banks can continue originating loans and finance this activity by selling them rather than holding them on their now more constrained balance sheets. Similarly, under QE, large-scale purchases of debt securities (e.g., MBS) can increase the relative attractiveness of originating loans for sale, encouraging banks to offload more loans and reduce direct balance sheet lending.

Buchak et al. (2024b) document the importance of the balance sheet retention margin, showing empirically that banks switch between balance sheet lending and loan sales depending on their balance sheet strength, behaving more like shadow banks after negative capital shocks. They develop and estimate a structural model of the financial intermediation sector that incorporates this

adjustment margin, in which banks and shadow banks compete for borrowers. Banks face regulatory constraints but retain the advantage of engaging in balance sheet lending; critically, and in contrast to much of the prior literature, they can also choose to access the securitization market like shadow banks. Using this framework, Buchak et al. (2024b) analyze the quantitative effects of monetary and regulatory policies on lending volumes and pricing, bank stability, and the distribution of consumer surplus. Estimates from their model indicate that the balance sheet retention margin plays a central role in shaping policy responses by mitigating the impact of adverse bank capital shocks. While such shocks reduce banks' balance sheet lending, banks adjust along the retention margin by selling more loans. They also find that unconventional monetary policy, such as QE, can have substantially larger effects on aggregate lending than capital shocks, as it influences the secondary loan market on which both banks and, in particular, shadow banks rely to finance their lending.

Building on these insights, Buchak et al. (2024a) use granular lending data and a calibrated dynamic quantitative model to show that the balance sheet retention margin substantially dampens the immediate contraction in lending following an adverse bank capital shock and accelerates the recovery, as loan sales help banks rebuild capital. Ignoring this mechanism can lead to substantial errors in predicting the magnitude, direction, and composition of lending responses to capital shocks, including those triggered by changes in monetary policy. Their findings suggest that the link between bank capital and aggregate lending is weaker than traditional macroeconomic models imply. While the balance sheet margin of adjustment allows banks to manage risk and rebuild capital more quickly, it also weakens the traditional capital–credit supply relationship. As a result, monetary policy transmission through bank balance sheets to aggregate lending is diminished as well.

### 4.3. Bank Security Holdings Margin

Relatedly, the bank security holdings margin captures the flexibility banks have in adjusting the composition of their balance sheets in response to changing market conditions or monetary policy shocks. Just as the balance sheet retention margin allows banks to substitute loan sales for balance sheet lending in response to capital shocks, the security holdings margin enables them to shift their asset mix away from direct loans and toward debt securities—including those originated by the nonbank sector, such as MBS and corporate bonds. This reallocation can occur, for example, when tighter monetary policy or adverse capital shocks make traditional balance sheet lending less attractive but opportunities in secondary markets remain profitable.

As Buchak et al. (2025) demonstrate, by increasing their holdings of such securities, banks can continue to deploy capital in credit markets while reducing direct lending exposure, thereby linking themselves more closely to market-based intermediation channels. Similarly, the QE policy can crowd out bank balance sheet lending and increase bank holdings of reserves (Diamond et al. 2024, Buchak et al. 2025). Such interventions can also affect the relative value of long-term assets, including bank security holdings (Krishnamurthy & Vissing-Jorgensen 2011), impacting bank lending (Rodnyansky & Darmouni 2017). Finally, heightened liquidity regulation can further encourage banks to hold securities on their balance sheets at the expense of loans (Sundaresan & Xiao 2023), providing another illustration of the security holdings margin of adjustment.

### 4.4. Shadow Bank Lending Substitution Margin

On the lending side, the shadow bank lending substitution margin—formalized by Buchak et al. (2018, 2024b)—captures how nonbank intermediaries can step in to originate loans that traditional banks might otherwise make, particularly in markets where those loans are standardized and easily sold. Their analysis shows that substitution is strongest in loan markets with high securitization

potential, such as conforming mortgages, where shadow banks can compete directly by accessing secondary market funding.

This channel becomes important after negative capital shocks to banks—such as those triggered by higher interest rates—when bank balance sheet lending contracts and shadow banks expand their activity to fill part of the gap. While this substitution can soften the aggregate contraction in credit supply following bank capital shocks, it is incomplete: Shadow banks and market-based credit cannot fully replace traditional banks in informationally sensitive lending, such as relationship-based or bespoke credit. Unconventional monetary policy can also influence the strength of this margin. As Buchak et al. (2024b) show, QE lowers market-based funding costs and boosts demand for securitized assets, thereby amplifying the substitution margin and enabling shadow banks to expand lending.

Relatedly, Corbae & D’Erasmus (2021) develop a model of banking industry dynamics to examine the impact of regulatory policies on risk taking and market structure with banks and nonbanks, while Begenau & Landvoigt (2022) analyze the role of capital requirements in a quantitative general equilibrium framework with both regulated and unregulated intermediaries. These contributions, like the one by Buchak et al. (2024b), underscore the importance of modeling the shadow bank sector and its interaction with traditional banks to fully capture compositional changes and substitution effects in credit supply.

#### **4.5. Deposit Substitution Margin of Adjustment**

On the funding side, banks face a deposit substitution margin of adjustment, driven by competition from nonbank savings vehicles such as money market funds, mutual funds, ETFs, and Treasury bills. The value of the deposits to banks lies in their ability to provide a stable, low-cost funding source that—up to a point—is less sensitive to market interest rates. This franchise value supports banks’ profitability, particularly during periods of rising rates, and shapes how they compete for funding. Classic evidence from Hannan & Berger (1991) and Neumark & Sharpe (1992) shows that deposit rates adjust sluggishly, especially in less competitive markets, allowing banks to maintain funding costs well below market rates.

Drechsler et al. (2017) identify the “deposits channel” of monetary policy, showing that this sluggish adjustment can prompt deposit outflows as customers shift funds to higher-yielding alternatives. These outflows tighten banks’ funding constraints and may lead to a contraction in lending, especially for banks heavily reliant on deposit funding. Egan et al. (2017) develop a structural model of the US banking sector in which banks compete for both insured and uninsured deposits, and they show that a strong base of stable, insured deposits—the core of the deposit franchise—provides resilience against run-prone funding outflows, while heavy reliance on uninsured deposits heightens fragility. Their model highlights how deposit competition can erode franchise value and trigger run-like equilibria, a vulnerability also underscored by Jiang et al. (2024), who analyze how concentrated exposure to uninsured deposits can contribute to bank runs and bank instability during the period of rising interest rates.

This liability-side mechanism provides an additional channel through which monetary policy affects bank credit supply, complementing traditional asset-side views of the bank lending channel. However, as emphasized by Buchak et al. (2025), fully assessing the impact of the deposit outflows during the period of rising interest rates on overall funding to firms and households requires understanding where deposits reallocate and how this reallocation affects total credit market funding, including nonbank lending and debt securities markets. Xiao (2020) provides evidence on the deposit substitution margin, showing that shadow bank money creation expands significantly during monetary tightening cycles. This expansion offsets reductions in commercial bank deposits and

dampens the contractionary effects of monetary policy on lending. A structural equilibrium analysis by Buchak et al. (2025) confirms that deposit outflows from banks following rising rates can be counterbalanced by inflows into nonbank savings vehicles that continue to fund lending, including through the debt securities market. Relatedly, but through a distinct mechanism, Hachem & Song (2021) show that, in response to liquidity regulation, banks may create off-balance-sheet savings instruments, reallocating funding toward shadow-banking vehicles that are not subject to the liquidity requirement.

Overall, these studies indicate that the aggregate impact of deposit outflows on total lending is far more modest, reflecting substitution rather than a pure reduction in credit supply. Like other margins discussed above—such as the shadow bank lending substitution margin and the bank balance sheet lending margin—this channel reallocates credit in response to monetary shocks between the traditional bank lending channel and nonbank funding vehicles, again underscoring the need for a system-wide perspective on credit intermediation.

#### **4.6. Bank-to-Nonbank Lending Margin**

Finally, the bank-to-nonbank lending margin captures bank credit provision to nonbanks such as hedge funds, private equity firms, mortgage originators, and broker-dealers through mechanisms including repo agreements, margin loans, warehouse lines, and credit facilities. This intermediary-facing credit exposure constitutes a distinct margin of adjustment in banks' balance sheet management. Credit lines are a major component of bank lending, providing firms with flexible, prearranged access to liquidity that can be drawn upon as needed.

In the context of the transmission of shocks through banks, Ivashina & Scharfstein (2010) highlight the critical role of credit lines as an often-overlooked channel shaping lending dynamics. During the 2008 financial crisis, firms drew heavily on precommitted revolving credit facilities to secure liquidity, effectively transforming off-balance-sheet commitments into on-balance-sheet funding needs at precisely the moment when banks' own access to wholesale funding was impaired. This credit-line run amplified the contraction in loan supply. Banks with stable deposit funding could absorb these drawdowns and sustain lending, whereas those reliant on short-term market funding curtailed new credit more sharply.

Importantly, such facilities are extended not only to nonfinancial corporates but also to nonbank financial intermediaries, including shadow bank lenders and other finance companies. Jiang et al. (2020) and Jiang (2023) show that bank warehouse lines are a key source of debt funding for nonbank lenders. Consistent with this, Chernenko et al. (2025) provide evidence that banks often find lending to private credit funds more attractive than direct middle-market lending, while Acharya et al. (2025) document significant use of bank credit lines by nonbank financial intermediaries such as real estate investment trusts. This interconnectedness means that stress in one part of the financial system—whether in the corporate sector or among nonbank financial institutions—can rapidly transmit to banks through large-scale drawdowns, turning contingent commitments into immediate funding pressures. For example, as monetary policy tightens, banks may respond by raising haircuts, shortening maturities, or reducing overall exposure, thereby constraining nonbank leverage and liquidity. Conversely, during easing cycles, banks may expand credit to nonbanks, facilitating procyclical risk-taking outside the regulatory perimeter.

### **5. CONVENTIONAL AND UNCONVENTIONAL MONETARY POLICY WITHIN A MODERN FINANCIAL INTERMEDIATION FRAMEWORK**

The above discussion of adjustment margins highlights their potential importance in shaping how monetary policy transmits through the financial system. Without accounting for the full spectrum

of adjustment margins and their general equilibrium interactions across institutions, policy analyses risk presenting an incomplete or even misleading picture of how monetary or regulatory policy affects credit markets and financial stability. Crucially, this requires recognizing that policy impacts extend beyond banks to encompass the broader nonbank intermediation sector and its equilibrium interactions with the banking system. For instance, the ability to sell loans and the presence of active debt securities markets can substantially dampen the contractionary effects of bank capital shocks by enabling banks to reduce on-balance-sheet exposures without meaningfully reducing aggregate lending. Likewise, monetary policy may have sizable effects on bank balance sheets while producing more muted changes in aggregate credit if lending activity shifts from banks to nonbank intermediaries. These dynamics underscore the need for a framework that captures the full set of margins and their cross-sector linkages.

In this regard, Buchak et al. (2025), building on Buchak et al. (2024b), take a first step toward such a framework. In their model (see **Figure 2** for a schematic representation), the financial intermediation sector creates both borrowing and savings technologies. On the savings side, intermediaries offer households two types of financial products: bank deposits and securities, which may include debt securities, equities, or Treasuries and can also be intermediated by shadow money vehicles (e.g., ETFs, debt funds). These securities are imperfect substitutes for deposits, differing in the transaction services they provide and in portfolio benefits such as diversification. On the borrowing side, firms choose between informationally sensitive loans (bank loans) and informationally insensitive debt securities (nonbank financed loans), which are also imperfect substitutes. While both bank loans and nonbank finance loans provide financing, they differ in ex ante screening and ex post monitoring, making them distinct from the borrower's perspective.

The intermediation sector comprises two types of intermediaries: banks and OTD intermediaries. Banks are unique in their ability to offer both deposits and informationally sensitive loans, whereas the OTD sector can only originate informationally insensitive loans and issue securities. Banks can invest in securities even when they earn the same returns as other savers, implying that deposits are partly invested in securities that investors could hold directly. Intermediation introduces a wedge between the (risk-adjusted) returns paid by borrowers and those earned by savers. Imperfect substitution gives intermediaries market power, producing a gap between household returns on deposits and securities and the lending rates set by intermediaries. Banks also provide working capital to the nonbank financial intermediation sector, meaning that a portion of nonbank lending is financed by informationally sensitive bank loans.

The monetary authority, funded by currency and reserves, can influence long-term interest rates and conduct asset purchases or sales (e.g., MBS) at market prices through QE or quantitative tightening (QT) policies. Banks hold central bank reserves, which they treat as imperfect substitutes for other securities. Equilibrium returns and quantities for saving and borrowing technologies are jointly determined by the preferences of savers and borrowers and the wedges introduced by intermediaries. For example, the rate savers earn on deposits relative to T-bills reflects both savers' substitution preferences—which affect markups—and the equilibrium wedges banks face in funding and lending markets. These wedges, shaped by banks' balance sheet conditions, are only partially passed through to deposit rates due to market power.

A distinctive feature of Buchak et al.'s (2025) model is its explicit treatment of the coexistence and interconnectedness of bank balance sheet intermediation and OTD intermediation via bank securities holdings. This structure allows them to examine how the interaction between these two models shapes equilibrium saving and borrowing outcomes. A key takeaway is that, under current conditions, bank balance sheet size is driven more by saver demand for deposits than by borrower demand for loans. Marginal increases in deposits are often invested in securities funding informationally insensitive lending rather than in new bank loans. A second important insight is

that the decline in traditional bank balance sheet intermediation has altered the trade-offs faced by macroprudential policy: Higher capital or liquidity requirements lead to only modest reductions in total lending, as declines in bank lending are offset by greater debt securities issuance.

Buchak et al.'s (2025) framework allows analyzing the implications of the shift away from the traditional bank-based model of intermediation for monetary policy transmission. In what follows, we summarize their findings on how both conventional and unconventional monetary policy propagate through today's interconnected system of bank and nonbank financial intermediation.

## 5.1. Conventional Monetary Policy

First, we discuss how, in Buchak et al.'s (2024b, 2025) framework, a stylized version of conventional monetary policy can impact lending, its composition, and the allocation of savings. In their counterfactuals, conventional monetary policy is defined as a shock to both the benchmark interest rate and the rate on reserves. In **Table 1**, panel *a* summarizes these mechanisms and their net effects across the six margins. In both cases, the interaction of these margins produces broad, system-wide changes in credit conditions, amplifying the initial policy move.

Under conventional monetary policy, a reduction in interest rates lowers banks' funding costs and sets off changes along multiple interconnected margins. On the balance sheet loan retention margin, cheaper funding encourages banks to keep more originated loans on their balance sheets rather than selling them into secondary markets. The securities holdings margin also shifts meaningfully, as lower yields prompt banks to hold more debt securities, substituting toward higher-yielding but still relatively safe instruments—a sizeable effect given their broad appeal in a low-rate environment. In parallel, the shadow bank lending substitution margin operates as savers, and banks increase their demand for nonbank credit instruments; the yield decline here is moderate but still stimulates an increase in the capital market-based lending.

On the deposit substitution margin, imperfect pass-through means that deposit rates fall by less than risk-free rates, making deposits relatively more attractive to savers compared with nonbank saving vehicles. This induces sizeable deposit inflows into banks, bolstering their funding base and reflecting the deposit channel of monetary policy. These excess deposit inflows are allocated toward both new bank lending and increased debt securities purchases. The bank-to-nonbank lending margin adjusts as both channels expand: Bank lending rises more strongly than nonbank lending, though the latter still sees a moderate increase. Finally, on the balance sheet valuation margin, as analyzed by Jiang et al. (2024) the fall in market yields increases the value of banks' existing securities and loans—a positive effect on the asset side that can improve balance sheet strength and support further intermediation, depending on the extent of adjustment on the deposit side.

Overall, a decrease in interest rates leads to a sizable decline in loan rates and debt security yields, along with a sizable increase in lending to households and firms. Although both bank and nonbank lending expand, the growth of bank balance sheet lending, further supported by deposit inflows into the banking system, is sufficiently large to raise the overall fraction of loans in the economy that are financed by banks.

When rates rise, these dynamics reverse. Higher funding costs lead to a rising cost of credit to households and firms. To retain fewer loans, banks shift away from riskier debt securities toward safer assets and reduce demand for nonbank credit instruments. Deposits become less attractive relative to market alternatives, leading to sizeable outflows and tightening of the deposit channel. Both bank and nonbank lending contract, with a sharper pullback in bank lending. Asset valuations fall, potentially weakening balance sheet strength, dampening intermediation, and increasing bank instability.

Table 1 Conventional and unconventional monetary policy effects

| a. Conventional monetary policy tool (rate cut versus rate hike)                            |                                                                                                                                                                                                                                    |                                                                                                                                                                                                              |
|---------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Adjustment margin                                                                           | Rate cut (↓ policy rate)                                                                                                                                                                                                           | Rate hike (↑ policy rate)                                                                                                                                                                                    |
| Balance sheet loan retention margin                                                         | Banks originate and retain more loans (cheaper funding, stronger demand)                                                                                                                                                           | Banks originate and retain fewer loans (costlier funding, weaker demand)                                                                                                                                     |
| Securities holdings margin                                                                  | ↑ Banks increase their holdings of securities                                                                                                                                                                                      | ↓ Banks decrease their holdings of securities                                                                                                                                                                |
| Shadow bank lending substitution margin                                                     | ↑ Debt security issuance increases; ↑ shadow banks expand lending                                                                                                                                                                  | ↓ Debt security issuance decreases; ↓ shadow banks decrease lending                                                                                                                                          |
| Deposit substitution margin                                                                 | ↑ Deposit inflows into banks; ↑ bank assets expand                                                                                                                                                                                 | ↓ Deposit outflows toward nonbank alternatives; ↓ bank assets contract                                                                                                                                       |
| Bank-to-nonbank lending margin                                                              | ↑ Lending to nonbank intermediaries increases                                                                                                                                                                                      | ↓ Lending to nonbank intermediaries decreases                                                                                                                                                                |
| Balance sheet valuation margin                                                              | ↑ Value of existing loans and securities on bank balance sheets increases (mark-to-market gains); the value of bank liabilities changes dependent on the bank-specific deposit franchise; ↓ overall bank solvency concerns decline | ↓ Value of existing loans and securities declines (mark-to-market losses); the value of bank liabilities changes dependent on the bank-specific deposit franchise; ↑ overall bank solvency concerns increase |
| Net effect                                                                                  | ↑ Sizable increase in aggregate lending; ↑ bank balance sheet lending share increases                                                                                                                                              | ↓ Sizable decrease in aggregate lending; ↓ bank balance sheet lending share decreases                                                                                                                        |
| b. Unconventional monetary policy tool (quantitative easing versus quantitative tightening) |                                                                                                                                                                                                                                    |                                                                                                                                                                                                              |
| Adjustment margin                                                                           | Quantitative easing (central bank buys debt securities)                                                                                                                                                                            | Quantitative tightening (central bank sells debt securities)                                                                                                                                                 |
| Balance sheet loan retention margin                                                         | Banks retain fewer originated loans (shift toward reserves)                                                                                                                                                                        | Banks retain more originated loans (replace lost reserves with loans)                                                                                                                                        |
| Securities holdings margin                                                                  | ↓ Banks decrease their holdings of securities; ↑ banks increase their reserves holdings                                                                                                                                            | ↑ Banks increase their holdings of securities; ↓ banks decrease their reserves holdings                                                                                                                      |
| Shadow bank lending substitution margin                                                     | ↑ Debt security issuance increases; ↑ shadow banks expand lending                                                                                                                                                                  | ↓ Debt security issuance decreases; ↓ shadow banks contract lending                                                                                                                                          |
| Deposit substitution margin                                                                 | Little effect                                                                                                                                                                                                                      | Little effect                                                                                                                                                                                                |
| Bank-to-nonbank lending margin                                                              | ↑ Lending to nonbank intermediaries increases                                                                                                                                                                                      | ↓ Lending to nonbank intermediaries decreases                                                                                                                                                                |
| Balance sheet valuation margin                                                              | ↑ Value of targeted securities increases (mark-to-market gains); ↓ overall bank solvency concerns decline                                                                                                                          | ↓ Value of targeted securities decreases (mark-to-market losses); ↑ overall bank solvency concerns increase                                                                                                  |
| Net effect                                                                                  | ↑ Moderate increase in aggregate lending; ↓ bank balance sheet lending share decreases                                                                                                                                             | ↓ Moderate decrease in aggregate lending; ↑ bank balance sheet lending share increases                                                                                                                       |

This table summarizes the effects of monetary policy across six margins—balance sheet loan retention, securities holdings, shadow bank lending substitution, deposit substitution, bank-to-nonbank lending, and balance sheet valuation—drawing on Buchak et al. (2024b, 2025) and, for the balance sheet valuation margin, Jiang et al. (2024). Panel *a* reports the effects of conventional monetary policy (rate cuts and hikes), while panel *b* reports the effects of unconventional monetary policy (quantitative easing and quantitative tightening).

5.2. Unconventional Monetary Policy

In contrast to conventional tools, unconventional monetary policy, such as QE or QT, operates through different mechanisms. Buchak et al. (2025) examine QE by counterfactually increasing the central bank’s holdings of government-sponsored MBS, financed by issuing an equal number of reserves to banks. This exercise isolates the effects of asset purchases from those of the conventional rate cuts that often accompany them. In Table 1, panel *b* summarizes the effects of

the unconventional policy mechanisms across the six margins. Taken together, these results show that policies that overlook the adjustment margins—whether rate changes, large-scale asset purchases, or regulatory adjustments—risk misjudging their true effects on aggregate lending, credit composition, and financial stability.

The direct impact of QE is concentrated on the securities holdings margin: Large-scale purchases raise the price and lower the yield of targeted assets, and MBS rates fall substantially, in line with historical estimates. However, because purchases from banks simply swap MBS for reserves, bank balance sheet capacity does not expand materially. Instead, banks reallocate within existing balance sheets, reducing their holdings of debt securities and increasing reserve holdings. This portfolio reshuffling limits the pass-through to other rates, dampening conventional loan-pricing effects. On the balance sheet retention margin, the shift toward reserves and away from loans leads banks to retain fewer originated loans.

As MBS rates drop sharply, the shadow bank lending substitution margin becomes active as QE stimulates debt security issuance, a funding form on which shadow banks depend. This change is reflected in the bank-to-nonbank lending margin, where direct bank lending contracts and bank lending to nonbank intermediaries expands. On the deposit substitution margin, QE exerts little direct influence, as the policy primarily changes asset composition rather than altering deposit rates; deposit flows remain largely unaffected. Finally, on the balance sheet valuation margin, targeted asset price can increase the value of existing MBS holdings, but the overall valuation effect on bank portfolios is more muted relative to a rate cut.

Overall, QE increases the overall lending but only to a moderate degree. This is because while it leads to debt security issuance expansion among the target debt instruments, it also contracts the bank balance sheet lending to households and firms by reallocating credit from banks to capital markets, shifting the composition toward less relationship intensive, more standardized lending. As a result, following the QE intervention the fraction of loans in the economy directly financed on bank balance sheets declines.

QT, as the mirror image of QE, operates by reducing the central bank's holdings of targeted securities and draining reserves from the banking system. Instead of lowering yields, QT places upward pressure on the rates of the securities being sold—for example, MBS yields rise—while reducing their market value. On bank balance sheets, the contraction of reserves forces banks to rebalance in the opposite direction, replacing lost reserves with balance sheet lending and increased holdings of debt securities and reducing their lending to nonbank intermediaries. This raises the fraction of loans in the economy that are directly financed on bank balance sheets. Overall, QT shifts credit provision away from capital markets and back toward banks, moderately reducing aggregate lending.

Importantly, QE and QT in practice involve simultaneous changes in asset holdings and policy rates. The counterfactuals presented here are designed to isolate the effects of rate cuts and asset purchases separately. However, the overall policy impact would typically involve the combination of these two channels.

## **6. IMPLICATIONS FOR BANK REGULATION AND RISK SUPERVISION**

The above insights also have important implications for bank capital regulation, bank risk supervision, and their interaction with monetary policy. The conventional view has long been that raising bank capital or liquidity requirements would sharply reduce lending. However, the research surveyed here suggests that this concern is overstated.

First, US banks appear significantly overleveraged compared with nonbank lenders, which typically maintain capital buffers more than twice as large as traditional banks (Jiang et al. 2020). At the same time, as Jiang et al. (2024) document, banks face substantial interest rate exposure, leaving

them highly vulnerable to monetary tightening that compresses asset values and increases bank solvency risk. Bank equity holders, moreover, may be reluctant to recapitalize or insure against this risk (Granja et al. 2024). Against this backdrop, stronger capital requirements or mandated recapitalization could help mitigate bank solvency risk and reduce fragility.

Second, because only about one-third of lending to households and firms is currently financed directly on bank balance sheets, tighter capital standards would likely have only a modest effect on aggregate lending. Instead, they would primarily reallocate credit toward nonbank intermediaries, operating through the substitution and retention margins of modern intermediation (Buchak et al. 2024a,b, 2025).

This reallocation has two key implications for monetary policy. First, it tempers the contractionary effect of higher capital requirements on aggregate lending, while also blunting the traditional bank lending channel as credit migrates outside the regulatory perimeter. Second, by lowering bank leverage and reducing banks' exposure to interest rate risk, stricter capital regulation enhances the stability of banks' responses to monetary policy, making them less likely to amplify tightening through insolvency or fire sales.

Within this broader regulatory framework, the Federal Reserve's supervisory tools—most notably, its annual stress tests—also warrant reconsideration. As emphasized by Jiang et al. (2025) the current bank stress-testing framework continues to overlook key vulnerabilities, particularly the risk of rising interest rates and the fragility posed by uninsured deposits. Moreover, while the focus remains on the largest banks, smaller regional banks often face disproportionately high exposure to both credit and duration risk, suggesting that stress testing should be broadened to better capture vulnerabilities across the system.

## 7. CONCLUSION AND DISCUSSION

The financial system has fundamentally changed: Banks no longer dominate credit creation, and shadow banking has introduced new margins of adjustment that blunt the effects of both monetary policy and financial regulation. Recognizing the balance sheet retention and substitution margins is essential for understanding the true transmission of monetary policy and the stability of the banking system. As such, both macroeconomic modeling and regulatory design must adapt to the new architecture of financial intermediation. Conventional and unconventional monetary policy operate through different channels, and their effects differ sharply depending on how the intermediation system is structured.

### 7.1. Interconnectedness and Reallocation

A central lesson is the need to recognize the interconnectedness of intermediaries. Much of the adjustment to monetary policy shocks takes the form of reallocation—away from bank balance sheets and toward debt securities and the broader nonbank sector. This reallocation reshapes the composition of credit, redistributes risks across institutions, and alters the effectiveness of monetary and regulatory tools, even when the aggregate quantity of credit changes only modestly. Similar considerations apply to capital and liquidity regulation, which may no longer exert the same contractionary force on aggregate lending as once feared but instead primarily reallocate credit toward less regulated segments of the financial system (Buchak et al. 2018, 2024a,b, 2025). Policymakers must therefore shift their focus from the size of bank activity alone to the broader ecosystem of credit intermediation, where different players, funding models, and guarantees interact.

### 7.2. The Measurement Challenge

Equally important is the measurement challenge. As shown by Buchak et al. (2024a), focusing exclusively on bank balance sheet data—such as call reports—provides only a partial and often very

misleading picture of lending dynamics. A large share of credit creation now occurs outside the balance sheets of traditional banks, whether through shadow banks, securitization, or loans sold into secondary markets. More broadly, recent work underscores the limitations of bank balance sheets as a source of data on lending and highlights the critical importance of collecting and making available data that capture total lending activity across both banks and nonbank intermediaries, including loans not retained on financial institutions' balance sheets. Without such comprehensive measurement, empirical work risks producing biased estimates of monetary and regulatory policy, misattributing movements in credit supply, or even assigning the wrong sign to the effect of a given intervention (Buchak et al. 2024a). Better data collection—covering flows, holdings, and reallocation channels across the entire financial system—is therefore essential for both academic research and effective policy design.

### 7.3. Welfare Implications

Looking forward, the next step is to assess the welfare implications of this transformation. It is not enough to document how credit is reallocated; we must also ask whether it matters where lending occurs and under what institutional guarantees. Does the migration of credit toward nonbank intermediaries enhance efficiency and resilience, or does it raise new vulnerabilities and hidden forms of systemic risk? How do these shifts interact with monetary policy goals and explicit and implicit guarantees provided by the government, deposit insurance, or central bank backstops? These questions speak directly to the ultimate goals of monetary policy and financial regulation.

### 7.4. Directions for Future Research

Future research should incorporate the monetary policy constraints arising from financial stability concerns—such as those identified by Jiang et al. (2024, 2025)—into the analysis of monetary policy. This should also include recognition of the potential for multiple equilibria and bank runs in response to policy changes as well as of the broader macroeconomic and welfare consequences of credit reallocation between the bank and nonbank sectors. The ultimate objective should be to further develop a modern financial intermediation framework proposed by Buchak et al. (2024b, 2025) that enables a shift from positive to normative analysis—evaluating not only how monetary and regulatory interventions transmit through the system but also which policies best balance resilience, efficiency, and credit provision. In a financial system that is increasingly interconnected, heterogeneous, and reliant on diverse margins of adjustment, developing such a framework is a pressing priority for both scholars and policymakers.

## DISCLOSURE STATEMENT

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## LITERATURE CITED

- Acharya V, Gopal M, Jager M, Steffen S. 2025. Shadow always touches the feet: implications of bank credit lines to non-bank financial intermediaries. NBER Work. Pap. 33590
- Amador M, Bianchi J. 2024. Bank runs, fragility, and credit easing. *Am. Econ. Rev.* 114:2073–110

- Begenau J, Landvoigt T. 2022. Financial regulation in a quantitative model of the modern banking system. *Rev. Econ. Stud.* 89:1748–84
- Begenau J, Piazzesi M, Schneider M. 2025. Banks' risk exposures. NBER Work. Pap. 21334
- Bianchi J, Bigio S. 2022. Banks, liquidity management, and monetary policy. *Econometrica* 90:391–454
- Brunnermeier MK, Sannikov Y. 2014. A macroeconomic model with a financial sector. *Am. Econ. Rev.* 104:379–421
- Buchak G, Matvos G, Piskorski T, Seru A. 2018. Fintech, regulatory arbitrage, and the rise of shadow banks. *J. Financ. Econ.* 130:453–83
- Buchak G, Matvos G, Piskorski T, Seru A. 2024a. Aggregate lending and modern financial intermediation: why bank balance sheet models are miscalibrated. *NBER Macroecon. Annu.* 38:239–87
- Buchak G, Matvos G, Piskorski T, Seru A. 2024b. Beyond the balance sheet model of banking: implications for bank regulation and monetary policy. *J. Political Econ.* 132:616–93
- Buchak G, Matvos G, Piskorski T, Seru A. 2025. Monetary policy, bank regulation and the secular decline of bank balance sheet lending. Work. Pap., National Bureau of Economic Research. [https://conference.nber.org/conf\\_papers/f226479.pdf](https://conference.nber.org/conf_papers/f226479.pdf)
- Chernenko S, Ialenti R, Scharfstein D. 2025. Bank capital and the growth of private credit. Work. Pap., Purdue University
- Cookson JA, Fox C, Gil-Bazo J, Imbet JF, Schiller CM. 2026. Social media as a bank run catalyst. *J. Financ. Econ.* 176:104218
- Corbae D, D'Erasmo P. 2021. Capital buffers in a quantitative model of banking industry dynamics. *Econometrica* 89:2975–3023
- Crosignani M, Prazad S. 2024. Extend-and-pretend in the U.S. CRE market. Staff Rep. 1130, Federal Reserve Bank of New York
- Davilla E, Goldstein I. 2023. Optimal deposit insurance. *J. Political Econ.* 131:1676–730
- DeMarzo, Krishnamurthy A, Nagel S. 2024. Interest rate risk in banking. NBER Work. Pap. 33308
- Diamond DW. 1984. Financial intermediation and delegated monitoring. *Rev. Econ. Stud.* 51:393–414
- Diamond DW, Dybvig PH. 1983. Bank runs, deposit insurance, and liquidity. *J. Political Econ.* 91:401–19
- Diamond DW, Rajan RG. 2001. Liquidity risk, liquidity creation, and financial fragility: a theory of banking. *J. Political Econ.* 109:287–327
- Diamond WF, Jiang Z, Ma Y. 2024. The reserve supply channel of unconventional monetary policy. *J. Financ. Econ.* 159:103887
- Drechsler I, Savov A, Schnabl P. 2017. The deposits channel of monetary policy. *Q. J. Econ.* 132:1819–76
- Drechsler I, Savov A, Schnabl P. 2021. Banking on deposits: maturity transformation without interest rate risk. *J. Finance* 76:1091–143
- Drechsler I, Savov A, Schnabl P, Wang O. 2024. Deposit franchise runs. NBER Work. Pap. 31138
- Egan M, Matvos G, Hortaçu A. 2017. Deposit competition and financial fragility: evidence from the US banking sector. *Am. Econ. Rev.* 107:169–216
- Flannery MJ, Sorescu SM. 2023. Partial effects of Fed tightening on U.S. banks' capital. Work. Pap., University of Florida
- Goldstein I, Pauzner A. 2005. Demand–deposit contracts and the probability of bank runs. *J. Finance* 60:1293–327
- Gorton GB. 2010. *Slapped by the Invisible Hand: The Panic of 2007*. Oxford University Press
- Granja J, Jiang E, Matvos G, Piskorski T, Seru A. 2024. Book value risk management of banks: limited hedging, HTM accounting, and rising interest rates. NBER Work. Pap. 32293
- Hachem K, Song Z. 2021. Liquidity rules and credit booms. *J. Political Econ.* 129:2721–65
- Haddad V, Hartman-Glaser B, Muir T. 2023. *Bank fragility when depositors are the asset*. Unpublished manuscript
- Hannan TH, Berger AN. 1991. The rigidity of prices: evidence from the banking industry. *Am. Econ. Rev.* 81:938–45
- He Z, Krishnamurthy A. 2013. Intermediary asset pricing. *Am. Econ. Rev.* 103:732–70
- Ivashina V, Scharfstein D. 2010. Bank lending during the financial crisis of 2008. *J. Financ. Econ.* 97:319–38
- Jiang E. 2023. Financing competitors: shadow banks' funding and mortgage market competition. *Rev. Financ. Stud.* 36(October):3861–905

- Jiang E, Matvos G, Piskorski T, Seru A. 2020. Which banks are (over) levered? Insights from shadow banks and uninsured leverage. NBER Work. Pap. 26903
- Jiang E, Matvos G, Piskorski T, Seru A. 2024. Monetary tightening and U.S. bank fragility in 2023: mark-to-market losses and uninsured depositor runs? *J. Financ. Econ.* 159:103899
- Jiang E, Matvos G, Piskorski T, Seru A. 2025. Monetary tightening, commercial real estate distress, and US bank fragility. *J. Political Econ. Macroecon.* 3(4):525–73
- Kashyap A, Rajan R, Stein J. 2002. Banks as liquidity providers: an explanation for the coexistence of lending and deposit-taking. *J. Finance* 57:33–73
- Kashyap AK, Stein JC. 2000. What do a million observations on banks say about the transmission of monetary policy? *Am. Econ. Rev.* 90:407–28
- Koont N, Santos T, Zingales L. 2024. Destabilizing digital “bank walks.” Work. Pap. 328, George J. Stigler Center for the Study of the Economy and the State, Booth School of Business, University of Chicago
- Krishnamurthy A, Vissing-Jorgensen A. 2011. The effects of quantitative easing on interest rates: channels and implications for policy. *Brook. Pap. Econ. Act.* 2011:215–87
- Neumark D, Sharpe SA. 1992. Market structure and the nature of price rigidity: evidence from the market for consumer deposits. *Q. J. Econ.* 107:657–80
- Office of the Comptroller of the Currency. 2021. High business debt does not represent a “bubble.” *Onpoint*, June 1. <https://www OCC.gov/publications-and-resources/publications/economics/on-point/pub-on-point-business-debt.pdf>
- Rodnyansky A, Darmouni O. 2017. The effects of quantitative easing on bank lending behavior. *Rev. Financ. Stud.* 30:3858–88
- Sundaresan MS, Xiao K. 2023. Liquidity regulation and banks: theory and evidence. *J. Financ. Econ.* 151:103747
- Xiao K. 2020. Monetary transmission through shadow banks. *Rev. Financ. Stud.* 33:2379–420