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ABSTRACT

This paper examines the decline of the bank balance sheet model of financial intermediation since 1970 and its regulatory implications. The share of private lending on bank balance sheets fell from 55% in the 1970s to 33% in 2023, while the deposit share of savings dropped from 21% to 13%. Loans as a percentage of bank assets also declined from 70% to 55%. We develop a model that captures the interaction between bank balance sheets and originate-to-distribute (OTD) intermediation through securities holdings. Our analysis identifies three key factors driving these trends: a shift in borrower demand toward informationally insensitive lending, a shift in saver demand away from deposits, and evolving regulations affecting bank balance sheets. Regulatory changes and technological advancements primarily drive these shifts. Borrower demand plays a dominant role in reducing balance sheet lending, particularly from the 1970s to the 1990s. Saver demand shifts away from deposits have reduced bank balance sheets but had a smaller impact on overall lending. Bank regulation, especially since the financial crisis, has altered bank balance sheet composition. Simulations of increased capital requirements show that while balance sheets contract in both the 1960s and 2020s, the impact on overall lending is smaller today due to the substitution of bank loans with debt securities. These results suggest the financial sector has become more resilient to regulatory changes, with the decline in bank balance sheet intermediation reshaping the trade-offs faced by macroprudential policies and financial regulation.

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1. Introduction

Key policies on financial regulations, monetary measures, and bank bailouts are shaped by the traditional view of banks' balance sheets as central to financial intermediation. In this framework, banks connect savers and borrowers by issuing demandable deposits to savers and using the proceeds to make informationally sensitive loans (Diamond and Dybvig 1983; Diamond and Rajan 2001; Kashyap et al. 2023). This paper documents two main facts. First, the bank balance sheet model of intermediation has significantly declined over the past half-century. Instead, private credit is increasingly intermediated through arms-length transactions, where a lender originates loans and sells them via debt securities—known as the originate-to-distribute (OTD) model (see Keys et al. 2010, 2013; Buchak et al. 2018, 2024). While the shift toward OTD intermediation has been widely studied in the post-Great Financial Crisis context, we show that this trend is much more secular, with significant growth even during the 1980s and 1990s, affecting both deposits and various loan segments.

Second, we show that the balance sheet and OTD models are interconnected through bank securities holdings, as banks hold a significant share of securities produced by the OTD sector. While the traditional bank balance sheet model has declined, the share of securities on bank balance sheets has increased. This is noteworthy for several reasons. One, it suggests that the marginal dollar of bank funding may not be used for "informationally sensitive" balance sheet lending. Two, the extent of securities held by banks significantly affects how banking sector interventions influence overall lending in the economy.

We develop a model that captures the interaction between bank balance sheets and OTD intermediation through securities holdings. The need for such a model arises when considering two extreme scenarios. In the first, a "bank-centric" model, all OTD securities are held by banks, meaning deposits fund securities that finance informationally insensitive loans. A contraction in bank balance sheets would then lead to a contraction in both bank and OTD lending, making bank balance sheets crucial for financial intermediation. In the second, a "full decoupling" scenario, banks hold no OTD securities. Here, contractions in bank balance sheets could be offset by OTD expansion, reducing the impact on overall lending. Given that intermediation currently falls between these two extremes, our model allows us to examine the quantitative economic consequences of the secular decline in bank balance sheet lending.

Our model incorporates the coexistence of bank balance sheet intermediation and originate-to-distribute (OTD) intermediation, with a key distinction from existing work: it allows for the interconnectedness between the two through bank securities holdings. This framework enables us to study how the interaction between these intermediation models shapes equilibrium outcomes for saving and borrowing. A key takeaway from the model is that, in the current economic environment, the size of bank balance sheets is driven more by saver demand for deposits than borrower demand for loans. Marginal increases in deposits are largely invested in securities that fund informationally insensitive lending, rather than directly supporting bank loans. Additionally, the model explores the broader implications of the shift away from traditional bank balance sheet lending on financial regulation. A second key insight is that the significant decline in bank balance sheet intermediation has altered the trade-offs faced by macroprudential policies. For example, higher capital or liquidity requirements lead to only a modest reduction in overall lending, as the contraction in bank balance sheet lending is offset by increased issuance of debt securities.

We begin by highlighting key trends that illustrate the decline of the traditional bank balance sheet model. First, the share of "informationally sensitive lending" (bank balance sheet lending) peaked at around 55% in the early 1970s but has since nearly halved to 33%. This decline extends beyond loans eligible for securitization by government-sponsored entities (GSEs), affecting loans ineligible for such guarantees, including non-mortgage loans. Second, on the savers' side, the deposit share of household savings has dropped from 21% to roughly 13%, as savers increasingly allocate wealth to alternative savings vehicles such as securitized private credit and Treasury securities. Third, banks have adjusted their business models: in 1970, loans made up 70% of bank assets, but by 2023, this figure had fallen to 55%, with a larger share of bank funding now directed towards purchasing securities created by the OTD sector. Finally, despite these significant shifts in quantities, we observe that price changes have been minimal—spreads on deposits, loans, and credit securities have remained largely stable during this period of dramatic change in volumes.

We consider three broad institutional forces that likely contributed to these trends, which we later incorporate into the construction of our model. First, there has been a shift in borrower demand toward informationally insensitive lending. Second, saver preferences have moved from traditional deposits to alternative savings technologies. Third, evolving government regulations, including the relaxation of interstate banking and post-GFC reforms, have altered the implicit costs and subsidies associated with bank balance sheet lending and funding. We explore various technological, institutional, and regulatory changes driving these shifts, such as the introduction of GSE and private securitization, the automation and standardization of loan origination, the rise of alternative investment and retirement vehicles, and the evolving bank regulatory landscape through the 1980s, 1990s, and post-GFC period. We then formalize these associations using a structural model. Collectively, these forces have coincided with—and likely contributed to—the significant decline in the role of bank balance sheet lending over the past half-century, influencing the extent to which banks hold securities originated by the OTD sector.

We then provide micro-evidence supporting these three forces. First, using the variation in mortgage eligibility for securitization by Government Sponsored Enterprises, following Buchak et al. (2024), we find that reductions in OTD frictions lead to a decline in informationally sensitive bank balance sheet lending and a shift in bank assets from loans toward securities. Second, we demonstrate that the rise of "shadow money" debt financing could explain approximately 40% of the decline in bank balance sheet lending during the 1970-1990 period. Lastly, we show that banks subject to heightened regulatory regimes following the GFC experienced a relative decline in the loan share of their assets and slower growth in bank balance sheet lending. These results suggest that stricter regulatory requirements, including enhanced liquidity and capital standards, coincided with a shift in bank balance sheets away from loans, contributing to the decrease in bank balance sheet lending.

In the second part of the paper, we construct a model in which bank balance sheet intermediation interacts with OTD intermediation, introducing two key departures from the existing literature. First, the model is designed to explore the role of intermediation frictions and household preferences in shaping long-term intermediation trends. As a result, we incorporate a rich set of intermediation frictions, at the expense of modeling dynamics, which are more relevant for explaining business cycle fluctuations.

The second departure is that we explicitly model the interconnectedness between bank balance sheets and OTD intermediation through bank securities holdings. Several existing models examine the interaction between the bank balance sheet and shadow banking sectors, focusing on lending, liability creation, or both.[1] Like these models, ours treats the two sectors as *imperfect substitutes*. However, as we document, banks have increasingly invested in informationally insensitive securities as their balance sheet intermediation has declined. Banks invest in securities because they are more liquid than loans, helping them manage liquidity shocks in the spirit of Diamond and Dybvig (1983). Additionally, when their balance sheets are "too large"—when deposit attraction and rent-earning exceed the optimal level of informationally sensitive lending—banks turn to securities. This interconnectedness suggests that a contraction in bank balance sheets may reduce OTD intermediation, even though the two sectors provide substitutable saving and borrowing technologies.

The broad outline of our model is as follows: the financial intermediation sector creates borrowing and savings technologies. Intermediaries offer savers two types of financial products—bank deposits and securities, which may include debt securities, equities, or treasuries. These securities are imperfect substitutes for deposits, differing in the transaction services they provide and other characteristics such as diversification benefits for household portfolios. On the borrowing side, firms can choose between informationally sensitive loans or informationally insensitive debt securities, which are also imperfect substitutes. For instance, bank loans and bonds both allow firms to borrow, but they differ in ex ante screening and ex post monitoring, making them imperfect substitutes from the borrowers' perspective.

The intermediation sector consists of two types of intermediaries: "banks" and "OTD" intermediaries.[2] Banks play a central role because they are the only intermediaries that can offer deposits and informationally sensitive loans, whereas the OTD sector can only create

[1] Buchak et al. (2018), Ordonez (2018), Xiao (2020), Corbae and D'Erasmo (2021), Begenau and Landgvoit (2022).
[2] When applying the model to the institutional setting and data, only banks (depository institutions) can perform what we refer to as "banking" activities. However, a significant portion of OTD intermediation is also conducted by traditional banks (see Buchak et al. 2024). Thus, the definition of the OTD sector is functional rather than strictly institutional.

informationally insensitive loans and issue securities. As emphasized earlier, banks can invest in securities despite earning the same returns as other savers, meaning deposits are partly invested in securities that investors could own directly. Intermediation introduces a wedge between (risk adjusted) returns paid by borrowers and those earned by savers. Imperfect substitution gives intermediaries market power, leading to a gap between the rates paid and earned by households and those set by intermediaries. Critically, borrower demand for similarly priced informationally sensitive and insensitive lending is allowed to fluctuate over time, reflecting implicit shifts in borrower demand. These shifts capture factors like technological advancements that increase the efficiency of informationally insensitive lending and institutional changes, such as the expansion of government loan guarantees. Additionally, banks provide working capital to the OTD sector, with a portion of the OTD sector financed by informationally sensitive bank loans.[3]

We derive the equilibrium returns and quantities for saving and borrowing technologies based on the preferences of savers, borrowers, and the wedges faced by intermediaries. For example, we determine the rate savers earn on deposits relative to T-Bills (outside securities) as a function of savers' substitution preferences, which influence mark-ups, and the equilibrium intermediation wedges banks face in both funding and lending activities. These wedges, shaped by the endogenous state of banks' balance sheets, are only partially passed through to deposit rates due to the banks' market power.

We combine equilibrium intermediary price setting with bank balance sheet decisions to estimate the frictions faced by banks, as well as the substitution preferences of savers and borrowers. Intuitively, the pass-through of risk-free rates to deposit rates, loan rates, and bank equity returns allows us to estimate the parameters governing price setting. Similarly, we estimate the substitution parameter for borrowing rates. To address the endogeneity of treasury rates, we follow Krishnamurthy and Li (2022) and use the total quantity of treasury securities as an instrument. The remaining preferences and frictions are calibrated to match the time series of prices and quantities.

Our estimates indicate that shifts in borrower demand between informationally sensitive and insensitive lending have been the primary driver of changes in aggregate lending over the past half-century. Specifically, our model identifies a significant rise in borrower demand for lending financed by government-affiliated securitization from the 1970s to the 1990s, coinciding with the growing role of Government-Sponsored Enterprises (GSEs). The private sector also made considerable advances in securitization technology during the 1980s, alongside broader improvements in financial information technology and credit scoring. We formalize this narrative by regressing our estimated borrower demand shifters on indices of regulation and technology, finding that both significantly contribute to the rise of informationally insensitive lending. Furthermore, we reject the idea that increases in firm intangibles or R&D expenses explain the shift away from bank lending, as these factors would predict more informationally sensitive lending over time. Our analysis suggests that borrower demand shifts alone account for an 8%

[3] See Jiang (2023) in the context of residential mortgages.

increase in aggregate lending compared to a scenario without these advancements. These shifts also largely explain the decline in informationally sensitive lending, particularly in the early part of our sample, highlighting the critical role of technological progress in expanding credit availability and reshaping the financial intermediation sector. [4]

We estimate a significant shift in saver preferences during the 1980s, with individuals increasingly favoring securities over traditional bank deposits. These changing preferences had a substantial impact on the *size* of bank balance sheets and deposit funding but were less critical for aggregate lending in the economy. This shift coincided with the rise of money market funds, the evolution of modern pension funds, and growing foreign demand for U.S. assets. We formalize this narrative by projecting saver demand shifts onto technological and regulatory advancements, finding that both played significant roles. Our model suggests that bank balance sheets are approximately 19% smaller than they would have been if saver preferences had remained constant. However, the shift in depositor preferences had little effect on aggregate lending or the decline in informationally sensitive bank lending. Intuitively, bank balance sheets are large not because of attractive lending opportunities but due to the high demand for deposits from savers. Excess deposits are then invested in securities rather than loans. This underscores how saver behavior, rather than borrower demand (or bank lending opportunities), has become a key driver of the size and composition of bank balance sheets.

The financial landscape has been further shaped by shifts in implicit subsidies and costs, especially following the global financial crisis. We estimate that the post-crisis period saw an increase in implicit subsidies for bank deposits and equity, while the implicit costs associated with bank loans also rose. These changing implicit bank costs and subsidies have contributed to the declining share of informationally sensitive lending and the shrinking proportion of loans on bank balance sheets, particularly in the latter half of our study period. Since the mid-2000s, it has become implicitly more expensive for banks to issue loans, prompting them to pivot towards holding securities rather than extending credit. This shift in bank behavior underscores how regulatory and economic changes influence resource allocation by banks and the intermediary sector.

Finally, we use the model to demonstrate that the impact of increased capital or liquidity requirements on aggregate lending has diminished over time, even though the effect on bank balance sheet intermediation remains significant. We simulate raising capital requirements to 25% in both a 1963 and 2023 economy, finding that while bank balance sheets contract considerably in both cases, the effect on aggregate lending is more modest, particularly in the 2023 scenario, where lending declines by less than half of the impact seen in 1963. We observe similar results for

[4] These findings connect with the literature in banking that has emphasized the role of "soft information" — i.e., information that is based on interactions between banks and potential borrowers and is difficult to transmit to third party — in lending (e.g., Petersen and Rajan 1994; Stein 2002). It is understood that adoption of information and credit scoring technology over time has helped "harden" part of the soft information, allowing for a greater "distance" between the bank and borrowers (Petersen and Rajan 2002) as well as between originators of risk (i.e., lender) and investors who ultimately hold the risk in the intermediation chain (Rajan et al. 2014).

liquidity requirements. This indicates that, despite the connection between bank balance sheet and OTD intermediation through securities holdings, the substitution effect found in prior literature still dominates. The reduction in bank lending is partially offset by an increase in lending through debt securities. As a result, higher capital or liquidity requirements lead to only a modest decline in aggregate lending, despite a significant contraction in bank balance sheet lending. More broadly, these counterfactuals suggest that the evolution of the financial sector has made it more resilient to certain regulatory and macroprudential changes—particularly increases in capital requirements—due to changing household preferences and reduced OTD frictions.

Our paper contributes to the vast literature on financial intermediation and banking, which we cannot cover comprehensively here. Most closely related to our work is the research by Buchak et al. (2023; 2024), which examines the interaction between bank balance sheet lending and OTD intermediation, highlighting the importance of bank retention and shadow bank substitution margins in financial intermediation pass-through. We take a broader approach by analyzing the entire private credit market to explore the secular decline in balance sheet banking.[5] Our model endogenizes the supply of funds to intermediaries—the savers' side of the economy—and incorporates the fact that banks purchase securities originated by the OTD sector, linking the two. By focusing on the credit market equilibrium across savers, borrowers, and intermediaries, our study also relates to recent models on financial intermediation markets and banking (e.g., He and Krishnamurthy 2013; Brunnermeier and Sannikov 2014; Atkeson et al. 2018; Xiao 2020; Corbae and D'Erasmo 2021; Elenev et al. 2021; Begenau and Landvoigt 2022; Bianchi and Bigio 2022; Davila and Goldstein 2023). Within this literature our work emphasizes the secular decline in bank balance sheet lending, its key drivers, the role of bank balance sheets as purchasers of OTD securities, and the equilibrium implications for financial intermediation pass-through and macroprudential regulation.

2. Aggregate Credit Market Trends and the Secular Decline of Bank Balance Sheet Lending

2.1 The Main Credit Market Segments and Data Sources

Our primary focus centers on the overall credit market for households and non-financial business in the United States and its intermediation by the financial sector. While in essence, US households, and to a lesser extent, global investors, ultimately fund the vast majority of credit to households and firms, there are two key credit market segments that intermediate this funding.

The first credit market segment comprises "traditional" loans that banks offer to households and non-financial firms and retain on their balance sheets thereafter. The funding for these loans primarily comes from bank deposits. The banks invest surplus cash, calculated as deposits plus equity minus loans, in non-bank savings instruments such as cash, debt securities, and other

[5] While we document the secular decline in bank balance sheet lending over the last fifty years, including the period from the 1970s to the 1990s, Hanson et al. (2024) focus on banking trends in the 21st century and discuss their potential implications for regulations preventing uninsured depositor bank runs in the spirt of Jiang et al. (2023).

assets.[6] We will refer to loans originated by depository institutions and held on their balance sheets as the *informationally sensitive lending* segment. The choice of this terminology stems from potential frictions impacting these loans, which encompass moral hazard issues during their origination and informational asymmetries that render the retention of such loans by their originators a desirable equilibrium outcome. Furthermore, these loans may require additional monitoring and servicing by financial intermediaries, with the implicit assumption that banks are better equipped to fulfill these roles. The degree of informationally sensitive lending within the economy is also influenced by the state of financial technology and the regulatory framework, which we explore later.

The second market segment, *debt securities*, comprises the total credit extended to the private non-financial sector, excluding loans held on the balance sheets of depository institutions. This sector primarily consists of loans that are not retained by their originators but are instead sold to investors through various debt securities, though it also includes loans held on the balance sheets of non-bank lenders. We will consider all these loans as *less informationally sensitive* than traditional bank loans, making their secondary market sale a possible equilibrium outcome. Examples of such lending include loans bundled into asset-backed securities, collateralized loan obligations, credit card receivables, or mortgage-backed securities. The originators of these loans are primarily originate-to-distribute (OTD) lenders, encompassing both "independent" shadow banks (non-depository institutions) and the originate-to-distribute business lines of traditional banks (see Buchak et al. 2024). Thus, when discussing the traditional banking sector, we are referring narrowly to their traditional depository intermediation business. The OTD lenders function as pass-through entities with respect to these loans, meaning these loans are fully securitized and sold to households (directly or through pension funds and other vehicles) or to the depository banking sector.

Our primary data source is the Financial Accounts of the United States from the Federal Reserve. We aggregate different segments of lending to arrive at aggregate measures of bank and non-bank private lending. Appendix A3 details the construction and underlying data series for our measures.

Total lending is defined as the outstanding debt of households and non-financial businesses in the United States. Household debt chiefly consists of single-family residential mortgages, and non-mortgage consumer credit such as auto loans and consumer loans. We exclude lending done directly by the federal government, e.g., federal student loans.[7] Business debt includes lending to corporate and non-corporate non-financial businesses. It consists chiefly of mortgages other than those on single family homes (e.g., multifamily residential lending and non-housing real estate lending) and non-mortgage business lending. Importantly, our measures of lending to the private sector exclude intra-financial sector lending, such as bank loans made to non-bank financial

[6] Banks also finance themselves partially with (non-deposit) debt, though quantitatively it constitutes relatively minor share of their funding. As our focus is on non-financial debt, for the purposes of measurement, we net out bank debt from both sides of banks' balance sheets.
[7] Inclusion of such loans do not materially affect our results.

intermediaries. We measure and consider this lending separately, as discussed below. Panel (a) of Figure 1 shows the nominal value of outstanding total lending that rose from approximately \$0.45 trillion in 1962 to around \$37.8 trillion in 2023.

Informationally sensitive lending is defined as the aggregate outstanding amount of loans on the balance sheets of private depository institutions. Private depository institutions include U.S. Chartered Depository Institutions, Foreign Banking Offices in the United States, Banks in U.S.-Affiliated Areas, and Credit Unions. The series is constructed by adding the total amount of loans held in each depository sector and extended to each non-financial sector from the Financial Accounts of the United States database. As noted above, we exclude bank lending to other sectors within the financial sector. Panel (b) of Figure 1 shows the outstanding volume of loans on the balance sheets of depository institutions, referred to as informationally sensitive lending. This lending segment witnessed substantial nominal growth, surging from \$0.25 trillion in 1962 to approximately \$14.2 trillion by 2023.

Total debt securities are defined as the aggregate outstanding amount of *Total Lending* less *Informationally sensitive lending* at the aggregate level and within each sector (e.g., business, mortgage, and so on). That is, it is the total credit to the private non-financial sector that is not loans held on depository institutions' balance sheets.

Government-affiliated debt securities are defined as the aggregate or within-sector (e.g., single-family GSE loans for the household sector, or multi-family GSE loans for the business sector) outstanding amount of Agency- and GSE-backed securities. It is measured directly from the Financial Accounts of the United States.

Private debt securities are defined as the aggregate outstanding amount of *Total debt* less *Government-affiliated debt securities*. That is, it is the total credit to the private non-financial sector that is neither loans held on depository institutions' balance sheets nor Agency- or GSE-backed securities.

Panel (c) of Figure 1, shows the total outstanding volume of debt securities (represented by the bold line). The observed growth in outstanding debt securities is striking, escalating from nearly zero (\$0.2 trillion) in 1962 to approximately \$23.5 trillion by 2023. Approximately 45% of this growth is attributed to government-affiliated debt securities (depicted by the dashed line), which surged from zero in 1962 to about \$11 trillion.

Note that definitionally,

$$\begin{aligned} Total\ lending = {} & Informationally\ sensitive\ lending \\ & +government\ affiliated\ debt\ securities \\ & +private\ debt\ securities \end{aligned}$$

Where *informationally sensitive lending* and *government affiliated debt securities* are measured directly, and *private debt securities* are a residual.

Bank deposits are defined as the sum of checkable deposits, time deposits, and federal funds and security repurchase agreements of private depository institutions. These series are constructed from the Financial Accounts of the United States database.

Total saver financial assets are calculated as the total financial assets of the domestic non-financial sectors. This series is taken directly from the Financial Accounts of the United States database.

We note that our measurement approach, by definition, includes international holdings of all relevant assets. That is, non-bank owners of *deposits*, *private debt securities,* and *government-affiliated debt securities* include both the US domestic household sector and foreign owners of these securities. The one exception is total holdings of *other* US financial assets, such as US Treasuries and equity securities, which we do not measure directly but rather as a residual between *total saver financial assets* and the asset holdings we measure directly. While it is not the focus of our paper, our approach will tend to understate the importance of these *other* assets as it excludes foreign holders of these assets.

Finally, we supplement our measures to capture (1) private debt funds, and (2) undrawn credit lines, neither of which are well-captured in the Federal Reserve data. We obtain data on private debt outstanding from Preqin[8], and undrawn credit lines from the FDIC Quarterly Banking Profile.

2.2 Three Facts on the Secular Decline of Balance Sheet Banking

We document three trends, which capture the different aspects of the decline in balance sheet banking in Figure 2.

First, we document a substantial decline in the relative importance of informationally sensitive lending in Figure 2, Panel (a). It plummets from approximately 55% at its peak in the 1960s-1970s to about 33% by 2023, with the majority of this decline occurring between early 1980s and mid-1990s. In other words, lending has substantially shifted towards OTD intermediation. Consistent with the findings of Buchak et al. (2024), we note a reduction in the share of informationally sensitive lending (bank balance sheet lending) during the Great Recession, coinciding with compromised bank balance sheets. However, this decline is relatively modest compared to the enduring decrease in the informationally sensitive lending share observed over several decades.

Second, we document that households shift their savings away from deposits towards securities: the deposit share of domestic non-financial sector financial wealth declined from a peak of roughly 21% in the mid-1970s down to 9% in 2000, before seeing a minor increase to roughly 13% in 2023 (Figure 2, Panel (b)). While our focus is on the composition of savings and lending, as Figure 2 Panel (g) shows, the fall in deposit-to-wealth ratio takes place in a broader context of a dramatically rising financial wealth-to-GDP ratio.

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[8] Preqin is a financial data company specializing in alternative investments. It provides insights into investment funds, fund managers, investors, strategies, and performance across various asset classes like hedge funds, private equity, private debt, and venture capital.

Third, the share of loans to the non-financial sector as a percentage of bank assets has also concurrently fallen from about 65% to 50% (Figure 2, panel (c)). When including loans to non-bank financial intermediaries, i.e., loans made to support non-bank lending, the share, shown with a dotted line, has fallen from 70% to 55%. This trend suggests that the balance sheet and OTD models of financial intermediation have become more interconnected through bank securities holdings over time. Indeed, bank debt securities holdings as a share of bank assets grow from less than 3% at the beginning of our sample to more than 15% (Figure 2, panel d).

To assess the extent to which bank balance sheets are financing overall lending, both through informationally sensitive loans and debt securities, Panel (e) of Figure 2 shows the bank balance sheet lending share that includes bank debt securities holdings. Although this inclusion increases the bank balance sheet lending share in recent years, we still observe a significant decline: from approximately 60% in the 1970s to slightly above 40% in the recent period. Our framework will make an important distinction between these two forms of credit and will also allow us to examine how substitutable informationally sensitive lending is with debt securities and the importance bank balance sheets play in this regard.

Finally, we note that banks can also indirectly finance debt securities market by providing loans to the non-bank financial sector. To shed light on it Figure 2, panel (f) plots loans from banks to the non-bank financial sector as a share of aggregate non-bank lending. We note that this lending is at the similar level now relative to the beginning of our sample: it began the sample at roughly 8%, fell during the 1980s, before mostly recovering since 2010.

2.3 Robustness of Main Trends

2.3.1 Bank Balance Sheet Share across Market Segments

One explanation for the decline in the informationally sensitive lending share is the growth of government-affiliated debt securities, primarily agency mortgage-backed securities. Government credit guarantees could have facilitated the securitization of mortgages that constitute a substantial share of total lending, crowding out financing of these loans through bank balance sheets.

To delve deeper into this, Figure 3 illustrates the informationally sensitive lending share among mortgages (Panel a) and among all loans excluding mortgage loans (Panel b). As observed in Panel (a) of Figure 3, there is a significant decline in the informationally sensitive mortgage lending share from over 60% in the 1970s to 33% by 2023, with the majority of this decline occurring between the early 1980s and mid-1990s. However, Panel (b) of Figure 3 indicates a broadly similar decline in the informationally sensitive lending share among loans that do not include mortgages, and thus were largely ineligible for government guarantees. There is a partial reversal in the trend following the financial crisis but the 2023 level, 33%, is far below the 47% peak. This suggests that the growth of the government-affiliated securities market alone cannot entirely account for the overall decline in the informationally sensitive lending share.

Panel (c) illustrates this further by showing bank balance sheet lending share among non-financial businesses (excluding mortgages). Focusing on loans to firms that are largely ineligible for government guarantees we again see a significant decline in bank balance sheet share from about 42% at its peak in 1970s to 30% in 2023 with essentially no recovery following the Global Financial Crisis.

In summary, there is robust evidence for secular decline in the informationally sensitive lending share. While the growth of the government-backed mortgage-backed securities market may account for a part of this trend, the substantial decline in the bank balance sheet lending share among non-mortgage loans suggests that other factors have also played an important role in this trend. In Section 2.6, we delve into several such factors.

2.3.2 Role of Unused Bank Credit Lines

Banks have increasingly offered credit lines to households and firms, a trend that has gained momentum over recent decades (Kashyap et al. 2002; Ivashina and Scharfstein, 2008; Acharya et al. 2023). While our data captures credit lines that have been drawn, one could argue that the decline in the bank balance sheet lending share might at least partly reflect a shift in bank lending towards credit lines. This shift may result in undercounting, as a significant portion of this credit may remain unused at any given point in time.

To better understand the scale of this phenomenon, in panel (a) of Figure 4, we incorporate the unused outstanding credit available to households and firms, assuming its maximum potential utilization based on historical data. Utilization peaks in times of aggregate negative shocks like Covid-19 and Great Recessions (Ivashina and Scharfstein, 2008; Acharya et al. 2023). Accounting for such an adjustment reveals that while this "potential" credit mechanically increases the bank balance sheet share in more recent periods, there is still a notable overall decline in the bank balance sheet share in overall lending. Additionally, because we do not observe undrawn credit lines until the 1990s, this analysis mechanically understates the trend away from bank balance sheet lending, inclusive of credit lines.

2.3.3 Role of Private Equity Debt Funds

Our calculations based on the flow of funds data may not fully reflect the recent rise in private credit offered by private equity (PE) debt funds. There is a lot of discussion about growth of private credit in the last two decades (Ivashina, Hanson, Sunderam, Stein 2024). To gauge how such private credit might change our inferences we utilize data from Preqin on private debt funds. Focusing on funds managed in the US, we aggregate annual AUM figures, excluding indirect holdings like funds of funds and secondary funds to avoid double counting.

Our analysis reveals substantial growth in private credit debt funds over the past two decades. Their total assets under management (AUM) steadily increased from $37.5 billion in 2000 to $1,125 billion in 2023. Notably, private debt funds saw significant expansion since 2019, with

AUM rising by over 105% during this period. Despite the substantial growth in private credit debt in recent years, Figure 4, panel (b) illustrates that its overall magnitude is still relatively modest and does not have a pronounced effect on the bank balance sheet share. Indeed, as shown in the figure, accounting for private credit debt only modestly decreases the bank balance sheet lending share in recent years (32% instead of 33% if we ignored private credit provided by PE debt funds).

2.4 Institutional Developments and Decline in the Informationally Sensitive Lending Share

In this subsection, we briefly describe several institutional developments that may have played a role in the secular decline of balance sheet banking. We categorize these developments into three main groups: (i) technological and institutional changes around informationally insensitive borrowing, (ii) institutional changes in "savings technologies" and demand for securities, (iii) and regulations, subsidies, and implicit costs in bank intermediation.

2.4.1 Technological and institutional changes around informationally insensitive borrowing

We first start by reviewing technological and institutional changes that could have facilitated growth of informationally insensitive lending (debt securities). The government-affiliated securities market saw significant changes starting in 1968 when Fannie Mae was split into Fannie Mae (retaining GSE status) and Ginnie Mae (fully government-owned). In 1970 Ginnie Mae issued its first MBS, followed by Freddie Mac in 1971 and in Fannie Mae in 1981. Following the Global Financial Crisis, an increase in conforming loan limits expanded the range of securitization-eligible loans.

The private securities market developed in parallel. In the late 1970s, private enterprises began issuing MBS. 1991 saw the creation of the CMBS market. Throughout the 1980s and 1990s, securitization expanded to include auto loans, credit card loans, and student debt. CLOs originated in the late 1980s, and ABCP conduits were developed in the mid-1980s. The 1980s saw further expansion and innovation in the corporate bond market. The market became more diversified, with the introduction of high-yield bonds ("junk bonds") and other financial instruments.

These developments were accompanied by a host of technological innovations. The 1980s brought improved computer technology and data processing capabilities. Specialized securitization software was developed, and the FICO score was introduced in 1989. Rating agencies grew in importance for evaluating debt securities. Electronic trading platforms improved market liquidity, and post-GFC online loan origination platforms facilitated non-bank lending.

We observe that the majority of the above developments in both private and government affiliated debt securities market took place from late 1970s to the mid-1990s. These advancements align broadly with the noticeable decline in the share of informationally sensitive lending observed during the early 1980s and mid-1990s (refer to Figure 2 and Figure 3). It is noteworthy that the Global Financial Crisis, coupled with the collapse of the private mortgage-backed securities market, brought to light significant concerns related to potential moral hazards in the origination of debt securities (Keys et al., 2010), agency conflicts in loan servicing and the resolution of financial distress (Piskorski et al., 2010), and misrepresentations of the characteristics of private debt securities (Piskorski et al., 2013). These developments, combined with a decline in investor trust in private debt securities, may have contributed to the observed increase in the share of informationally sensitive lending following the Global Financial Crisis, particularly among non-mortgage loans (refer to Figure 3, panel b). This increase did not manifest among mortgage loans (Figure 3, panel a), which have an active market for government-affiliated securities that could, at least partially, serve as substitutes for private debt securities. Nevertheless, we note that even after this post-financial crisis increase, the share of informationally sensitive lending among non-mortgage loans remained substantially lower relative to earlier periods, with essentially no recovery among business loans (Figure 3, panel c).

2.4.2 Institutional changes in "savings technologies" and demand for securities

In this subsection, we briefly describe several pivotal developments that may have influenced "savings technologies" and the demand for debt securities from capital suppliers. First, money market funds were established in the 1970s. Second, a series of regulatory changes facilitated growth of pension funds through which households can acquire and finance debt securities. In 1974, ERISA established guidelines for pension fund management. The 1986 Tax Reform Act enhanced the attractiveness of defined contribution plans. Third, following the end of the Cold War in 1989, there was a notable surge in global interest in U.S. securities. As barriers to international capital flows diminished, foreign investors found it easier to engage in U.S. financial instruments. Second, the U.S. dollar maintained its position as the world's primary reserve currency. According to flow of funds data, the private debt securities (excluding U.S. Treasuries) owned by foreign investors increased significantly, growing from a mere $0.24 trillion in 1989 to approximately $5.3 trillion by 2023.

Overall, the timing of these developments also broadly aligns with the significant decrease in the deposit share of domestic non-financial sector financial wealth that we observe from 1980s to late 1990s (see Figure 2, panel b).

2.4.3 Regulations, subsidies, and implicit costs in bank intermediation

In this subsection, we briefly describe various regulatory changes that could impact the relative cost of intermediation on bank balance sheets. The 1986 Tax Reform Act allowed for the creation of REMICs, which were SPVs that could issue collateralized mortgage obligations (CMOs) and have them qualify as asset sales. The Financial Institutions Reform and Recovery Act of 1989 established the Resolution Trust Corporation to address the failures of thrift institutions earlier in the decade. In conjunction with the Federal Savings and Loan Insurance Corporation (FSLIC), the government resolved the failures of thousands of savings and loan institutions. This process involved significant loan sales in the secondary market. The Federal Deposit Insurance

Corporation Improvement Act (FDICIA) of 1991 also introduced measures encouraging distressed banks to alleviate financial stress by selling assets, including loans.

The Riegle-Neal Interstate Banking and Branching Efficiency Act of 1994 facilitated interstate banking, prompting banks to streamline loan portfolios, often resulting in increased loan sales. The Gramm-Leach-Bliley Act (GLBA) of 1999 repealed Glass-Steagall Act restrictions, fostering affiliations between banks, securities firms, and insurance companies. This expanded financial services landscape led to heightened diversification and specialization, frequently accompanied by increased loan sales.

The Basel II framework, implemented in the US from 2008 onwards, introduced risk-sensitive capital requirements, compelling banks to actively manage risk exposure and elevating the costs of bank balance sheet lending. Subsequently, Basel III, building on Basel II, imposed more stringent capital and liquidity requirements on banks in the aftermath of the Global Financial Crisis, further increasing the costs of bank balance sheet lending. Additionally, certain provisions of the Dodd-Frank Wall Street Reform and Consumer Protection Act of 2010, aimed at financial regulatory reform, may have influenced banks to reassess their loan portfolios. Overall, the regulatory burden imposed on banks post-Global Financial Crisis contributed to the expansion of non-bank lending reliant on loan sales (Buchak et al. 2018).

2.5 Evidence on Mechanisms

We now provide evidence on the possible mechanisms behind the trends we have documented.

2.5.1 Borrower demand for informationally insensitive lending, expansion of securitization/ OTD technology and regulation

We argue that a major factor contributing to the decline in bank balance sheet lending is the expansion of secondary loan markets, which can lead borrowers to shift their demand away from informationally sensitive bank lending toward informationally insensitive OTD lending. To support this, we present micro-evidence exploiting an institutional discontinuity in the types of loans suitable for informationally insensitive lending. Specifically, we leverage the fact that robust secondary markets exist for one type of loan but not for a very similar alternative. This allows us to conclusively demonstrate that the availability of OTD lending, rather than other factors, drives the choice to fund projects with informationally insensitive rather than informationally sensitive lending.

In particular, we build on Buchak et al. (2024) and use the variation in the eligibility of mortgages for securitization sponsored by the Government Sponsored Enterprises as a source of variation for the “ease of securitizing loans”. Using loan-level mortgage origination data from HMDA between 2007 and 2017, we estimate the following regression:

$$Bank_i = \beta \times Non-conforming_i + \gamma_i + \epsilon_i \tag{1}$$

Here, $Bank_i$ is an indicator for whether the loan is financed on a bank's balance sheet, i.e., the loan is originated by a bank and retained by that bank, or the loan is sold to a bank. $Non-conforming_i$ is an indicator for whether the loan amount exceeds the conforming loan limit, i.e., GSE financing is unavailable. We interpret such a loan as being informationally sensitive and harder to sell, as the financier of the loan must underwrite the credit risk that it holds. That is, such loans are harder to securitize.

γ_i is a fixed effect, which varies by specification, but our strictest specification uses loan characteristic interacted with originator fixed effect. Including originator fixed effects implies that we focus on loans on either side of the cutoff originated by the same lender. Our main specification examines loans +/- 25% around the conforming loan limit. We include a specification with a +/- 10% bandwidth for robustness. The results are shown in Panel (a) of Table 1 with the 25% bandwidth and Panel (b) with the 10% bandwidth.

Across all specifications in Table 1 we find that harder to sell loans are much more likely to be financed on bank's balance sheet. To examine the relationship graphically, Figure 5 shows a binned scatterplot, with % of conforming amount on the x-axis and fraction of loans financed on bank balance sheets on the y-axis. The analysis shows a sharp discontinuity at the conforming loan limit, with the bank balance sheet financing share jumping from roughly 40%, when loans can be easily securitized, to roughly 80% around the cutoff, when loans cannot be easily securitized. Overall, this analysis offers a clear, well-identified example of how increased borrower demand for informationally insensitive lending is related to the expansion of secondary markets and the reduction of OTD frictions (e.g., due to technological or regulatory factors).

Next, we explore how these shifts in borrower demand, which influence the type of lending used to finance a project, affect the composition of bank balance sheets. To do this, we develop a bank-level measure of exposure to changes in conforming loan limits for each institution. This measure is based on the bank's previous year (t-1) lending patterns. Specifically, the *Securitization Exposure* quantifies the percentage of a bank's residential mortgage lending volume from the previous year that would be affected by a change in conforming loan limits, typically an increase. Banks with positive securitization exposure experience an increase in the proportion of their mortgage lending eligible for GSE-sponsored securitization. These more affected banks originate a greater share of loans from areas affected by conforming loan limit increases, with a larger portion of these loans falling within the new conforming loan limits range.

Table 2, Column (1) investigates the association between securitization exposure measure used above and bank's loan to asset ratio. Banks experiencing an increase in their ability to securitize loans also exhibit a reduction in their loan-to-asset ratios relative to less exposed (or unexposed) banks. Column (2) shows that this reduction in loan to asset ratio is accompanied by increased security holdings relative to bank assets. Column (3)-(4) repeat this analysis within the subsample of banks that experience a non-zero value of their exposure measure in a given year. Within this "affected bank sample" we also observe that more affected banks experience a reduction in their loan-to-asset ratios and substantial increase in their security holdings relative to their assets.

Finally, to address differences in bank characteristics driving our inferences, we use propensity score matching. We pair each bank in the treatment group (with non-zero exposure) with a control group bank (with zero exposure) based on equity-to-asset ratio, equity-to-deposit ratio, residential loan-to-total loan ratios, and location of the bank's headquarters. Columns (5)-(6) show consistent results in this matched sample. Banks with increased securitization capacity exhibit a decrease in their loan-to-asset ratio and an increase in security holdings relative to banks in the control group. Moreover, zooming in on the debt security holdings of banks that finance credit for households and firms, shows that they account for 40% of the overall increase in bank security holdings. Specifically, in Column (6) of Table 2, the increase in security holdings by 10.3 percentage points relative to assets includes a notable 4.2 percentage points attributable to debt securities.

Overall, this analysis suggests that a reduction in OTD frictions—stemming from technological advancements or regulatory factors—increases borrower demand for informationally insensitive loans. This results in a decline in the share of bank balance sheet lending and a shift in bank assets from loans to securities, including debt securities.

2.5.2 Saver demand for securities, institutional changes, and savings technologies

Next, we explore how technological and institutional changes in "savings technologies" might explain some of the observed trends in saver demand. To do this, we examine trends in "shadow money" vehicles—such as money market funds, ETFs, mutual funds, and closed-end funds—that provide alternatives to traditional deposit-based savings.

In Panel (a) of Figure 6, we illustrate the share of "shadow money" intermediation in investments in financial assets of non-financial sector (mainly households). The share has grown significantly, from virtually zero in the 1960s to over 20% in recent years. This growth coincides temporally with the decline in the deposit share of total financial assets (Panel b, Figure 2), and its magnitude is large enough to account for the entire decline of deposit share.

One could argue that the expansion of "shadow money" intermediation may primarily reflect the "innovations" in saving technologies and evolving household preferences for investing in financial market instruments such as equities or US Treasuries and/or overall growth of the stock market. This would imply minimal impact on how credit is financed for firms and households.

To probe this, we focus specifically on "shadow money" investments in debt securities (MBS, corporate bonds etc.). Panel (b) of Figure 6 examines the share of "shadow money" intermediation in total debt extended to households and firms. It reveals a remarkable increase, from nearly zero in the 1960s to now exceeding 10%. Moreover, a significant portion of this growth coincides with the decline in the bank balance sheet share of lending (refer to Figure 2, panel a). A simple calculation suggests that growth of "shadow money" debt financing could potentially account for around 40% of the decline in the bank balance sheet lending share during 1970-2000 period.[9]

2.5.3 Regulations, subsidies, and implicit costs in bank intermediation

We conclude this section by examining how various bank regulatory regimes might have influenced changes in bank balance sheet composition and lending practices. From 2010 to 2018, various regulatory measures such as the Dodd-Frank Act and Basel III were implemented, aiming to strengthen capital requirements, liquidity standards, and risk management practices. These regulations predominantly targeted larger banks, those with assets greater than \$50 billion and particularly exceeding \$250 billion. Post-2018, regulatory pressures eased for banks with assets under \$250 billion, influenced by legislative changes like the Economic Growth, Regulatory Relief, and Consumer Protection Act (EGRRCPA).

Table 3 exploits these changes and analyzes relative changes in the *Loan to Asset Ratio* and *Balance Sheet Loan Growth Rate* after the Global Financial Crisis based on the bank exposure to new bank regulations. In Column (1), regression results explore the interaction effects between bank size categories and regulatory regimes: Between 2010-2018 and After 2018. Banks are categorized into three groups based on asset size, with smaller banks below \$50 billion serving as the excluded (base) category. The midsize group includes banks with assets ranging from \$50 billion to \$250 billion, while the large group comprises banks with assets exceeding \$250 billion.

Column (1) shows that during heightened regulatory regime banks impacted by the regulation experienced relative decrease in their loan to asset ratios. Column (2) indicates that this effect was accompanied by differential relative decline in the bank balance sheet lending growth of affected banks. These results suggests that heightened bank regulatory burden including more stringent liquidity and capital requirements coincided with the shift of bank balance sheet composition away from loans and decreased bank balance sheet lending. These findings are broadly consistent with recent studies that analyze the impact of bank regulations on bank security holdings (Sundaresan and Xiao 2024; Stulz et al. 2024).

3. Model

As we document in Section 2, financial intermediation has moved away from the traditional bank balance sheet model towards private credit, which is increasingly intermediated through arms-length transactions, such as securitization. At the same time, banks have increased their holdings of informationally insensitive securities rather than shrinking their balance sheet proportionally to the decline of informed lending. We next construct a model of financial intermediation which explores the relationship between two models of intermediation:

[9] During the period from 1970s to early 2000s, the share of bank balance sheet lending in the overall credit to households and firms declined by approximately 20 percentage points (Figure 2, panel b). Concurrently, the share of "shadow money" financing of this credit, which essentially started from zero, grew by about 8 percentage points over the same period (Figure 6, panel b).

The bank balance sheet model, in which banks intermediate between borrowers and savers by taking deposits from savers and make informationally sensitive loans to borrowers.

The originate to distribute model in which borrowers obtain debt funding through issuing informationally insensitive securities which can be sold directly to savers.

Broadly, there are two central margins of interaction between these types of intermediation. The first is *substitutability margin*: the two intermediation models are imperfect substitutes from the perspective of savers (deposits versus securities) and borrowers (informationally sensitive loans versus informationally insensitive securities).[10] When one model of intermediation is constrained, the other can pick up some of the slack.

The second margin of interaction is *bank securities' holdings*. Banks' securities holding act as a buffer that breaks the direct mechanical link between savers' preferences for deposits and the amount of informationally sensitive lending banks engage in. Intuitively, if all securities are held on bank balance sheets, then even informationally insensitive lending may significantly decline from a contraction in bank balance sheets. Conversely, if securities can be mostly held by investors, then banks' balance sheet size is much less important for aggregate debt issuance.

The goal of the model is several-fold. First, we use the model to study how changes in intermediation wedges and preferences we identified in Section 2 affect the equilibrium allocation of savings and credit when accounting for the full interaction between balance sheet banking and originate to distribute. We calibrate the model and use it to decompose into distinct drivers of secular trends we document in Section 2. Next, we use the model to study how the impact of regulatory tools has changed over time with changes in the type of financial intermediation.

3.1. Model Setup

The focus of our paper is on secular trends. We therefore present a static model, which treats the economy as a sequence of static snapshots. This allows us to abstract from dynamics in intermediary capital levels or household consumption and savings decisions over short horizons and focus instead on a richer set of intermediation frictions.

Borrowers do not directly access funds from savers. Instead, the financial intermediation sector creates borrowing and savings mechanisms, offering them to both borrowers and savers. In the beginning of the period, intermediaries offer savers two broad technologies: bank deposits and securities. At the same time, borrowers can either borrow informationally sensitive loans or informationally incentive securities. Banks play a central role in the intermediation system, because they are the only intermediaries who can offer deposits and informationally sensitive loans, while the OTD sector can only create informationally insensitive loans and issue securities. Critically, banks can invest in securities despite earning the same returns as other savers. In this

[10] This substitutability has been partially explored in a wide variety of models, though not necessarily in an integrated fashion.

way, deposits are partially invested in securities that investors could directly own. Securities and loans pay at the end of the period.

The financial intermediation sector is subject to frictions, which we capture as wedges between rates paid by borrowers and earned by savers, and those paid and earned by intermediaries.

3.1.1. Savers

The representative saver is endowed with aggregate planned savings wealth M_s, which they invest fully across different savings technologies, which includes debt issued by borrowers, as well as other securities, such as equities or government debt. They can invest their savings in two different ways: either as bank deposits, or as securities provided by the financial intermediation sector. Securities are imperfect substitutes for deposits and for each other as they vary in the transaction services they provide (i.e. how money like they are), as well as in other aspects such as diversification properties they provide to household asset portfolios.

There are J savings technologies in the market, which we index by j. A unit of savings j pays 1 at the end of the period and costs an endogenous price p_j at the start of the period earning a return $r_j = 1/p_j - 1$. There is no risk in the model, and so we interpret the returns as being risk-adjusted. Saver utility over savings technologies is given by the following CES aggregator:

$$u_s = \left(\sum_j \alpha_j^{\frac{1}{\sigma_s}} Q_j^{s\frac{\sigma_s - 1}{\sigma_s}} \right) \tag{S.1}$$

Q_j^s is the quantity of savings type j purchased by the household. α_j is the utility weight on type j. For instance, if households require a high volume of deposits to carry out valuable transactions, then the deposit α_j is high. α_j are of central interest in the model because they capture the changes in demand for securities that arise over time. These changes may result from factors such as the Employee Retirement Income Security Act of 1974 or the growing global demand for U.S. debt securities after 1980s.

$\sigma_s > 1$ is the elasticity of substitution. $\sigma_s \to \infty$ means that savings technologies are perfect substitutes, so even small differences in returns across securities or deposits result in large changes in how households save. Conversely, a small σ_s suggests that savings technologies perform specific roles, for example, it is difficult to substitute the transaction role of deposits with other securities.

Savers invest in technologies in order maximize their utility subject to saving their entire planned savings:

$$\max_{\{Q_j\}} u_s \text{ s.t. } \sum_j p_j Q_j \leq M_s \tag{S.2}$$

The saver's problem (S.2) yields demand for product j as a function of expected return r_j:

$$Q_j^s = \alpha_j \left(1 + r_j\right)^{\sigma_s} M_s / P_s \tag{S.3}$$

where P_s is the usual CES price index, $P_s = \sum_j \alpha_j \left(1 + r_j\right)^{\sigma_s - 1}$. Intuitively, if returns are low, then prices for savings technologies are high, which tightens the budget constraint, reducing overall demand.

The demand expression is intuitive. Higher utility, α_j, technologies have higher demand, and a higher substitutability across savings, σ_s, results in demand responding more to returns.

To match the data, we consider the following securities: bank equity, which allows us to endogenize the capital structure of banks; privately intermediated securities (e.g., corporate bonds or CRE securities pools), which substitute for bank loans as we describe below; securities intermediated through government-affiliates (e.g., agency mortgage-backed securities), which captures the fact that some securities have larger government intervention than others; and other assets (e.g., equity or treasury securities).

3.1.2. Borrowers

The representative borrower represents all non-government net borrowers in the economy. They include, for example, household borrowers and non-financial firms. They end the period with aggregate planned repayment (pledgeable income) M_b which they use to repay debts from the start of the period.

There are *I* borrowing technologies in the market, which we index by *i*. For each unit of credit borrowers receive at the start of the period, they repay the endogenous price p_i at the end of the period. This notational convention ensures consistency between borrowers and savers, such that, like savers, the borrower's demand function is downward sloping. Under this convention, the promised return for a borrowing technology *i* is thus $r_i = p_i / 1 - 1$.[11]

Borrowers can either borrow informationally sensitive loans or informationally incentive loans. Intuitively, informationally sensitive loans are those that cannot be done arm-length. These loans can require soft information, which the lender finds difficult to transmit to an outside investor, such as a local bank manager who knows a small business owner's reliability and business potential through personal interactions even though this informal assessment is difficult to formally verify for outside investors. Alternatively, informationally sensitive loans require intense interaction ex-post, for example, when using a credit line with significant covenants that need to be monitored and potentially renegotiated. Informationally insensitive loans can be seen as arm-length lending. They may also require ex ante information collection as well as ex post, but the frictions that arise are smaller, so that these loans can potentially be traded.

[11] Broadly "savings" technologies cost "p" today and return 1 tomorrow. "Borrowing" technologies cost 1 today and return p tomorrow.

Informatically sensitive and insensitive loans are imperfect substitutes. Some borrowers may have projects that require significant covenant monitoring (informationally sensitive loans), while creditworthiness is easy to transmit for other borrowers (e.g. AAA rated firms). Then lending mostly involves administrative expenses such as collecting payments. On the one hand, money from lending is fungible: a firm may be willing to borrow from either type of funding, depending on the price.

The representative borrower borrows Q_i^b of the quantity of borrowing type. Their utility (or profit for firms) from borrowing is given by the following CES aggregator:

$$u_b = \left(\sum_i \beta_i^{\frac{1}{\sigma_b}} Q_i^{b\,\frac{\sigma_b-1}{\sigma_b}}\right)^{\frac{\sigma_b}{\sigma_b-1}} \tag{B.1}$$

where β_i is the utility weight on the borrowing type i. Thus, when borrowers demand a high volume of informationally sensitive loans because many firms are young and opaque, β_i for those loans is high. Alternatively, if there is a significant implicit cost wedge in informationally insensitive lending, such as from inefficient intermediation technology, the β_i for informationally insensitive loans would be low. $\sigma_b > 1$ is the elasticity of substitution. If σ_b is high, then the aggregate amount of debt is a reliable proxy for measuring the overall economic impact of lending. Conversely, if σ_b is low, he specific composition of lending across different types of loans or borrowers becomes crucially important, as it plays a first-order role in determining outcomes.

Because different types of loans are imperfect substitutes, there are decreasing marginal returns to expanding either informationally sensitive or insensitive loans. One way to interpret these diminishing returns is as follows: As the availability of informationally sensitive loans decreases, only the economic activities that have the highest need for such loans can still obtain funding from the remaining supply. The activities with slightly lower need get crowded out first as the supply tightens. For example, if banks have a larger comparative advantage in credit lines rather than term loans, they will first reduce their term loan lending, and only then decrease their credit lines.

The borrower's problem is as follows:

$$\max_{\{Q_i\}} u_b \text{ s.t. } \textstyle\sum_i p_i Q_i \leq M_b \tag{B.2}$$

This leads to borrower demand for product i as a function of borrowing returns r_i:

$$Q_i^b = \beta_i (1 + r_i)^{-\sigma_b} M_b / P_b \tag{B.3}$$

where P_b is the CES price index, $P_b = \sum_i \beta_i (1 + r_i)^{1-\sigma_b}$.

To match the data, we consider two types of informationally insensitive loans, private securities, and securities which are issued with the assistance of GSEs.

3.1.3. Financial Intermediaries and Intermediation Frictions

3.1.3.A. Bank Balance Sheet Model

Bank Balance Sheet: At the beginning of the period, banks raise funds from savers through two sources: deposits $D = Q_d p_d$ and equity $E = Q_e p_e$. They then deploy these funds towards two activities: extending informationally sensitive loans to borrowers $L = Q_l$ and purchasing securities $S = Q_{bs} p_s$, which comprise bank assets at the beginning of period $A = L + S$.

Frictions: There are frictions present in the process of transforming deposits and equity into loans. These frictions, which can be thought of as costs faced by banks in their intermediation activities, drive a wedge between the interest rates paid to depositors and the rates charged to borrowers. In other words, banks cannot simply pass through the returns from loans and securities one-for-one due to the costs of financial intermediation.

Recall, for each unit of deposits raised from a saver at price p_d, the bank commits to returning the principal amount of 1 unit to the depositor at the end of the deposit term. This costs the bank $1 + p_d \Delta_d$ at the end of term, with $p_d \Delta_d$ representing the deposit wedge. This wedge arises, for example, from the cost of maintaining branches, the costs of regulatory compliance, and the risks associated with deposit withdrawal. Specifically, we assume that the cost of deposit funding is decreasing in bank's holdings of liquid securities:

$$\Delta_d = \delta_d^1 + \delta_d^2 \left(\frac{S - \phi D}{D}\right)^{1/2}$$

Where $\delta_d^2 < 0$. This relation captures the idea that the bank faces the possibility of deposit outflows, for example, between the early and late period in the spirit of Diamond and Dybvig (1983). It then needs liquid securities (as opposed to loans) to meet this demand. If such shocks are not completely diversifiable, i.e. there are aggregate fluctuations in deposits, then there is a liquidation risk whenever the share of interim deposit outflows exceeds ϕ.

Banks experience a wedge $p_e \Delta_e$ when raising equity, representing, for example, equity issuance costs. We assume these costs are simply proportional issuance costs.

Last, a bank is paid p_l per loan by informationally sensitive borrowers but earns $p_l + \Delta_l$ on repayment, with the wedge representing costs of screening and monitoring these loans. The wedge is a function of bank capitalization:

$$\Delta_l = \delta_l^1 + \delta_l^2 \left(\frac{E - \xi A}{A}\right)^{1/2}$$

With $\delta_l^2 > 0$, a better-capitalized bank receives effectively more repayment per loan, for example, because of better alignment of incentives between equity and proper screening and monitoring of bank lending. One can also interpret this relationship as an effect of capital requirements, in which banks hold a buffer exceeding the minimum regulatory requirement ξ. While the micro foundations for such a capital buffer choice could be derived in a dynamic setting (see Corbae and D'Erasmo 2021), this paper's focus lies elsewhere.

Bank Profits: The bank is operated for the benefit of the bank manager, or equivalently the (unmodeled) inside equity holder (distinct from those in the saver sector who own publicly issued bank equity). The bank manager receives income from lending and securities investment net of financing costs. The banker's profit at the end of the period is as follows:

$$\Pi^{\text{Bank}} = -\underbrace{Q_d(1 + p_d\Delta_d)}_{deposit\ cost} - \underbrace{Q_e(1 + p_e\Delta_e)}_{cost\ of\ equity} + \underbrace{Q_l(p_l + \Delta_{lb})}_{loan\ interest} + \underbrace{Q_{bs}}_{securities} \tag{I.1}$$

Observe that at the end of the period, the bank must pay 1 per unit of deposits and equity plus the intermediation wedges, receives p_l plus the intermediation wedge per unit of informationally sensitive loan, and receives 1 per unit of securities purchased. The bank chooses the quantity of deposits, $Q_d,$ and equity to issue to the saver sector, Q_e, the quantity of informationally sensitive loans to issue to the borrower sector, Q_l, and the quantity of securities to purchase at the endogenous securities price p_s.

At the start of the period, the bank's balance sheet must balance, i.e., $D + E = L + S$. Recall that the bank receives $D = Q_d p_d$ per unit of deposit issued, $E = Q_e p_e$ per unit of equity issued, pays $L = Q_l$ per unit of loan issued, and pays $S = Q_{bs} p_s$ per unit of securities purchased. At the end of the period, after being repaid by loan borrowers and securities issues, the bank pays its depositors and equity holders the promised amounts, and returns any excess income to the insider. The bank faces the downward-sloping demand curves for loans Q_l (S.3) and funding (B.3) and takes securities prices as given when making these decisions. The banker's problem is then to maximize the payments to the insider at the end of the period as follows:

$$\max_{Q_d, Q_e, Q_l, Q_{bs}} \Pi^{Bank} \text{ s.t. } D + E = L + S \tag{I.2}$$

Additionally, securities holdings have implicit wedges ($\mathrm{r_{sp}} = \mathrm{r_0} + \Delta_{sp}, r_{sg} = r_0 + \Delta_{sg}$) relative to the outside option r_0.

3.1.3.B. Originate-to-distribute intermediaries

Originate-to-distribute intermediaries provide informationally insensitive loans to the borrower sector and provide securities to the saver sector. They are pass-through entities in the sense that the loans they issue are sold directly to the saver or bank sector (e.g., through bond issuance or securitization). We interpret the originate-to-distribute sector as encompassing both "independent" shadow banks (e.g., non-depository institutions like Rocket Mortgage) as well as the originate-to-distribute business lines of traditional depository institutions.

The originate-to-distribute intermediary (OTD Lender) originates Q_{AL} informationally insensitive loans (arm's length) at price p_{AL} and obtains funding by issuing Q_s securities at price p_s. We also allow for the possibility that originating loans cannot be done with fully arm's length lending, and that a portion ψ of the loan has to be financed by informationally sensitive lending, i.e., $\psi Q_{AL} \leq Q_{l,OTD}$, which in equilibrium will hold with equality. For example, banks commonly provide credit lines to intermediaries who engage in OTD intermediation (see Jiang et al. 2020 and Jiang 2023). This nests the idea that, even if all lending were to shift to OTD, some of the funding would still have to be provided by banks. As with banks, the OTD lender's beginning-of-period balance sheet must have assets equal to liabilities:

$$\underbrace{Q_{AL}}_{Assets} = \underbrace{p_s Q_s + Q_{l,OTD}}_{Liabilities}$$

Or, substituting in the bank financing requirement,

$$\underbrace{Q_{AL}}_{Assets} = \underbrace{p_s Q_s + \psi Q_{AL}}_{Liabilities}$$

On repayment of an informationally insensitive loan, an originate-to-distribute intermediary receives p_{AL}. The profit of an OTD intermediary is the difference between the price at which they originate loans minus the cost of funding, where the cost of funding is the weighted average of securities they issue and the information sensitive loans they obtain.

$$\Pi^{\text{OTD Lender}} = Q_{AL}\left(p_{AL} - \left((1-\psi)1/p_s + \psi p_l\right)\right) \tag{I.4}$$

We assume that the OTD intermediation is perfectly competitive. To match the data, there are two originate-to-distribute sub-sectors solving analogous problems, each with its own wedge. The private originate-to-distribute sector that makes informationally insensitive *private* loans and issues privately intermediated securities (e.g., corporate bonds). The government-affiliated originate-to-distribute sector that makes informationally sensitive *government-affiliated* loans and issues government-sponsored securities (e.g., Agency MBS).

3.1.4. Outside and government sector

There is an outside savings technology is provided perfectly elastically with price and return $p_0 = 1/(1+r_0)$. This represents, e.g., treasury securities or (risk adjusted) equities.

3.2. Equilibrium

3.2.1. Equilibrium definition

Equilibrium in the model is a set of prices and quantities of savings and borrowing technologies such that:

1. The saver sector maximizes utility (S.3 holds)
2. The borrower sector maximizes utility (B.3 holds)
3. The bank manager maximizes profits (I.2 holds),
4. OTD lenders maximize profits (I.4) and earn zero profits in equilibrium.
5. All markets must clear.

a. The quantity of bank equity and bank deposits demanded by savers equals the quantity of bank equity and bank deposits issued by banks
b. The quantity securities issued by the OTD lending sectors must equal the quantity of securities owned by the saver and bank sector.
c. The quantity of informationally sensitive loans demanded by the borrower sector must equal the quantity of informationally sensitive loans provided by the bank sector.

3.2.2. Deposit Rates and Bank Equity Returns

We can use banks' profit maximization problem to derive the return earned by depositors, and outside bank equity holders. These returns can be expressed as a function of saver preferences and wedges faced by banks at equilibrium bank balance sheet choices. This equilibrium relationship helps us recover intermediation wedges, as well as some borrower and saver preferences when we take the model to the data. The return earned by depositors can be expressed in the following way.

$$r_d = \underbrace{\left(\frac{\sigma_s - 1}{\sigma_s}\right)[1 + r_0] - 1}_{market\ power} - \left(\frac{\sigma_s - 1}{\sigma_s}\right)\left[\underbrace{\delta_d^1 + \delta_d^2\left(\frac{S - \phi D}{D}\right)^{\frac{1}{2}}}_{deposit\ wedge}\right] - \frac{1}{2}\left(\frac{\sigma_s - 1}{\sigma_s}\right)\left[\underbrace{\delta_d^2\left(1 - \frac{S}{D}\right)\left(\frac{S - \phi D}{D}\right)^{-1/2} + \delta_l^2\left(\frac{E}{A}\right)\left(\frac{L}{A}\right)\left(\frac{E - \xi A}{A}\right)^{-1/2}}_{Marginal\ liqudity\ and\ capital\ wedge\ tighthening}\right] \quad \text{(E.1)}$$

Deposits earn less than they would by investing in the outside savings product, r_0. The first term shows the effect of banks market power, which arises because deposits are differentiated, for example, by offering transaction services. The second term illustrates that banks pass the deposit wedge, i.e. the cost of taking deposits, partially to depositors. Banks' market power limits the passthrough of costs to depositors. The last term captures the fact that deposits on the margin tighten both banks' liquidity and capital, which have increasing marginal costs.

The return on bank equity has a similar structure to that of deposits:

$$r_e = \underbrace{\left(\frac{\sigma_s - 1}{\sigma_s}\right)[1 + r_0] - 1}_{market\ power} - \left(\frac{\sigma_s - 1}{\sigma_s}\right)\underbrace{\delta_e^1}_{equity\ wedge} - \left(\frac{\sigma_s - 1}{\sigma_s}\right)\frac{1}{2}\left[\underbrace{\delta_d^2\left(\frac{S - \phi D}{D}\right)^{-1/2} - \delta_l^2\left(\frac{1 - E}{A}\right)\left(\frac{L}{A}\right)\left(\frac{E - \xi A}{A}\right)^{-\frac{1}{2}}}_{Marginal\ liquidity\ and\ capital\ wedge\ loosening}\right] \quad \text{(E.2)}$$

However, unlike deposits, on the margin, equity relaxes the capitalization wedge faced by banks, thus increasing the return on equity—the last term in expression E.2. In other words, consistent with intuition that equity funding is "expensive," banks face a wedge of raising equity δ_e^1. On the other hand, raising equity relaxes capital requirements, and a part of this benefit is passed back to equity holders.

3.2.3. Loan Pricing

Banks offer informationally sensitive lending to borrowers and the OTD sector offers informationally insensitive loans. The bank's first order condition pins down the return on informationally sensitive loans. The return is as follows:

$$r_{bl} = \underbrace{\left(\frac{\sigma_b}{\sigma_b - 1}\right)[1 + r_0] - 1}_{market\ power} - \left(\frac{\sigma_b}{\sigma_b - 1}\right)\left[\underbrace{\delta_l^1 + \delta_l^2\left(\frac{E - \xi A}{A}\right)^{1/2}}_{lending\ wedge}\right] - \left(\frac{\sigma_b}{\sigma_b - 1}\right)\frac{1}{2}\left[\underbrace{\delta_d^2\left(\frac{S - \phi D}{D}\right)^{-1/2}}_{liquidity\ tightening}\right] \tag{E.3}$$

As above, because banks exercise market power to charge a markup on informationally sensitive lending over and above their marginal cost. Their market power is a function of the borrower's elasticity of substitution, σ_b. The cost of lending is directly impacted by the lending wedge, with constant δ_l^1, which also varies with the bank's excess capitalization. A better capitalized bank is able to charge lower rates to borrowers on balance sheet loans. Finally, banks charge lower rates when the bank is more liquid. Intuitively, banks substitute loans (illiquid) with securities (liquid) on the deposit side, and when the bank is nearer to its liquidity constraint, marginal balance sheet lending is more costly because the alternative---owning securities---relaxes the constraint.

The bank's indifference condition on holding various types of securities pins down wedges between the outside option security (e.g., treasuries) and private sector or government supported securities:

$$r_{sp} = r_0 + \Delta_{\text{sp}} \tag{E.4}$$

$$r_{sg} = r_0 + \Delta_{\text{sg}} \tag{E.5}$$

Finally, OTD sector loan rates are pinned down by the sector's being perfectly competitive. In particular, the zero-profit condition implies the following:

$$r_{OTDp} = (1 - \psi)r_{sp} + \psi r_l \tag{E.6}$$

$$r_{OTDg} = (1 - \psi)r_{sg} + \psi r_l \tag{E.7}$$

3.3. Model Estimation

We estimate saver and borrower preferences, as well as the frictions that govern financial intermediation in several steps. We first use intermediary price setting in conjunction with bank balance sheet choices to estimate frictions faced by banks as well as saver and borrower substitution preferences, which give rise to intermediary market power. In the next step we calibrate the remaining saver and borrower preferences and endowments and securitization frictions, which rationalize the time series of price and quantity data.

We use the following data for rates: For r_0, we use the 10-year constant maturity treasury yield. This series is available from 1961, and this constitutes the first year of all estimation procedures. For r_{sp}, we use the Moody's AAA yield. This data series is available for the entire estimation period. For r_{sg} we use Bloomberg's US Mortgage-Backed Securities Index (LUMSSTAT) Yield to Worst. This data is available beginning in 1976. For r_l, we use the average majority prime rate charged by banks on short-term loans to business, quoted on an investment basis. This data is available over the entire estimation window. For r_d, we calculate bank interest expense on deposits divided by total deposits. This series is available beginning in 1984. For r_e, because bank equity is conceptually no different from other outside assets from the point of view of the investor, we set $r_e = r_0$. Bank balance sheet variables are discussed previously and are available over the entire estimation window. We extend our observations for r_d back to 1962 by projecting them on observed treasury and loan rates, and our observations for r_{sg} back to 1962 by projecting them on observed AAA yields.[12]

3.3.1. Bank Wedges and Preferences for Substitution

We begin by utilizing time-series returns data and bank balance sheet data, together with equilibrium pricing equations E.1-5, to estimate bank intermediation parameters as well as saver and borrower substitution preferences. Intuitively, we observe a time series of returns on saving and borrowing technologies as well as a time series of bank balance sheet data. We use the passthrough of risk-free rates to deposit rate, loan rates, and returns on bank equity to estimate the parameters governing price setting. Broadly, as banks become more constrained, they pass some of the associated wedges to savers and borrowers. However, the passthrough depends on their market power, i.e., σ_s. The model estimation allows us to account for these forces simultaneously.

We observe a time series of $\{r_0, r_{sp}, r_{sg}, r_l, r_d, r_e, L, S, D, E\}_t$. $\{r_0, r_{sp}, r_{sg}\}$ immediately identify a time series of securities wedges, $\{\Delta_{\text{sp}}, \Delta_{\text{sg}}\}$. Additionally, we impose the following structural assumptions:

$$\delta^1_{d,t} = \overline{\delta^1_d} - \epsilon_{d,t}$$

$$\delta^1_{e,t} = \overline{\delta^1_e} - \epsilon_{e,t} \tag{Est. 1}$$

$$\delta^1_{l,t} = \overline{\delta^1_l} + \epsilon_{l,t}$$

$$E\left[\epsilon_{j,t} \middle| Z_t\right] = 0 \tag{Est. 2}$$

We interpret these $(\epsilon_{d,t}, \epsilon_{e,t}, \epsilon_{l,t})$ as time-varying implicit regulatory costs or subsidies. That is, they are wedges that make issuing deposits, equity, or loans more or less advantageous for the bank than returns alone suggest. Observe that with these definitions, positive values are advantageous to the bank, e.g., $\epsilon_{d,t} > 0$ means that intermediating deposits is relatively less expensive for the bank (and the bank will offer a higher deposit rate to attract more deposits). Intuitively, these epsilons are time-varying wedges that make issuing deposits, equity, or loans more or less advantageous for the bank than returns and the modeled balance sheet costs suggest. Additionally, because we fix the parameters mapping balance sheet variables to intermediation costs, time variation in these epsilons implicitly captures changes in capital or liquidity requirements.

[12] In particular, post-1984 when our deposit rates data begins, we regress $r_{dt} = \beta_0 + \beta_1 r_{0t} + \beta_2 r_{lt} + \epsilon_t$, obtain the estimated $(\hat{\beta}_0, \hat{\beta}_1, \hat{\beta}_2)$, and then for pre-1984 data use $\hat{r}_{dt} = \hat{\beta}_0 + \hat{\beta}_1 r_{0t} + \hat{\beta}_2 r_{lt}$. We run the analogous regression and projection for r_{sgt} using r_{spt}.

With these assumptions, we aim to identify seven parameters: $(\sigma_s, \sigma_b, \overline{\delta_d^1}, \overline{\delta_e^1}, \overline{\delta_l^1}, \delta_d^2, \delta_l^2)$. As instruments we use those suggested by ordinary least squares. That is, we use where relevant, $\{r_0, S/D, L/A, D/A, E/A\}$. To account for endogeneity of r_0, we instrument it using the total quantity of treasury securities following Krishnamurthy and Li (2022). Together, this yields 13 moment conditions which we describe in Appendix A.4. We implement our estimation as a feasible two-stage GMM estimation on the part of the sample where all data are observable, quarterly, from 1962-2023.[13] As the statutory capital requirement, we use $\xi = 4\%$. We set the lower bound on liquidity at $\phi = 5\%$. This corresponds to the statutory limit on liquidity, is likely more than what the banks would choose privately.[14]

The results of this estimation are shown in Table 4, Panel (a) together with standard errors. We discuss the estimation results below. Figure 7, panel (a) shows the structural error terms on bank deposits, equity, and securities wedges. We find that broadly, these are trending upwards over time, indicating a steady rise in the shadow return for owning these assets, which we interpret as rising implicit subsidies over time. Panel (b) shows the structural error terms for bank loans, which show a marked decrease starting in the 1990s and accelerating after the financial crisis. As we formalize below, we interpret this shift as an increase in implicit costs on bank loan issuance.

3.3.2. Borrower, saver, and shadow bank parameters

Having estimated how substitutable saving and borrowing technologies are (σ_s, σ_b) in the previous stage, we are left to determine saver and borrower preferences for specific technologies (α_j, β_j), and borrower and saver endowments M_s and M_b. To see what drives the calibration, consider the demand for saver technologies in year *t* (S.3). The total size of investable financial wealth at any point of time $M_{s,t}$ is the total invested financial wealth. Given how consumers substitute across savings technologies σ_s, only one set of relative preferences *across* savings products, α_j rationalize their quantities given their returns. We can only estimate relative preferences across products—if all preferences, α_j, increase by the same factor, that leaves demand unchanged. Therefore, the level of α_j is not determined, so we normalize $\alpha_d = 1$. Thus, the saver preference parameters are reported relative to savers demand for deposits. With this normalization, we then exactly identify the time series of saver preferences relative to deposits, $\alpha_j = (\alpha_{0,t}, \alpha_{sp,t}, \alpha_{sg,t}, \alpha_{e,t})$.

Borrower preferences: We use an equivalent approach to calibrate preferences of borrowers. As was the case with savers, we (innocuously) normalize $\beta_l = 1$ over the entire sample, so we measure preferences relative to informationally sensitive bank loans. This allows us, in a given period, to exactly determine $(\beta_{OTDp,t}, \beta_{OTDg,t}, M_{b,t})$, where $(\beta_{OTDp,t}, \beta_{OTDg,t})$ are borrower demand preferences for informationally insensitive private and government-backed OTD lending relative to informationally sensitive lending. Table 4, panel (b) shows the static demand

[13] Having estimated these structural parameters, we also recover the time series of epsilons.
[14] https://www.bis.org/basel_framework/chapter/LCR/40.htm

parameters, (α_d, β_l). Figure 7, panel (c) shows borrower demand for informationally insensitive lending relative to informationally sensitive lending, and Panel (d) shows saver preferences over savings technologies relative to deposits.

3.3.3. Identification Intuition

Before discussing the results, we briefly provide intuition around our estimation and calibration approach. The key starting place is borrower and saver elasticities of substitution. As per equations E.1, E.2, E.3, these are essentially identified through the imperfect passthrough of the outside option rate (here, treasury rates) to lending and deposit rates. If the passthrough is perfect, then the assets are perfect substitutes. To the extent to which rates are not passed through one-to-one disciplines the elasticities of substitution. As interest rates are likely to be endogenous, we instrument using the quantity of treasuries, the idea being that treasury issuance is a supply shifter for r_0. Next, the other parameters of bank supply are obtained by projecting interest rate residuals on bank balance sheet observables such as excess capitalization or excess liquidity.

The parameters mapping bank balance sheet variables to intermediation costs, δ_j^i, as well as the epsilons $(\epsilon_{d,t}, \epsilon_{e,t}, \epsilon_{l,t})$, are also identified with the same time-series variation. The deltas are identified by how returns of debt, equity, and loans vary with balance sheet variables through time. For example, if loan rates increase when bank capitalization is low, we estimate a positive δ_l^2. The ϵ's are residuals, i.e., differences between observed returns and those predicted by markups over the outside option rate and the balance sheet variables. Intuitively, if, for example, required returns on loans are higher than would otherwise be predicted, our model attributes these differences as a negative $\epsilon_{l,t}$, i.e., a regulatory cost.

Once elasticities of substitution are known, we know the slope of saver and borrower demand curves. For savers, since we observe prices (returns) and quantities directly, we can directly calculate the preference parameters that jointly rationalize prices and quantities. For instance, if observed quantities of securities owned by the saver sector increase and prices remain constant, this must reflect a shift outwards in the demand curve, i.e., a preference change. Had prices also decreased, because the slope of the demand curve is known, we would calculate a shift in quantity demanded predicted by the price change and attribute the residual to a shift in the demand curve.

The same intuition holds for borrowers once we observe the slope of the borrowing demand curve and quantities. Thus, for a given price and quantity we can exactly back out the pair $(\beta_{OTDp,t}, \beta_{OTDg,t})$ to match observed quantities and prices and their shifts through time. Specifically, if the return (price) on informationally insensitive loans remains constant across periods while the observed quantity increases, we attribute this change to an outward shift in the borrower demand curve.

It is important to recognize that shifts in saver and borrower demand are independent and can be separately identified. An increase in the quantity of informationally insensitive lending does not directly correspond to a proportional increase in household savings in securities. Borrower demand for informationally insensitive lending and saver demand for securities are connected only through the intermediation sector. For example, suppose there is a significant outward shift in demand for informationally insensitive borrowing. In response, the OTD sector issues more such loans and finances them by issuing additional securities. However, these new securities need not be issued to households—they can be absorbed by the banking sector. In fact, as borrower demand for informationally insensitive loans increases, it is likely accompanied by a relative decline in demand for informationally sensitive bank lending. Consequently, the newly issued securities tend to replace loans on bank balance sheets, leaving the saver sector largely unaffected. The only way savers are impacted is if banks cannot absorb the additional securities. In that case, security returns will rise, prompting savers to shift their portfolios toward securities and away from other assets. Therefore, our model interprets large increases in both informationally insensitive lending and household securities holdings as separate phenomena—one does not necessarily imply the other.

Anticipating our results, we find that the quantity demanded of informationally insensitive loans from the borrower sector increases dramatically. Simultaneously, the quantity demanded of securities from the saver sector increases dramatically. If, counterfactually, this had been accompanied by a large increase in the return offered on securities, our model would say that this was a shift outwards in borrower demand, while savers were merely moving along their demand curve. However, because we observe these quantity changes *without* a dramatic price increase, this implies there must also be a shift in the saver demand curve.

3.3.4. Results

3.3.4.A. Bank Market Power, Funding, and the Production of Informationally Sensitive Loans

We estimate limited substitution across savings product which provides banks with substantial market power. Savers' elasticity of substitution across broad asset classes, σ_s, is 4.38. The elasticity estimate for borrowing is broadly in line with Buchak et al. (2024), who estimate a price elasticity of 6.5 for mortgage borrowers, even though the setting, identification procedure, and time period differ significantly.[15] This limited substitution provides significant market power to banks on the funding side, because they are the only sector who can provide deposits.

The cost of providing deposits is lower when the bank has a better liquidity position, $\delta_d^2 = -0.18$. Intuitively, when the bank possesses relatively few liquid assets (securities), when paying deposit withdrawals, the bank is forced to liquidate assets that are more expensive to liquidate. In contrast, when the bank possesses a large quantity of liquid securities, it is relatively cheap to provide deposits because deposit outflows can easily be satisfied with easy-to-liquidate securities.

[15] One might expect a higher elasticity of substation in Buchak et al. (2024) because it is measured within the same asset class of mortgage products rather than across broad asset classes, which we measure.

Banks have market power in providing informationally sensitive loans because borrowers cannot fully substitute informationally sensitive loans for informationally insensitive ones, with the elasticity of substitution of $\sigma_b = 3.87$. Intuitively, if a borrower is a small firm with an opaque project, it will find it difficult to replace a bank credit line with a public bond.

Better capitalized banks experience fewer frictions in providing informationally sensitive loans, with $\delta_l^2 = 0.015$. To interpret the quantities, a bank moving from a 9% capital ratio relative to the 4% requirement to a 14% capital ratio (excess capitalization increasing from 5% to 10%), the return on informationally sensitive lending increases by approximately 1 percentage point.[16] This is consistent with models of capital constraints as well as models in which better-capitalized banks face fewer conflicts of interest.

3.3.4.B Saver Demand Shifters for Securities

Our structural model produces a time series of saver demand shifters for securities, $(\alpha_{0,t}, \alpha_{sp,t}, \alpha_{sg,t}, \alpha_{e,t})$ and borrower demand shifters for loans, $(\beta_{OTDp,t}, \beta_{OTDg,t})$. We first discuss saver demand shifters for securities. Figure 7 Panel (a) shows the time series of our key parameters of interest, $(\alpha_{sp,t}, \alpha_{sg,t})$, the demand shifters for private and government-affiliated securities, in blue and red, respectively. As the figure shows, we find a large secular increase in demand for both private and government securities relative to deposits from mid 1980s. This increase is broadly consistent with several developments that we discussed in Section 2.5.2 such as the establishment of money market funds in the 1970s and the regulatory framework implemented during 1970s and 1980s, which has contributed to the growth of pension funds including 401(k) plans.

Savers' preferences for private securities reach their peak prior to the financial crisis, and fall dramatically thereafter, remaining fairly constant for the rest of the sample period, but still elevated relative to the 1984 base. As we explain later, our model interprets the run-up to the financial crisis as a period in which the *demand* for private securitizations increased, and the crash as a period in which *both* demand decreased and the technology around producing them decreased somewhat. Preferences for government affiliated securities, demand rose dramatically from 1980s onward before falling somewhat in the run-up to the financial crisis, as savers increasingly held private securities. Demand recovered following the private securitization collapse.

In order to provide a more rigorous interpretation for these parameters, we regress the time series of demand shifters on several variables that we expect ex-ante to be related to saver's changing preferences for securities relative to deposits. In particular, we run the following regression:

$$\alpha_{J,t} = X_t'\beta + \epsilon_t, \tag{2}$$

[16] $(\sqrt{14\% - 4\%} - \sqrt{9\% - 4\%}) \times 0.015 = 1.4\%$

where $\alpha_{J,t}$ are the saver demand shifters for government securities, $\alpha_{sg,t}$, the saver demand shifters for private securities, $\alpha_{sp,t}$, and the saver demand shifters for other savings technologies (including treasuries and equities), $\alpha_{0,t}$. X_t' is a vector of time-series covariates, defined as follows:

Regulation index: Our regulation index is an average of several intermediation-related indicators taking a value of 0 before the regulation is implemented and 1 after the regulation is implemented. The index varies between 0 (at the start of the sample) and 1 (at the end of the sample). It includes the key regulations discussed in Section 2.5, namely, FIRRA, GLBA, the date at which Fannie and Freddie were split, the date of the first Ginnie, Fannie, and Freddie MBS issuance, FDICIA, IBBEA, Basel II, and Dodd-Frank.[17]

Technology index: Like the regulation index, the *technology index* is an average of several intermediation-related indicators taking a value of 0 before the technology arrives and 1 afterwards. The index varies between 0 (at the start of the sample) and 1 (at the end of the sample). It includes the technologies discussed in Section 2.5, namely the first private CMBS, the first private CLO, the first money market fund, the first issuance of commercial paper, and the invention of the FICO score.

Wealth share: We include the top 10% wealth share as a way to capture shifting borrower preferences away from transaction products and towards return-earning products. That is, we try to capture the idea that wealthier savers hold a smaller fraction of their wealth in products that provide transaction services than poorer savers.

The results of this analysis are presented in Table 5. For government-affiliated securities (Column 1), we find a strong and statistically significant association between the regulation index and saver demand. In contrast, for private securities (Column 2), the relationship has the opposite sign, supporting the idea that certain regulations—such as the rise of GSEs—crowd out demand for privately issued securities. For other securities (e.g., equities and treasuries), we observe a positive but insignificant relationship. Additionally, we find that the technology index is positively and significantly associated with the increase in demand for all three types of non-deposit assets, aligning with the notion that improved financial technology has facilitated savers' shift away from traditional deposits toward other savings instruments. Lastly, the wealth share is significantly correlated with all three asset types, consistent with the hypothesis that higher-wealth households hold more return-generating products and fewer transaction-focused products relative to their total wealth.

3.3.4.C Borrower Demand Shifters for Informationally Insensitive Lending

Figure 7, Panel (b), displays the borrower demand shifters for both private and government-sector informationally sensitive lending, $(\beta_{OTDp,t}, \beta_{OTDg,t})$. Starting with private securitization demand,

[17] Note that because many of these regulatory developments are contemporaneous, we do not attempt to separately identify which regulation or set of regulations is more or less associated with our measured demand shifters.

shown in blue, the parameter remains flat before the 1980s, followed by a modest increase during the 1980s and early 1990s, before stabilizing. This rise aligns with a period of rapid technological advancements in finance (see Section 2), such as increased investment in financial information technology and the emergence of consumer and commercial credit scoring. It also coincides with significant financial deregulation, which likely facilitated the shift from traditional banking to a model that increasingly relied on originate-to-distribute intermediation.

The government-associated demand parameter, shown in red, rises steadily throughout the sample period until the 2000s. As discussed in Section 2.4, this trend reflects the growing influence of Fannie Mae, Freddie Mac, and Ginnie Mae in the U.S. housing market. In 1970, Freddie Mac was established by the federal government to expand the secondary mortgage market and promote homeownership, issuing its first mortgage-backed securities (MBS) in 1971. Fannie Mae was split into two entities in 1968: Fannie Mae retained its government-sponsored status, while Ginnie Mae became a fully government-owned entity, issuing its first MBS in 1970. Fannie Mae followed with its first securitization deal in 1981. In the 1990s, these entities were tasked with an "affirmative obligation to support affordable housing for low- and moderate-income families." These developments, summarized here, reflect a broader trend of increasing government involvement and subsidies in the housing market, which our model captures as a declining wedge from the 1960s through the 2000s.

As before, we formalize this intuition by regressing the time series of demand shifters on several variables that we anticipate will be related to borrowers' shifting preferences between informationally insensitive and sensitive lending. For this analysis, our time-series covariates include the *Regulation Index* and *Technology Index*. Additionally, for government-affiliated lending, we include the real average conforming loan limit, calculated as the loan-weighted conforming loan limit at time t, adjusted by the CPI at time t. For private-market lending, we include aggregate measures of total firm intangibles-to-assets and R&D expenses-to-assets from Compustat, reflecting the idea that the nature of the projects borrowers seek to finance may change over time.

The results are presented in Table 5, Columns (4) and (5), for government-affiliated and private-market securities, respectively. For government-affiliated securities, both the regulation and technology indices are statistically significant, with the regulation index playing a larger role. This aligns with the earlier narrative about the expansion of the GSEs and the introduction of FICO scoring, which streamlined and standardized MBS issuance. Additionally, the real conforming loan limit has a positive coefficient, supporting the idea that as GSEs expand the eligibility criteria for loan guarantees, more homes are financed through government-affiliated, informationally insensitive lending.

In the private sector, technology plays the largest role in the rise of private securitization. We also observe a modest negative association between R&D expenses-to-assets and private securitization, suggesting that as firms become more R&D-intensive, they rely more on informationally sensitive lending. However, this does not offset the overall growth of informationally insensitive lending; despite the rise of R&D-intensive firms, informationally insensitive lending continues to expand at a faster rate.

3.3.4.D Bank Funding Epsilons

Lastly, we conduct the same analysis on the bank funding epsilons, shown in Figure 7, Panels (c) and (d). We regress the bank funding epsilons for deposits, equity, and loans on the *Regulation Index* and *Technology Index*. The results, presented in Table 5, Columns (6)–(8), reveal a consistent pattern. For bank liabilities—specifically deposits and equity—we find a positive and significant relationship with the *Regulation Index*, suggesting that regulation acts as an implicit subsidy for these funding sources. In contrast, we observe a negative and significant association between the *Regulation Index* and bank loans, consistent with the narrative that regulation has increased the cost of bank lending. Finally, there is a modest but significant positive relationship between the *Technology Index* and bank lending, indicating that technological advancements have made bank lending more efficient.

4. Decomposing the Secular Lending Trends

We use the calibrated model to decompose the observed secular trends. We ask how three forces: (1) shifts in borrower preferences, (2) shifts in saver preferences, and (3) changes in the implied costs and subsidies to banks for issuing or holding assets, explain the major trends we observe in the data. To undertake this analysis, we examine counterfactual outcomes in 2023 under five scenarios. First, we consider the baseline 1963 scenario, where each of these forces are set to their 1963 levels, i.e., borrower preferences, saver preferences, and bank costs and subsidies (epsilons) are set to what the model implies in 1963. All other parameters, such as total market sizes, are allowed to vary to their 2023 levels. That is, we simulate a counterfactual 2023 intermediation sector where these forces have been held fixed since 1963 but other parameters of the economy. We then sequentially set the forces to their 2023 levels, recompute outcomes, and compare them to the baseline. Finally, we turn on all three forces, which mechanically generates the observed 2023 outcomes.

4.1. Impacts in 2023

To preview our findings at a high level, our model highlights the impact of three main forces since 1963. First, borrowers have shifted dramatically towards preferring to borrow with informationally sensitive lending, which our analysis attributes chiefly to technology in the case of the private sector and regulation in the case of the government-affiliated sector. This force increases overall lending and shifts the composition of lending towards informationally insensitive loans and away from bank balance sheets. Second, saver preferences to hold deposits have fallen relative to other savings technologies. This force reallocates deposit savings towards other technologies, including securitized private credit, but also towards other savings technologies such as treasury securities. Third, implicit subsidies towards bank deposits have increased, while implicit costs of informationally sensitive lending have increased. This force increases deposits, thereby growing bank balance sheets, but channels these new deposits towards financing securities rather than informationally sensitive loans. On net, as a result of these forces, total lending is higher, bank balance sheets are smaller, there is less informationally sensitive lending, and the composition of bank balance sheets has shifted away from informationally sensitive lending than they would be absent these forces. We discuss these effects in detail below.

Figure 8 shows various outcomes of interest. Panel (a) shows the total level of lending measured as a percentage change relative to the baseline with 1963 parameters. The figure shows that the 2023 shifts in borrower preferences generate roughly an 8% increase in total private credit relative to the baseline. Reduced saver preferences for deposits modestly reduce total private credit intermediation because savers replace deposits only partially with private securities (which would offset the decline one-for-one), but also with assets outside of the private credit intermediation sector altogether, such as US Treasury securities. Changing banks subsidies and costs—increased deposit subsidies paired with increases costs of informationally sensitive lending—on net reduce total lending. While deposits subsidies grow bank balance sheets, deposits are not necessarily channeled into private credit intermediation, especially in the face of rising implicit costs of making loans. On net, these changes result in fairly modest increase in total lending, which rises 6% relative to the baseline.

These modest aggregate differences mask larger changes in the structure of financial intermediation. Panel (b) shows change in the bank balance sheet lending, revealing a cumulative decrease of 22% relative to the baseline parameters. All three forces contribute to this change, although borrower demand shifts are the primary driver. These shifts naturally draw borrowers towards informationally insensitive financing, contributing approximately 14% to the total decline in bank balance sheet lending. Preferences against saving in deposits reduces bank balance sheet size and informationally sensitive lending along with it by about 5%. Finally, rising implicit costs of making informationally sensitive loans further reduces quantities by about 7%.

Panel (c) shows how these changes have impacted the composition of lending to borrowers. As a result of our identified forces, informationally sensitive lending in 2023 comprises a much smaller share of overall borrowing (roughly 14% lower) than it would otherwise. As we discussed above, borrower demand shifts are the primary driver in the overall change, although all three forces work against informationally sensitive lending.

Panel (d) examines bank balance sheet size. Shifts in borrower demand reduce bank balance sheet size by roughly 1%. This relatively small change is driven by the fact that banks themselves can endogenously shift their business models from making informationally sensitive loans towards owning informationally insensitive securities. Thus, the aggregate size of bank balance sheet lending shares does not dramatically alter bank balance sheet size. Changing saver preferences away from owning deposits, on the other hand, dramatically reduces bank balance sheet size. Our model attributes roughly an 19% decrease in bank balance sheet size to changes in borrower preferences. Finally, there is a small partially offsetting increase in bank balance sheets caused by changes in implicit banks' costs and subsidies, particularly on deposits, which cause bank balance sheets to be roughly 2% larger than they would be otherwise. On net, however, the two former forces dominate, and our model predicts that bank balance sheets are 20% smaller than they would have been had technology, preferences, and banks' costs and subsidies been kept at their 1963 level.

In addition to shrinking bank balance sheets, these forces also drive a compositional shift in how banks use their balance sheets. Panel (e) shows that on net, the informationally sensitive share of bank balance sheets declines by roughly 2.3 percentage points. Shifts in borrower demand lead banks to hold more securities relative to informationally sensitive loans, accounting for roughly an 8 percentage points shift in balance sheet composition. Interestingly, reduced saver preferences for deposits leads to an opposite compositional shift. As savers allocate less wealth towards deposits, bank balance sheets shrink. While balance sheets shrink, informationally sensitive lending opportunities are unaffected, and thus banks' primary margin of adjustment to reduce balance sheet size is to sell securities. This scaling effect accounts for roughly a 10 percentage points increase in the informationally sensitive share of bank balance sheets. Finally, increasing deposit subsidies and increasing costs of bank balance sheet lending result in net growth of bank balance sheets, which primarily occurs through owning more securities, and cause banks to make fewer informationally sensitive loans.

Turning to bank capitalization, Appendix A1 shows that changes since 1963 have had a largely offsetting impact on overall bank capitalization. Capital ratios rose on net roughly 70 basis points versus the baseline counterfactual where these forces were held fixed at 1963 levels. Borrower demand shifts have little effect in the financing structure of banks as they affect both bank deposits and bank equity equally. Rising preferences among savers to hold securities relative to deposits cause a reduction in total deposits, which leads banks to be better capitalized. Partially offsetting this force is rising deposit subsidies, but on net the former effect dominates.

Finally, turning to saver choices, panel (f) shows that deposits are a roughly 3 percentage points lower as a share of savings than they would be under the 1963 parameters. These parameters are driven partly by borrower demand shifts but mostly by decreased saver preferences to hold deposits. As above, these two trends are slightly offset by rising implicit deposit subsidies.

To summarize, shifts in borrower demand for informationally insensitive versus informationally sensitive lending have increased aggregate private lending and reduced the importance of informationally sensitive bank balance sheet lending. We attribute these borrower demand shifts to changes in technology in the case of the private sector and regulations supporting secondary loan markets in the case of the government-affiliated sector. Decreased saver preferences to own deposits have further shrunk banks, but also have reduced aggregate private credit intermediation as some of these deposit outflows are allocated towards assets outside of private credit, such as Treasury securities. Finally, rising implicit subsidies on deposits have tended to make bank balance sheets grow, but when paired with increasing implicit costs of informationally sensitive loans, this increase in deposits have primarily been used to purchase securities.

4.2. Impacts over time

The preceding analysis considered only the impacts on the latest period. Figure 9 shows this decomposition over time for four keys outcomes: total lending (panel (a)), informationally sensitive bank balance sheet lending (panel (b)), the informationally sensitive lending share (panel (c)), and the bank assets (panel (d)). In these time series, we allow market sizes and outside option returns to evolve as they did over time, and fix the three forces sequentially to their 1963 levels. Examining these changes over time serves two purposes: First, it helps illustrate when the changes occurred in order to provide a more specific narrative around what drove them. Second, it serves to illustrate in a striking way what underlying structural changes map most closely to the outcomes of interest.

Beginning with total lending shown in panel (a), the figure shows that the overall changes in total lending (light blue) are, to a first order, driven by changes in borrower demand. This is a key point of our paper: shifts in borrower demand impact total output in addition to causing a reallocation among intermediation sectors and lending technologies. Other changes, e.g., preferences and subsidies, are primarily reallocative. While they have second-order impacts on total output, these are quantitively minor relative to the effect of technological change. This plot shows that the primary impact of shifts in borrower demand on total lending quantities occurred from the 1980s through the 2000s, when, as discussed earlier, major advancements occurred in the private and government-affiliated intermediation sectors (Section 2.4), and slightly reversed thereafter, particularly after the financial crisis.

The decrease in the quantity of informationally sensitive lending, as illustrated in panel (b), is not solely due to one dominant factor. Instead, a combination of borrower demand, saver demand, and changes in bank subsidies/costs collectively influence the decline in this share. In particular, in the first half of the sample, up through the 1990s, increases in borrower demand for informationally insensitive lending was the primary driver. In the second half of the sample, increasing regulatory costs of lending primarily drove the decrease. Panel (c) further demonstrates how the reduction in the share of informationally sensitive lending in total lending is driven by the interplay of these factors. As previously discussed, the significant changes took place in the 1980s and 1990s, while a notable reduction in implicit subsidies (or increase in costs) on informationally sensitive bank lending occurred in the mid- to late-2000s (Section 2.4). This suggests that the reduction in the informationally sensitive lending stems from changes in demand on the borrower side, notably the development of the government-affiliated debt securities market and advancements in private securitization technology. It is also worth acknowledging that changes in implicit bank subsidies and costs do appear to exert a small influence on the decline of the informationally sensitive lending share, particularly toward the end of our sample period when various bank regulations proposed after the Global Financial Crisis become increasingly implemented. This contribution, however, is much smaller than the impact of borrower demand shifts for informationally insensitive lending during the 1980s and 1990s.

When explaining changes in bank balance sheet size shown in panel (d), our decomposition shows that reduced bank balance sheet sizes are largely driven by savers' preferences moving away from holding deposits (shown in yellow). This change occurs largely during the mid-1980s through 2000. As savers allocated a smaller share of their savings towards deposits, bank balance sheets naturally shrunk. While change in implicit deposit subsidies, particularly since the mid 2000s, had a partially-offsetting effect, it is not quantitatively large enough to significantly reverse the role of saver preferences. Additionally, shifts in the borrower demand toward informationally insensitive lending largely cancel out these subsidies.

On the other hand, the informationally sensitive share of bank balance sheets, shown in Appendix A2, is driven by a combination of all three factors. As discussed earlier, shifts in demand between informationally insensitive and informationally sensitive lending increases the total quantity of informationally insensitive at the expense of informationally insensitive lending, which leads to a decrease in the loan share of bank assets. Additionally, savers demand fewer deposits relative to their financial wealth, bank balance sheets are otherwise smaller, but because this does not impact informationally sensitive lending opportunities, banks adjust by reducing their holdings of securities. Thus, these preferences by themselves tend to increase the loan share of bank assets. Finally, increased regulatory costs of informationally insensitive lending has reduced the loan share of bank balance sheets, particularly in the latter half of the sample.

To summarize the findings in this section, we find that each of our forces was separately important in different outcomes. Shifts in the borrower demand toward informationally insensitive lending has been the primary driver of changes in total lending. Saver preferences have been the primary driver of the sizes of bank balance sheets. All three forces, including changes in implicit subsidies or costs to banks' loans have been the primary driver of how banks allocate their balance sheet capacity.

4.3. Counterfactual Capital and Liquidity Requirements

Finally, we use the model to consider how the impact of two major macro-prudential tools, capital, and liquidity requirements, has changed as financial intermediation has evolved through time. In particular, we consider the counterfactual impact of raising (to 25%) or removing (to 0%) capital and liquidity requirements.[18] We consider the impact of this change given the estimated 1963 parameters, when the financial intermediation system relied more on traditional bank balance sheet intermediation, and given the 2023 parameters, when the financial intermediation system relied more on securitization. We emphasize that our model is intended to capture the long-term effects of these regulations, rather than the short-term transition dynamics. These results are shown in

[18] We follow Jiang et al. (2020) who show that bank capital requirements of 25% would align bank capital ratios more closely with the capitalization of their non-bank counterparts who engage in similar activities as banks.

Figure 10, where blue bars represent the 2023 impacts and orange bars represent the impacts under the 1963 parameters.[19]

We first study the impact of capital and liquidity requirements on total lending in panel (a) of Figure 10. Higher capital or liquidity requirements reduce total lending in both cases, and lower capital or liquidity requirements increase lending in both cases. However, there are significant differences in magnitudes when comparing the economy with 1963 parameters and the economy with 2023 parameters. Broadly, the effects on total lending are much larger in magnitude in 1963 than in 2023. Raising capital requirements to 25% reduces lending by roughly 50 basis points in 1963, whereas it reduces lending by only 20 basis points in 2023---a 2.5x reduction in sensitivity. Similarly, raising liquidity requirements to 25% reduces lending by roughly 120 basis points in 1963, while it reduces lending by roughly 60 basis points in 2023. While we focus on tightening these regulatory ratios, in all cases the impact of *reducing* these ratios is quantitatively very small.

In both scenarios, banks react to capital regulations by contracting their bank balance sheet lending (panel (b)). Panel (c) shows that this is accompanied, in the case of increased capital requirements, with a dramatic decline in bank balance sheet size. In particular, in both the 1963 and 2023 situations, banks respond to the 25% increase in capital requirements by reducing their balance sheets by roughly 14%. Panel (d) shows that as capital requirements increase, the informationally sensitive balance sheet share of banks increases. This reflects a compositional shift arising as banks sell securities, rather than loans, to reduce the size of their balance sheets. These findings are due to the fact that while the increase in bank capital requirements results in a significant decrease in bank balance sheet lending, there is simultaneously an increase in lending through debt securities that substitute, albeit imperfectly, for informationally sensitive bank balance sheet lending. This result aligns with the findings of Buchak et al. (2024), who present empirical evidence and a structural model of the credit market, demonstrating that increases in capital requirements have relatively modest effects on aggregate lending. This is due to the "bank balance sheet substitution" margin of adjustments, where bank balance sheet lending is replaced by lending financed through loan sales when bank capital requirements increase. In effect, banks possess a comparative advantage in making informationally insensitive loans, so when bank balance sheet capacity becomes more expensive, they reduce activity in the sector where they are at a comparative disadvantage---owning informationally insensitive securities.

In contrast, panel (c) shows the impact on bank balance sheet size of increased liquidity requirements is small. Instead, as panel (d) shows, increased liquidity requirements impact balance sheet lending through a shift in bank business model. The informationally sensitive loan share of bank balance sheets falls by 3-4%, implying that banks substitute more liquid securities for less liquid loans. This contrasts with how banks' business models respond to increases in capital

[19] In terms of our model, the counterfactuals change ξ, the capital requirement, and ϕ, the liquidity requirement.

requirements. In this case, banks shrink their overall balance sheet by selling securities, which leads to an increased loan balance sheet share.

What accounts for the smaller aggregate response under the 2023 parameters? First, the impact of increasing capital requirements (or liquidity requirements) on total lending is more subdued in 2023, given the shift towards informationally insensitive lending that better facilitates the substitution of informationally sensitive loans with debt securities that do not require bank balance sheet funding. Second, the composition of bank balance sheets is significantly different in 2023 than it would be under 1963 parameters, and so balance sheet contraction has different impacts on lending. Under 1963 parameters, the informationally sensitive loan share of banks is roughly 65%, versus 50% under 2023 parameters. This means that a bank reducing its balance sheet size on an asset-weighted basis reduces aggregate informationally sensitive lending by more in the 1963 case than in the 2023 case. Because providing informationally sensitive loans can only be done by banks, but owning informationally insensitive securities can be done by both banks and savers directly, informationally sensitive lending leaving the banking sector is more consequential for overall lending than is informationally insensitive securities leaving the banking sector.

To summarize, the impact of capital requirements and liquidity requirements on total lending is overall modest and more muted under the 2023 intermediation system relative to the 1963 intermediation system. This occurs for two reasons. First the impact of higher capital requirements or liquidity requirements on overall lending is relatively modest as debt securities can substitute for informationally sensitive lending, albeit not perfectly. Second, shifts in demand towards informationally insensitive borrowing dramatically increase the number of securities, including on bank balance sheets. When banks face higher capital requirements, they reduce their balance sheet size, which in 2023 means selling securities, which the saver sector can easily absorb. Second, increased saver preferences for securities means that banks can more easily alter their asset mix to focus more on informationally sensitive loans, where there is no other substitute.

5. Conclusion

Our findings suggest a significant transformation in the intermediation sector, with important implications for macroprudential policy and financial regulation. The 2023 bank failures once again highlighted the fundamental vulnerability of banks due to their high financial leverage, a result of safety nets like insured deposit funding and the ability to issue money-like claims (Jiang et al. 2023, 2020). Current regulatory discussions, including the Basel III endgame, aim to address this vulnerability by considering increased capital requirements for banks. Critics argue that such measures could significantly harm aggregate lending and the broader economy. However, our analysis suggests that the role of banks and their balance sheets in credit provision has diminished over time. Our model indicates that raising bank capital requirements would have only modest adverse effects on aggregate lending, as credit would mainly shift from bank balance sheets to debt securities. This aligns with previous studies that emphasize how modern industrial organization of the credit market, which allow intermediaries to sell loans, reduce the impact of capital regulation on lending (Jiang et al. 2020; Buchak et al. 2023, 2024). Our paper shows that this insight holds substantial quantitative importance, applying to the entire lending market, including all loans to households and non-financial businesses, as well as “indirect” lending through banks' debt securities holdings.

Our analysis also highlights the importance of considering lenders' ability to sell their loans and the evolution of the debt securities market when evaluating policies targeting credit markets. Focusing solely on bank balance sheet lending without accounting for these adjustment margins can lead to faulty inferences. For instance, our findings show that the impact of bank capital requirements on aggregate lending is far less severe than suggested by simply examining bank balance sheets, especially when relying solely on bank call report data (see also Buchak et al. 2023, 2024). Therefore, it is crucial for regulatory policy analysis to incorporate lending data beyond what is available from bank balance sheets to provide a more comprehensive view of credit market dynamics.

More fundamentally, our paper addresses the shifting boundaries of the intermediation sector, revealing that banks are becoming less central to credit intermediation and aggregate lending. While banks may still play a key role in loan origination and monitoring, we offer two observations. First, although banks may retain some advantages in these areas, our analysis focuses on the declining significance of bank balance sheet lending. Our findings show that substitutes are increasingly available, diminishing the role banks play in financing loans. This shift carries important policy implications, suggesting a reduced impact of bank deposit funding and related capital regulations on aggregate lending. Second, non-banks now originate and service a substantial portion of loans in many credit market segments, a trend that has intensified over the past two decades (Buchak et al. 2018, 2024; Seru 2019). This suggests a further erosion of banks' “specialness” in loan origination and servicing. Moreover, the rise of financial innovations, including AI and machine learning, may further reduce the advantages of informationally sensitive bank balance sheet lending. Overall, our analysis suggests that regulatory policy should shift its focus from banks to the debt securities markets and non-bank intermediaries, which now finance a significant portion of lending activities.

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Table 1: Ease of Securitization and Bank Balance Sheet Lending Share

This table examines bank balance sheet share using US residential mortgage origination. *Bank balance sheet loan* is an indicator for whether the loan is financed on bank balance sheet (i.e., if it is originated by a bank and retained on balance sheet, or originated by any lender type and sold to a bank). *Non-conforming* is an indicator for whether the loan exceeds the conforming loan limit above which the GSEs will not guarantee the mortgage (i.e., is an informationally sensitive loan that is ineligible for GSE securitization). Panel A uses a bandwidth of +/- 25% of the local conforming loan limit. Panel B uses a bandwidth of +/- 10% of the local conforming loan limit. Column (1) has no fixed effects. Column (2) has loan characteristic fixed effects, i.e., the interaction of origination year, property type, loan purpose, occupancy, state, county, applicant race, ethnicity, sex, and income. Column (3) has originator fixed effects. Column (4) has loan characteristic times lender fixed effects. Data are from HMDA and run from 2007-2017. Standard errors are shown in parentheses.

Panel A: +/- 0.25 x Conforming Loan Limit

	Bank balance sheet loan			
	(1)	(2)	(3)	(4)
Non-conforming	0.422	0.343	0.312	0.186
	(0.0005)	(0.001)	(0.0004)	(0.001)
Constant	0.345			
	(0.0002)			
FE	None	Loan	Orig.	Loan x Orig.
N	9,183,165	9,183,165	9,174,465	9,183,165
R^2	0.082	0.606	0.303	0.870

Panel B: +/- 0.10 x Conforming Loan Limit

	Bank balance sheet loan			
	(1)	(2)	(3)	(4)
Non-conforming	0.367	0.294	0.267	0.130
	(0.001)	(0.001)	(0.001)	(0.002)
Constant	0.353			
	(0.0002)			
FE	None	Loan	Orig.	Loan x Orig.
N	4,031,790	4,031,790	4,028,149	4,031,790
R^2	0.053	0.687	0.284	0.907

Table 2: Ease of Securitization and Bank Balance Sheet Composition

Column (1) of this table investigates the relationship between a bank's *securitization exposure* and banks' loan-to-asset ratios. *Securitization exposure* refers to the extent to which a bank's mortgage lending volume is affected by changes in conforming loan limits, typically due to their increases in some regions. It is a measure that quantifies the percentage of a bank's residential mortgage lending volume from the previous year that would fall within the new conforming loan limits range following such changes. Column (2) examines the impact of securitization exposure on banks' security holdings relative to total assets. Columns (3)-(4) repeat the analysis within a subsample of banks that are affected by changes in conforming loan limits (those with non-zero securitization exposure). Columns (5)-(6) present results from a matched sample analysis using propensity score matching. This method pairs banks with increased securitization exposure (treatment group) with control group banks (zero exposure changed) based on a set of bank characteristics. Data are from HMDA and bank call reports run from 2007-2017. Standard errors are shown in parentheses.

	All banks		Affected banks		Matched banks	
	Loan/ Asset	Securities/ Asset	Loan/ Asset	Securities/ Asset	Loan/ Asset	Securities/ Asset
	(1)	(2)	(3)	(4)	(5)	(6)
Securitization Exposure	-0.023	0.060	-0.067	0.106	-0.068	0.100
	(0.043)	(0.039)	(0.057)	(0.051)	(0.049)	(0.045)
N	34,877	34,877	2,173	2,173	4,346	4,346
R^2	0.081	0.061	0.140	0.089	0.071	0.070

Table 3: Bank Regulatory Factors: Bank Balance Sheet Composition and Lending Growth Rate across Regulatory Regimes

Column (1) of this table presents regression results for the *Loan to Asset Ratio*, incorporating interaction terms between bank size and two regulatory regimes: (2010-2018) and (After 2018). Banks are grouped into three categories based on asset size, with banks below $50 billion excluded. The midsize group includes banks with assets from $50 billion to $250 billion, and the large group comprises banks with assets exceeding $250 billion. During 2010-2018, stringent regulations such as the Dodd-Frank Act and Basel III were implemented, focusing on bolstering capital requirements, liquidity standards, and risk management. These regulations were primarily targeting banks with assets greater than $50 billion and especially greater than $250 billion. Post-2018, regulatory burdens eased for banks with assets under $250 billion (the midsize group), influenced by legislative changes like the Economic Growth, Regulatory Relief, and Consumer Protection Act (EGRRCPA). Column (1) details coefficient estimates and standard errors for dummy variables representing midsize and large banks, periods (2010-2018) and (After 2018), as well as their interactions. Column (2) displays results for the *Balance Sheet Loan Growth Rate* across these bank groups. Data covers quarterly periods from 2001 to 2024 from bank Call Reports.

	Loan to Asset Ratio (1)	Balance Sheet Loan Growth Rate (2)
Midsize	-6.628	1.912
	(0.719)	(1.439)
Large	-23.29	4.363
	(0.458)	(1.482)
(2010-2018)	0.412	1.124
	(0.508)	(0.656)
(After 2018)	1.513	0.755
	(0.683)	(0.497)
(2010-2018) × Midsize	-2.129	-1.851
	(0.903)	(1.721)
(2010-2018) × Large	-1.231	-4.316
	(0.666)	(1.657)
(After 2018) × Midsize	0.493	-2.169
	(1.054)	(1.670)
(After 2018) × Large	-4.249	-3.554
	(1.022)	(1.657)
Constant	64.41	0.0703
	(0.318)	(0.355)
Observations	279	276
R-squared	0.944	0.058

Table 4: Static Structural Estimates

This table shows the results of the estimation for the key depository intermediation parameters. The estimation uses a feasible two-stage overidentified GMM approach based on the structural returns implied by the model, E.1-5. Panel A shows the parameters, their values, and their standard errors. Panel B shows calibrated structural demand parameters that do not vary over the sample period.

Panel A: Structural intermediation parameters

Parameter	Value	Std Error
ξ	0.04	-
ϕ	0.10	-
σ_s	4.38	(0.44)
$\overline{\sigma_b}$	3.87	(0.91)
δ_d^1	-0.18	(0.12)
$\overline{\delta_d^2}$	-0.08	(0.10)
$\overline{\delta_e^1}$	-0.20	(0.09)
$\overline{\delta_l^1}$	0.33	(0.12)
δ_l^2	0.015	(0.008)

Panel B: Persistent structural demand parameters

Parameter	Value
α_d	1 (normalization)
β_l	1 (normalization)

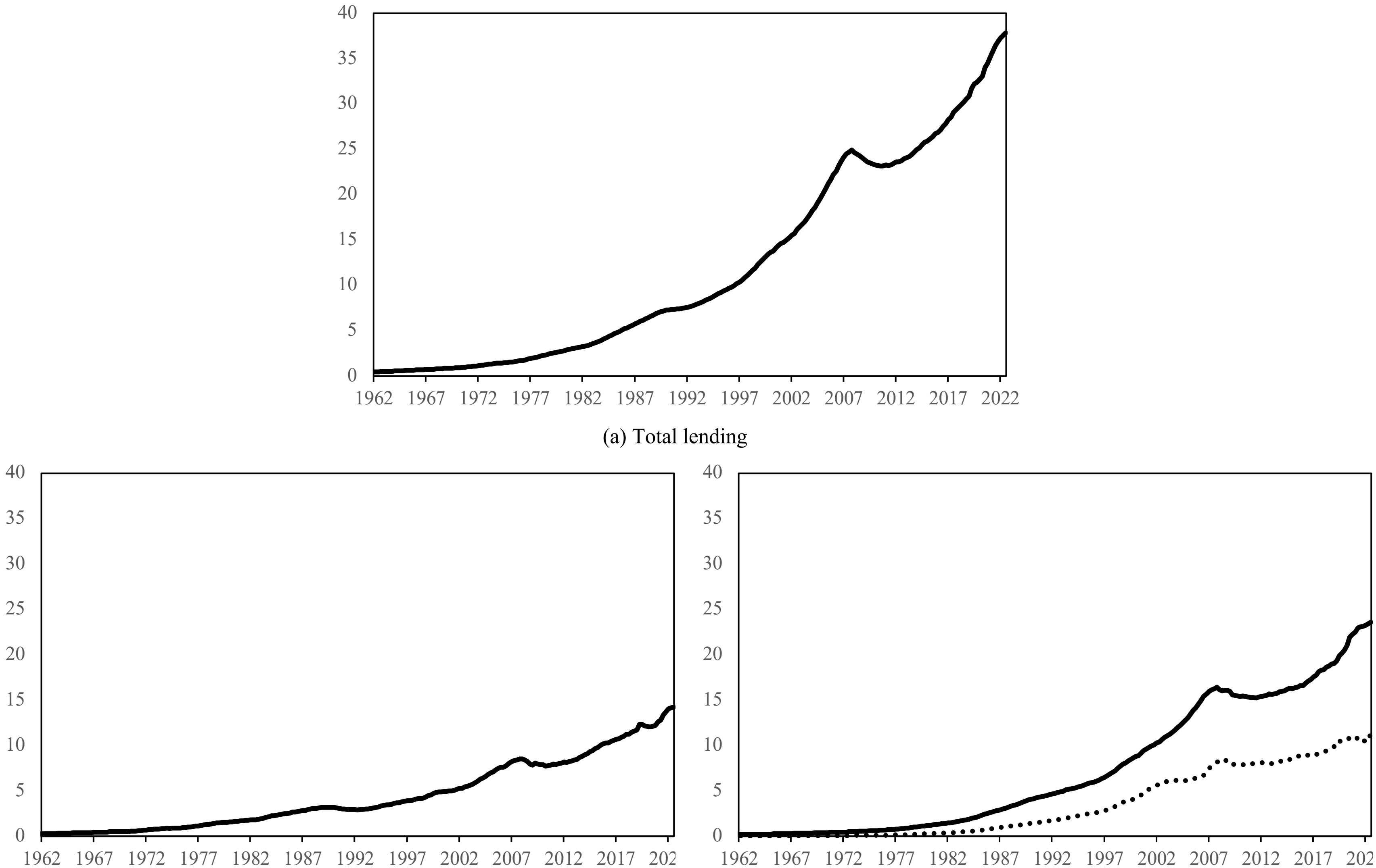
Table 5: Regulation, Technology, and Other Factors Explaining Demand Shifters

This table presents time-series regressions of the saver demand shifters (Columns 1 to 3), borrower demand shifters (Columns 4 to 5), and intermediary epsilons (Columns 6 to 8) on time-series covariates. *Regulation index* is an index tracking the implementation of various market and banking regulatory reforms through time. *Technology index* is an index tracking the implementation of various technology changes. *Top 10% wealth share* is the US top-10% wealth share from the WID database. *Real conforming loan limit* is the origination-weighted conforming loan limit divided by the CPI. *Intangibles / assets* is aggregate intangibles divided by aggregate assets, computed from Compustat. *R&D expense / assets* is aggregate R&D expense divided by aggregate assets, computed from Compustat. Standard errors are shown in parentheses.

	Dependent variable:							
	Saver			Borrower		Return epsilons		
	α_{sg}	α_{sp}	α_0	β_{OTDg}	β_{OTDp}	ϵ_d	ϵ_e	ϵ_l
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Regulation index	0.244^{***}	-0.266^{**}	0.257	0.554^{***}	0.216	0.018^{*}	0.028^{***}	-0.076^{***}
	(0.045)	(0.127)	(0.662)	(0.063)	(0.233)	(0.009)	(0.008)	(0.012)
Technology index	0.114^{***}	0.446^{***}	1.415^{***}	0.123^{**}	0.455^{***}	-0.004	-0.010	0.034^{***}
	(0.033)	(0.095)	(0.494)	(0.051)	(0.097)	(0.007)	(0.007)	(0.009)
Top 10% wealth share	0.020^{*}	0.063^{*}	0.865^{***}	-	-	-	-	-
	(0.012)	(0.034)	(0.178)	-	-	-	-	-
Real conforming loan limit	-	-		0.050^{***}	-	-	-	-
	-	-		(0.019)	-	-	-	-
Intangibles / assets	-	-		-	-0.018	-	-	-
	-	-		-	(0.051)	-	-	-
R&D expense / assets	-	-		-	-0.122^{***}	-	-	-
	-	-		-	(0.021)	-	-	-
Observations	61	61	61	61	61	61	61	61
R^2	0.940	0.596	0.755	0.966	0.839	0.213	0.377	0.605
Note:					$^{*}p<0.1$; $^{**}p<0.05$; $^{***}p<0.01$			

Figure 1: Total Lending to Households and Non-Financial Businesses over Time and its Main Funding Channels

Panel (a) of this figure illustrates the evolution of the outstanding volume of total lending to households and non-financial businesses. Panel (b) and (c) break down the total lending into its two primary funding segments: informationally sensitive loans (bank balance sheet loans) displayed in panel (b) and debt securities depicted by the solid line in panel (c). The dashed line in panel (c) additionally represents the subsegment of debt securities comprising government-affiliated debt securities. All values are presented in $ trillions. *Data Sources:* The Financial Accounts of the United States, the Federal Reserve System.



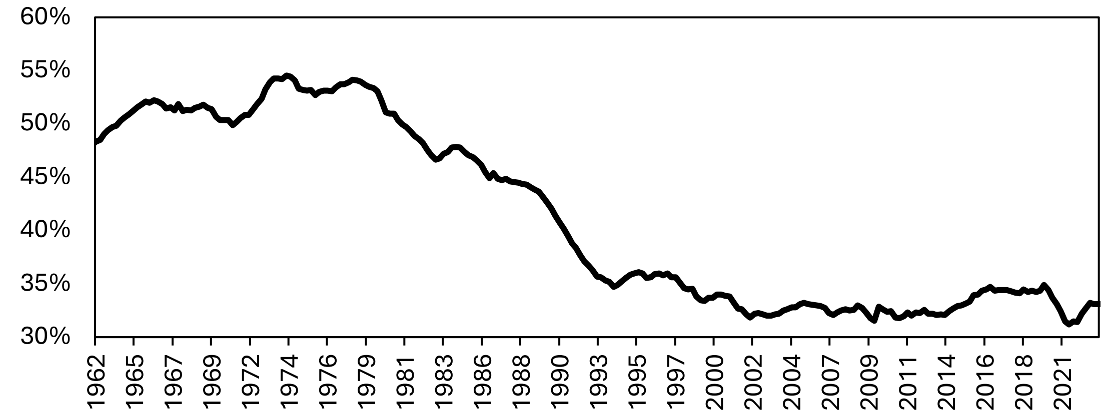
(a) Total lending

(b) Informationally sensitive lending

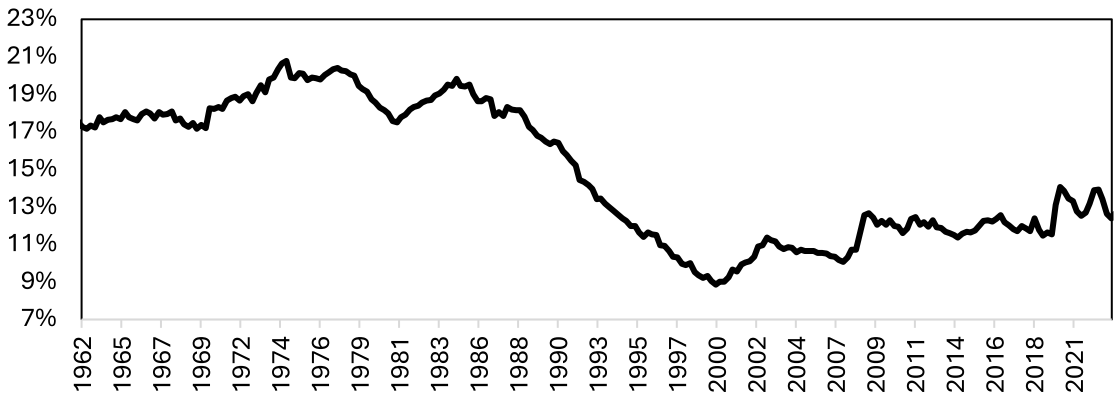
(c) Debt securities

Figure 2: Main Facts on the Secular Decline of Bank Balance Sheet Lending

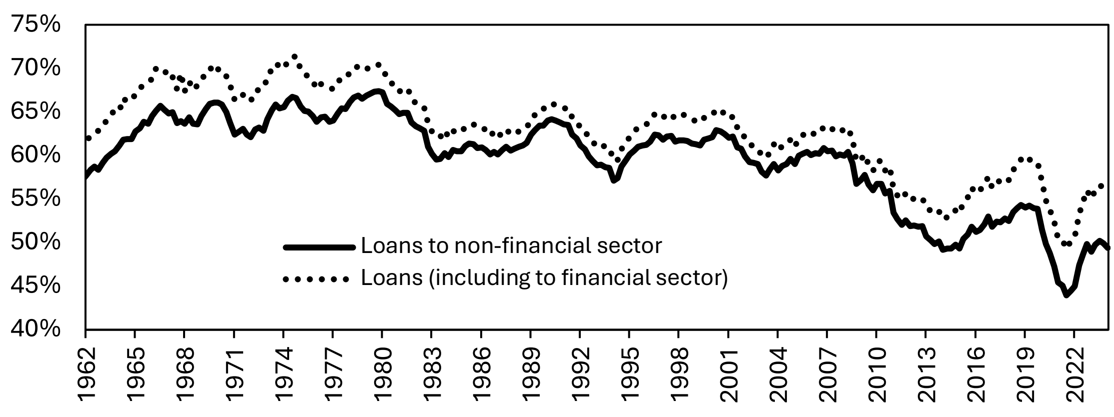
Panel (a) of this figure shows bank balance sheet lending as a percentage of the total outstanding lending volume to households and non-financial businesses. Panel (b) shows the total savings and time deposits own by the domestic non-financial sector relative to the domestic non-financial sector's total financial assets. Panel (c) shows informational sensitive lending (bank loans) as a percentage of bank assets, with the solid line considering only bank loans to the non-financial sector, and the dotted line including loans to the non-depository financial sector. Panel (d) illustrates the evolution of bank debt securities holdings financing households and firms as a share of bank assets. Panel (e) illustrates the evolution of bank balance sheet lending share where in addition we include bank holdings of debt securities financing credit to households and firms. Panel (f) shows the share of non-bank financing funded by bank loans to non-depository financial corporations. Panel (g) shows the domestic non-financial sector's total financial assets as a percentage of GDP. *Data Sources:* The Financial Accounts of the United States, the Federal Reserve System.



(a) Informationally sensitive lending share

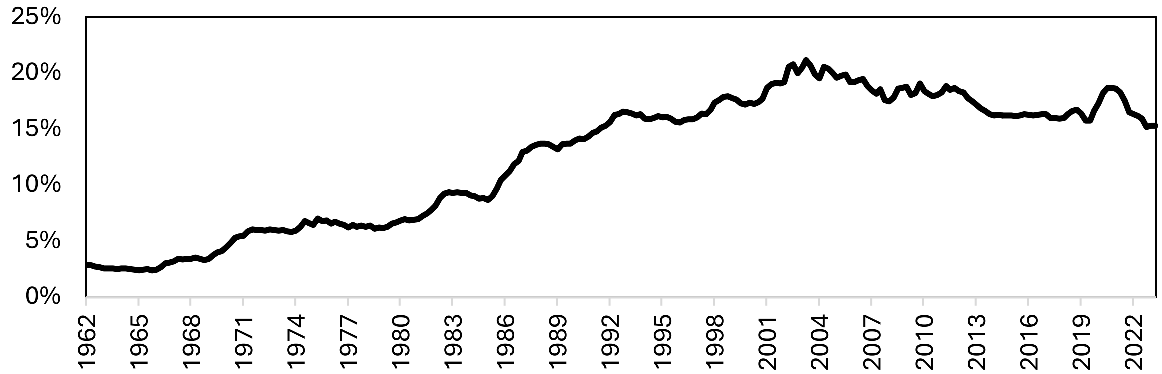


(b) Deposit share of domestic non-financial sector financial assets

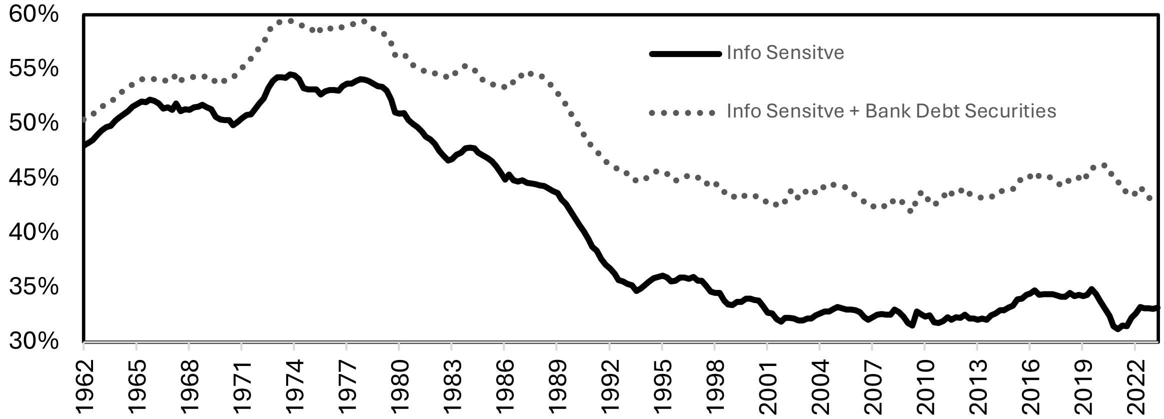


(c) Loan share of bank assets

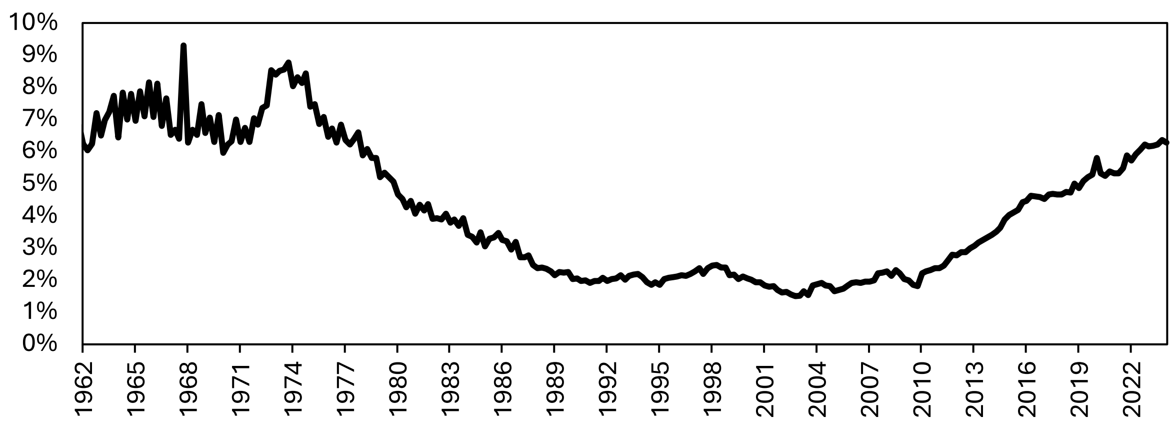
Figure 2: Main Facts on the Secular Decline of Bank Balance Sheet Lending (continued)



(d) Bank debt securities holdings as a share of bank assets

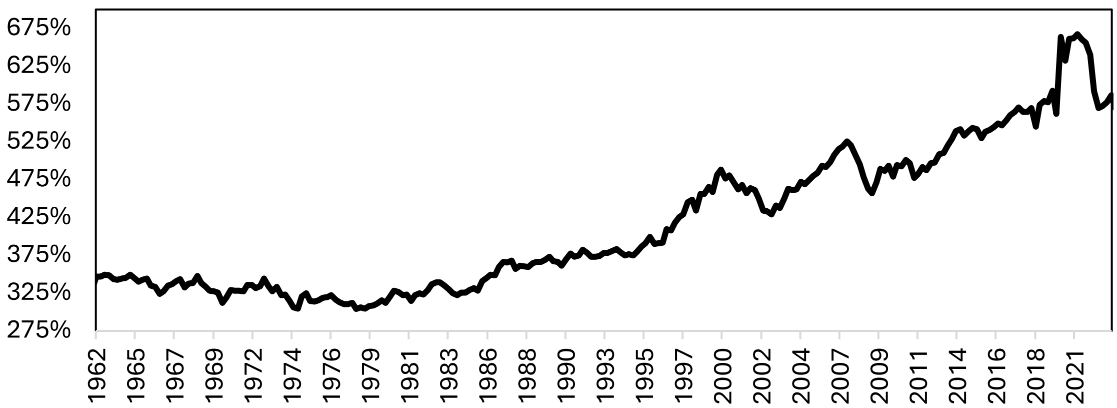


(e) Bank balance sheet lending share including bank debt securities holdings



(f) Bank loans to non-bank intermediaries as a share of non-bank lending

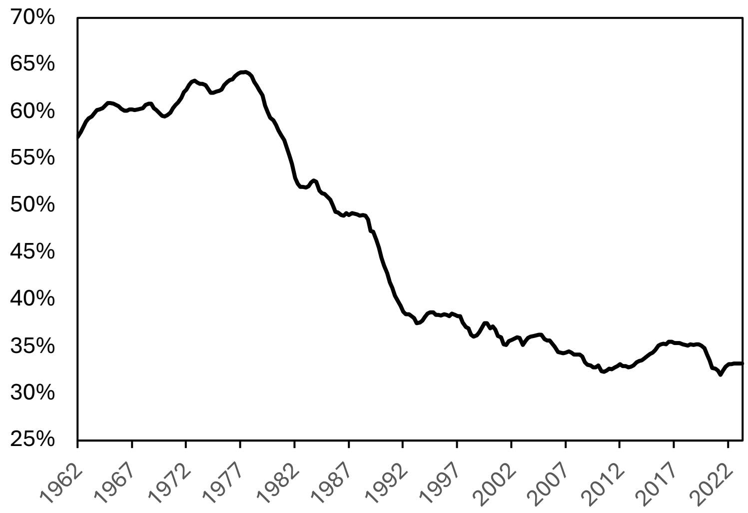
Figure 2: Main Facts on the Secular Decline of Bank Balance Sheet Lending (continued)



(g) Domestic non-financial sector financial wealth / GDP

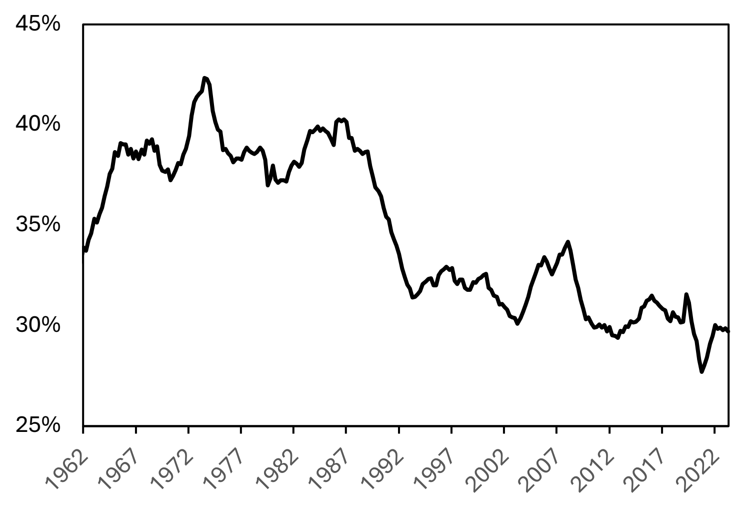
Figure 3: The Secular Decline of Informationally Sensitive Lending across Loan Segments

Panel (a) in this figure depicts the evolution of informationally sensitive lending ("bank balance sheet lending") as a percentage of the total outstanding mortgage loans. Panel (b) illustrates the evolution of informationally sensitive lending as a percentage of the total credit, excluding mortgages. Panel (c) shows the evolution of informationally sensitive lending as a percentage of the total outstanding non-financial business loans, excluding mortgages. *Data Sources:* The Financial Accounts of the United States, the Federal Reserve System.



(a) Mortgages

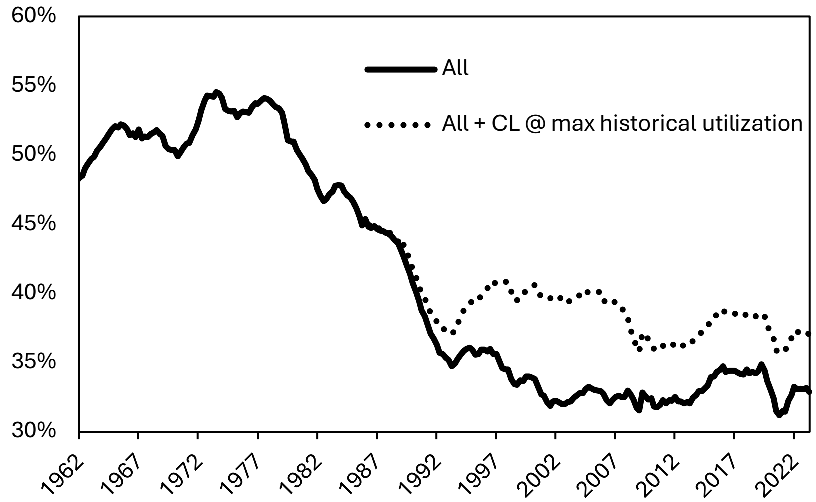
(b) All loans ex mortgages



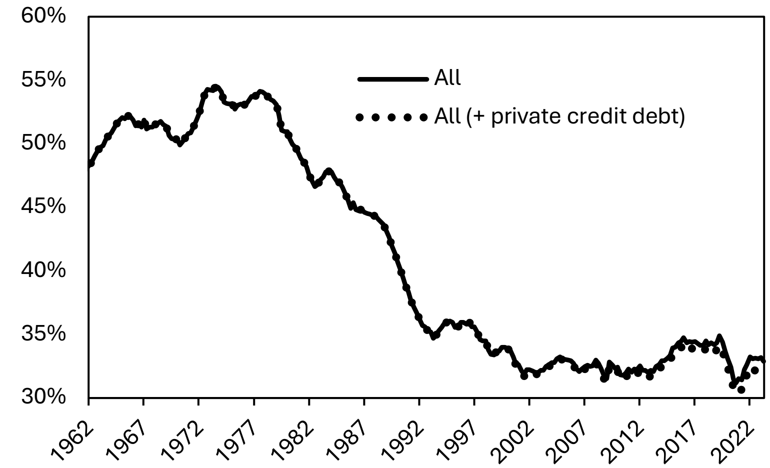
(c) Business loans ex mortgages

Figure 4: The Secular Decline of Bank Balance Sheet Lending (Robustness): Impact of Unused Bank Credit Lines and Private Equity Debt Funds

Panel (a) in this figure depicts the evolution of informationally sensitive lending ("bank balance sheet lending share") when in addition we consider an unutilized bank credit lines to households and firms as bank loans (at their peak historical utilization rate). Panel (b) shows the evolution of informationally sensitive lending share where in addition we include non-bank credit debt provided by private equity debt funds. *Data Sources:* The Financial Accounts of the United States, the Federal Reserve System, and Preqin.



(a) Impact of unused credit lines



(b) Impact of private equity debt funds

Figure 5: Securitization Technology: Bank Balance Sheet Lending and Ease of Securitization

This figure shows bank balance sheet lending using US residential mortgage origination in a binned scatterplot. The x-axis is the loan size relative to the conforming loan limit. Below the limit, GSE guarantees are available (making the loan informationally insensitive and eligible for GSE securitization). Above the limit, GSE guarantees are not available (making the loan informationally sensitive and potentially harder to sell). The y-axis is the fraction of loans in each bin that are financed on bank balance sheets, (i.e., is originated by a bank and retained by the originator, or originated by any lender type and sold to a bank). Data are from HMDA and run from 2007-2017.

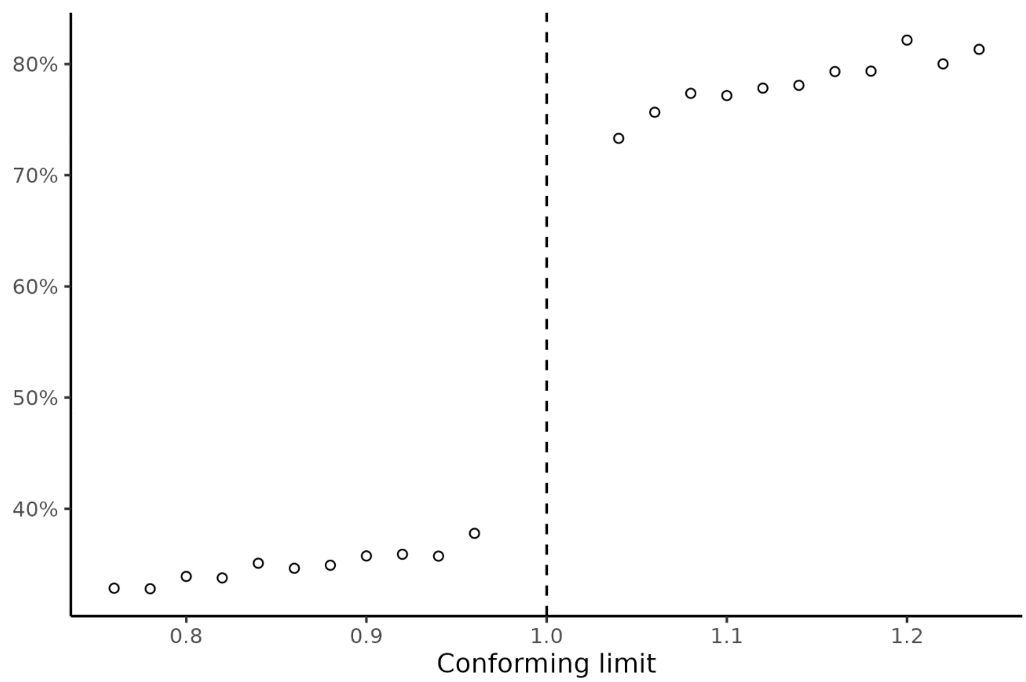
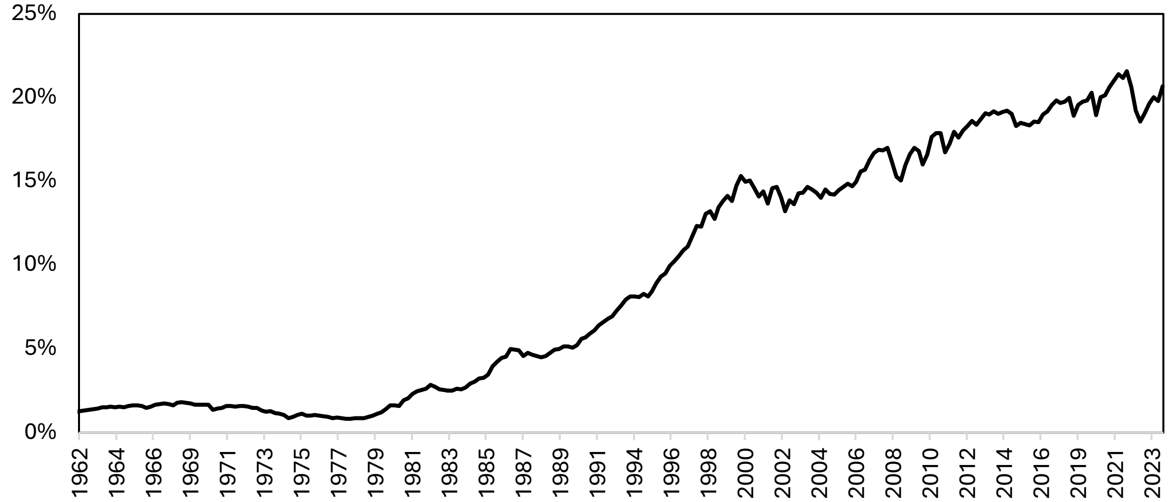
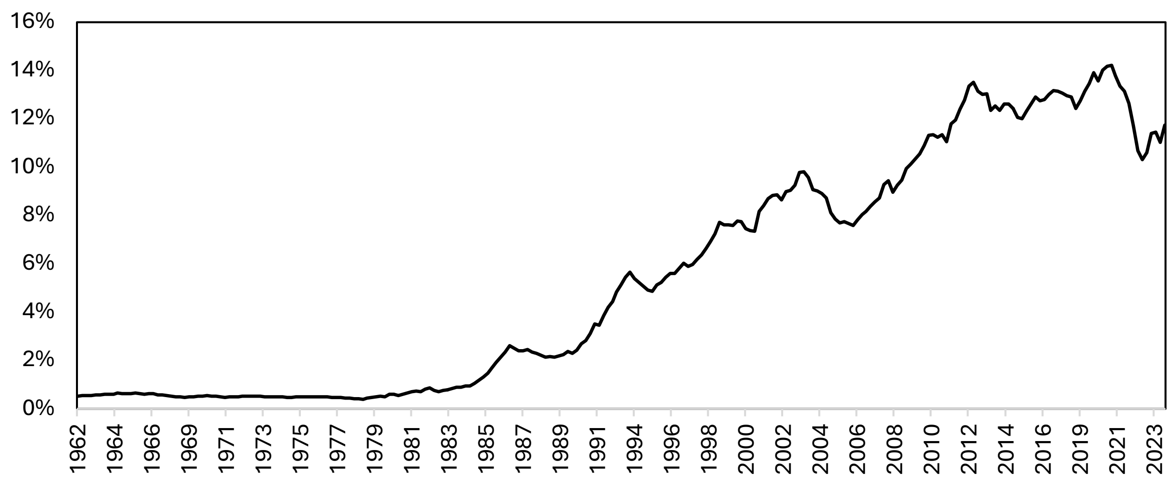


Figure 6: Saver Demand Factors: Growth of Shadow Money

Panel (a) of this figure shows the total shadow money "assets" as a percentage of domestic non-financial sector financial assets. The shadow money assets are defined as total assets of money market funds, closed end funds, ETFs, and mutual funds. Panel (b) shows the percentage of total credit to households and non-financial businesses that is financed with use of debt securities bought through shadow money intermediaries.



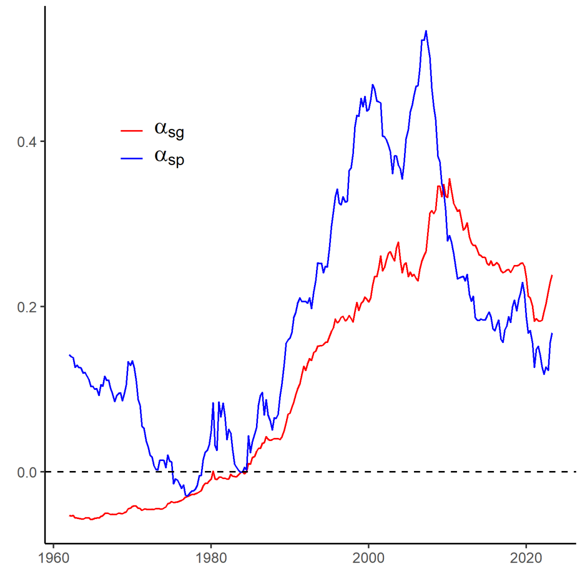
(a) Shadow money share of domestic non-financial sector financial assets



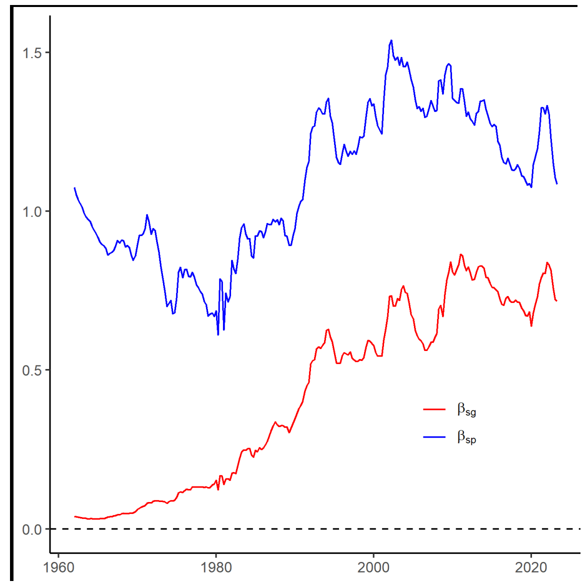
(b) Shadow money share in financing debt securities

Figure 7: Time-varying Structural Parameters

This table shows the time-varying structural parameters. Panel (a) shows savers' demand shifters over government affiliated and private securities relative to deposits. Panel (b) shows the borrower demand shifters for government and private-affiliated informationally insensitive OTD lending, $(\beta_{OTDg,t}, \beta_{OTDp,t})$, relative to informationally sensitive lending. Panel (c) shows the shocks to value for deposits, equity, and the convenience yield for private and government-affiliated securities. Panel (d) shows the shocks to value of bank loans. A positive number is an implicit subsidy, while a negative number is an implicit cost.

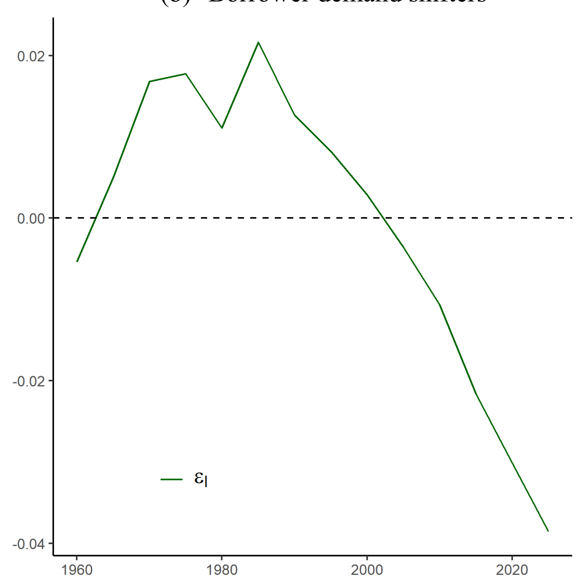


(a) Saver demand shifters



(b) Borrower demand shifters

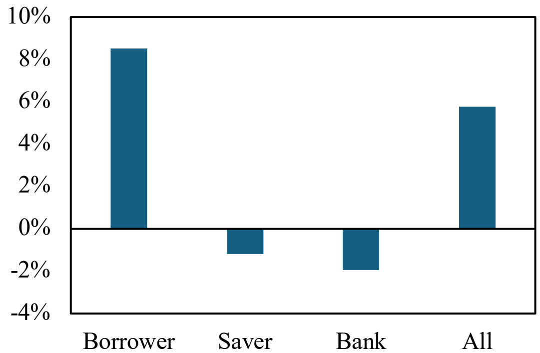
(c) Structural errors (no loans)



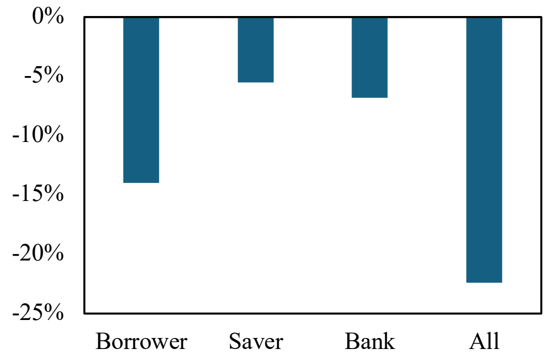
(d) Structural errors (loans only)

Figure 8: Decomposition of Changes

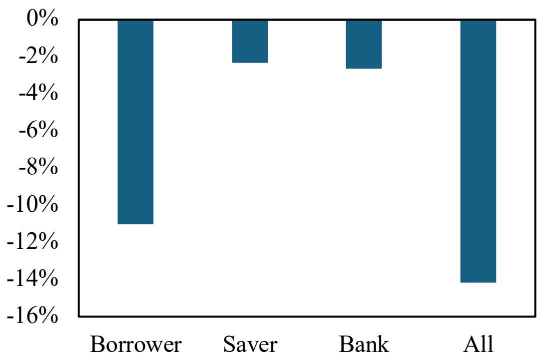
This figure decomposes changes in financial intermediation into changes shifts in borrower demand, shifts in saver demand, and implicit subsidies. Each chart shows the change in the relevant measurement versus a baseline scenario in 2023 where borrower demand, saver demand, and intermediation wedges ("subsidies") are set to their 1962 level. "Borrower" sets the borrower preferences to the 2023 level. "Saver" sets saver preferences to their 2023 level. "Bank" sets unobserved intermediation wedges to their 2023 level. "All" changes all three and corresponds to the observed equilibrium. Panel (a) shows % changes in total lending. Panel (b) shows % changes in bank balance sheet lending, i.e., changes in the quantity of informationally sensitive lending. Panel (c) shows changes in the share of informationally sensitive lending in total lending. Panel (d) shows % changes in bank assets. Panel (e) shows changes in the loan share of bank assets. Panel (f) shows changes in the deposit share of savings. For example, Panel (c) says the technological changes explain roughly a 10% drop in the informationally sensitive lending share.



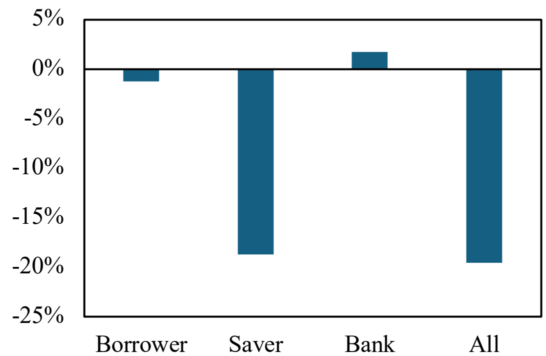
(a) % changes in total lending



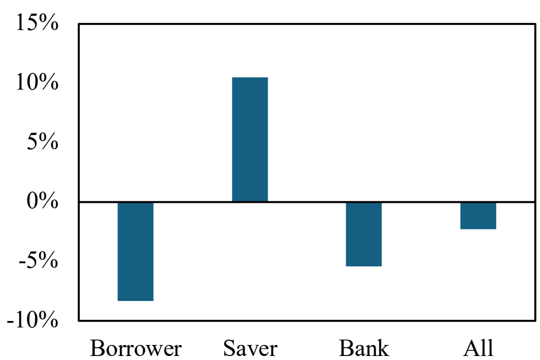
(b) % change in bank balance sheet lending



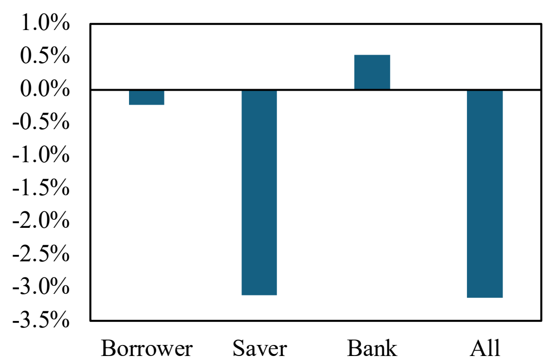
(c) change in info sensitive lending share



(d) % change in bank balance sheet size



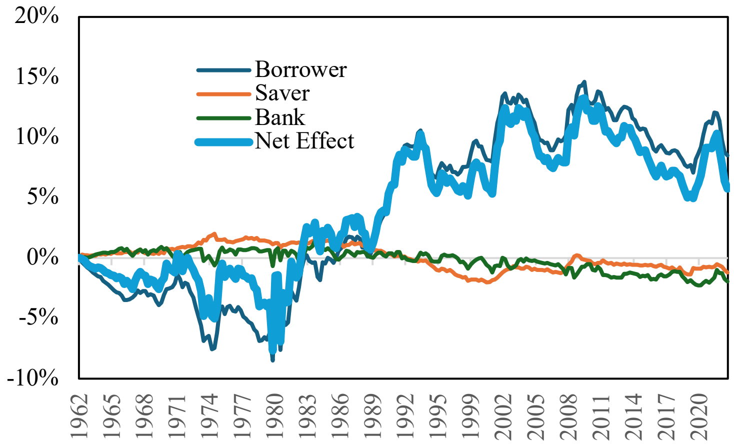
(e) change in loan share of bank assets



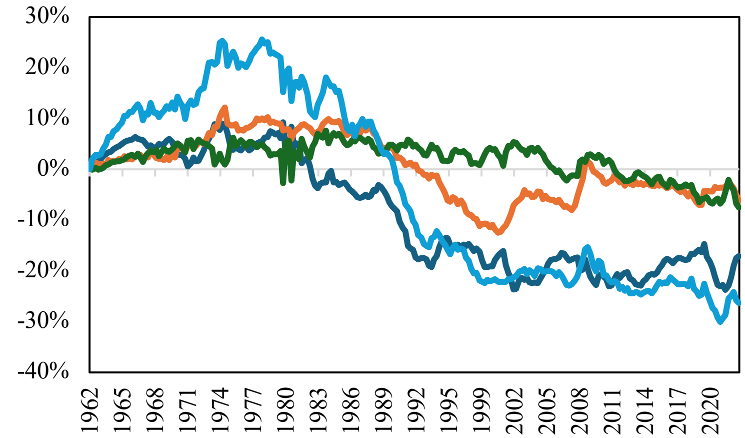
(f) change in deposit share of savings

Figure 9: Decomposition over Time

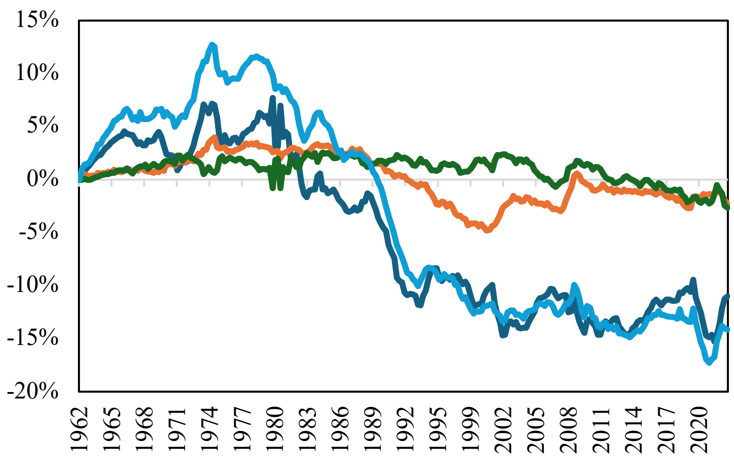
This figure shows the decomposition in changes in financial intermediation trends into changes in borrower preferences, saver preferences, and implicit subsidies over time. The exercise is the same as that presented in the previous figure. Each chart shows the change in the relevant measurement versus a baseline scenario in which borrower preferences, saver preferences, and subsidies are held constant at their 1963 level. “Borrower” allows borrower preferences to change through time. “Saver” allows saver preference parameters to change through time. “Bank” allows implicit bank subsidies and regulatory costs to change through time. “Net effect” shows the actual data. Panel (a) shows the % change in total lending versus the baseline. Panel (b) shows the % change in bank balance sheet lending versus the baseline. Panel (c) shows the % change in the share of informationally sensitive lending in total lending. Panel (d) shows the % change in bank assets.



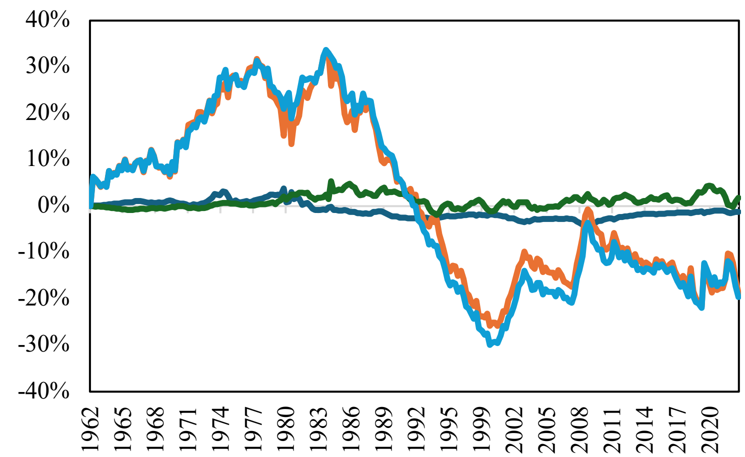
(a) % change in total lending



(b) % change in bank balance sheet lending



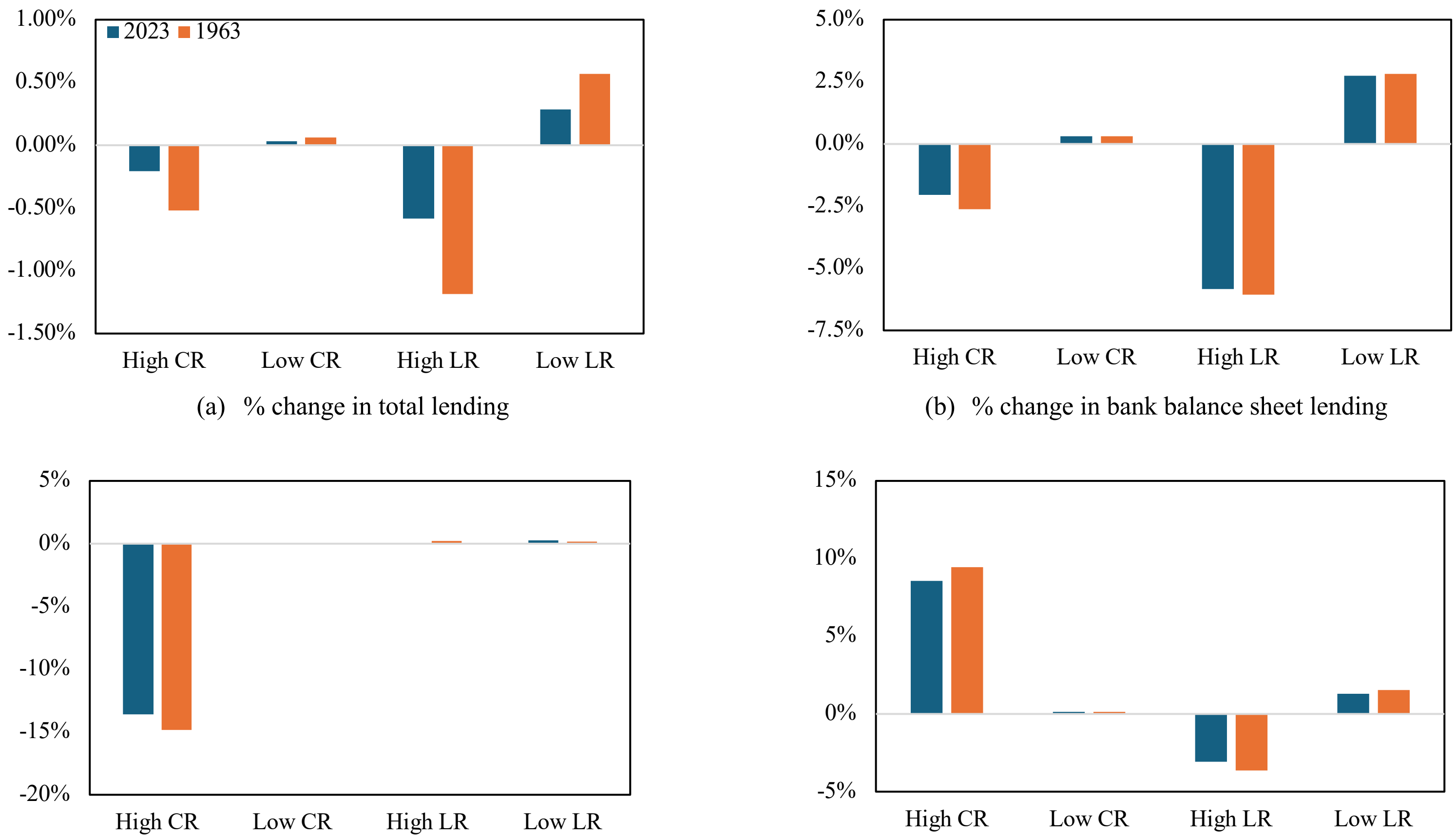
(c) change in info sensitive lending share



(d) % change in bank assets

Figure 10: Counterfactual Capital and Liquidity Requirements

This figure shows the counterfactual impact of high (25%) and low (0%) capital requirements and high (25%) and low (0%) liquidity requirements in the actual (2023, in blue) and historical (1963, in orange) regimes using the calibrated model. Each bar shows changes versus the associated baseline, that is, the 2023 bars show changes versus the 2023 baseline, and the orange bars show changes versus the 1963 baseline. Panel (a) shows the percentage change in total lending. Panel (b) shows the percentage change in bank balance sheet lending. Panel (c) shows the % change in bank assets versus the baseline. Panel (d) shows the change in informationally sensitive loan share of bank balance sheets.



(a) % change in total lending

(b) % change in bank balance sheet lending

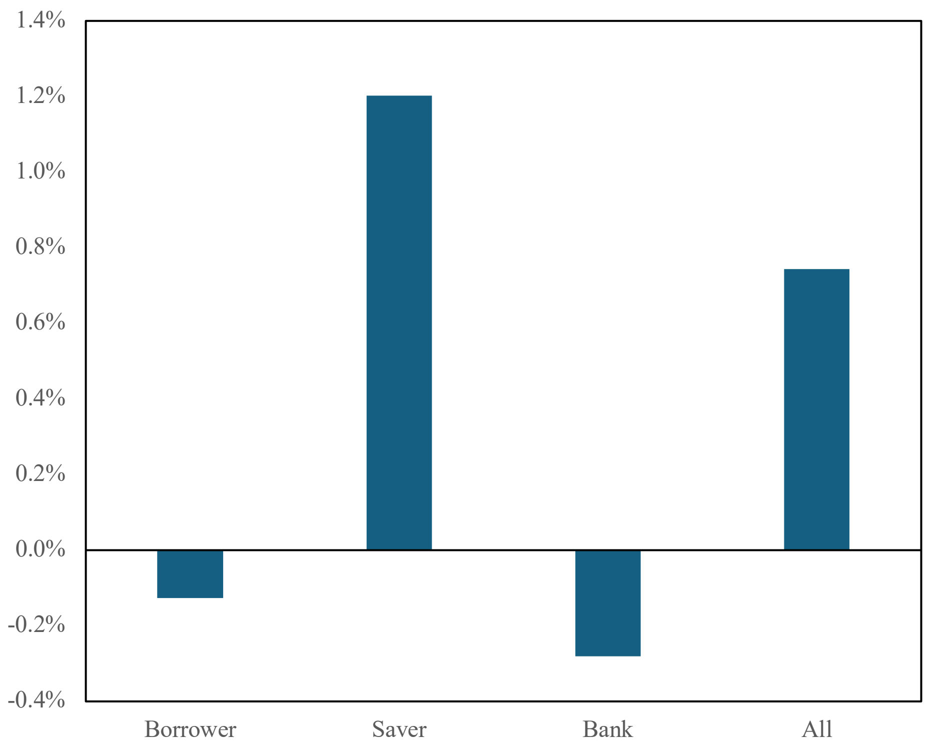
(c) % change in bank assets

(d) change in loan share of bank assets

Online Appendix

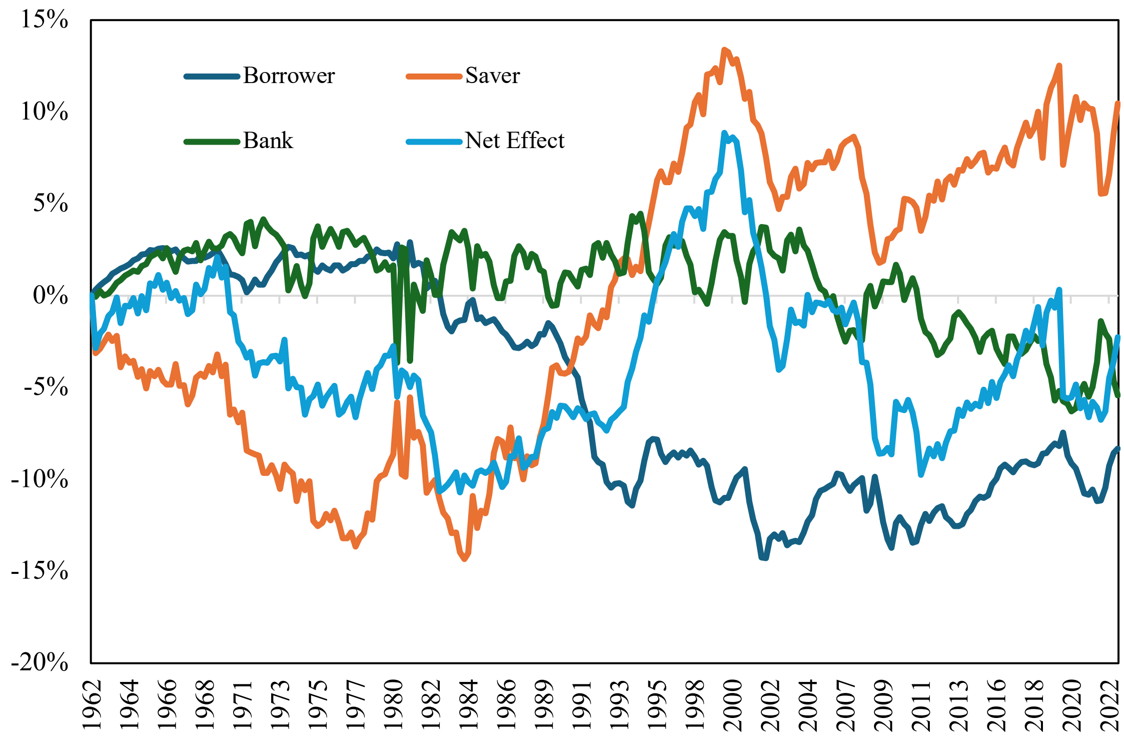
Appendix A1: Decomposition of Changes in Bank Capital Ratios

This figure decomposes changes in bank capitalization into changes in borrower preferences, saver preferences, and implicit subsidies. The chart shows the change in the bank capitalization versus a baseline scenario in 2023 where technology, preferences, and intermediation wedges ("subsidies") are set to their 1962 level.



Appendix A2: Decomposition of Change in Loan Share of Bank Assets

This figure shows the decomposition in changes in loan share of bank assets over time into changes in borrower preferences, saver preferences, and implicit subsidies over time. The exercise is the same as that presented in Figure 9. The chart shows the change versus a baseline scenario in which technology, preferences, and subsidies are held constant at their 1963 level. "Borrower" allows borrower preferences to change through time. "Saver" allows saver preference parameters to change through time. "Bank" allows bank subsidies (or costs) to change through time. "Net effect" shows the actual data.



Appendix A.3. Data Federal Reserve Flow of Funds Data Construction

This appendix details our data construction methodology. We obtain the following data series from the fed flow of funds through FRED:

Panel A: Raw Series

Number	Series description	Series name
1	U.S.-chartered depository institutions; other bank loans	BOGZ1FL763068205Q
2	U.S.-Chartered Depository Institutions; Loans for Purchasing or Carrying Securities	BOGZ1FL763067003Q
3	Foreign Banking Offices in the U.S.; Other Bank Loans	BOGZ1FL753068205Q
4	Foreign Banking Offices in the U.S.; Loans for Purchasing or Carrying Securities	BOGZ1FL753067003Q
5	All Sectors; One-to-Four-Family Residential Mortgages	ASHMA
6	U.S.-Chartered Depository Institutions; One-to-Four-Family Residential Mortgages	BOGZ1FL763065105Q
7	Foreign Banking Offices in the U.S.; One-to-Four-Family Residential Mortgages	BOGZ1FL753065103Q
8	Banks in U.S.-Affiliated Areas; One-to-Four-Family Residential Mortgages	BOGZ1FL743065103Q
9	Credit Unions; One-to-Four-Family Residential Mortgages	BOGZ1FL473065100Q
10	Agency-and GSE-Backed Mortgage Pools; One-to-Four-Family Residential Mortgages	BOGZ1FL413065105Q
11	Government-Sponsored Enterprises; One-to-Four-Family Residential Mortgages	BOGZ1FL403065105Q
12	Households and Nonprofit Organizations; Consumer Credit	CCLBSHNO
13	Federal Government; Consumer Credit, Student Loans	FGCCSAQ027S
14	U.S.-Chartered Depository Institutions; Consumer Credit	BOGZ1FL763066000Q
15	Credit Unions; Consumer Credit	BOGZ1FL473066000Q
16	Households and Nonprofit Organizations; Depository Institution Loans N.E.C.	BLNECLBSHNO
17	Households and Nonprofit Organizations; Other Loans and Advances	OLALBSHNO
18	All Sectors; Multifamily Residential Mortgages	ASMRMA
19	All Sectors; Commercial Mortgages	ASCMA
20	All Sectors; Farm Mortgages	ASFMA
21	Agency-and GSE-Backed Mortgage Pools; Multifamily Residential Mortgages	BOGZ1FL413065405Q
22	Government-Sponsored Enterprises; Multifamily Residential Mortgages	BOGZ1FL403065405Q
23	Agency-and GSE-Backed Mortgage Pools; Farm Mortgages	BOGZ1FL413065605Q
24	Government-Sponsored Enterprises; Farm Mortgages	BOGZ1FL403065605Q
25	Agency-and GSE-Backed Mortgage Pools; Commercial Mortgages	BOGZ1FL413065505Q
26	Government-Sponsored Enterprises; Farm Credit System Loans	BOGZ1FL403069345Q
27	U.S.-Chartered Depository Institutions; Multifamily Residential Mortgages	BOGZ1FL763065403Q
28	Foreign Banking Offices in the U.S.; Multifamily Residential Mortgages	BOGZ1FL753065403Q
29	U.S.-Chartered Depository Institutions; Commercial Mortgages	BOGZ1FL763065503Q
30	Foreign Banking Offices in the U.S.; Commercial Mortgages	BOGZ1FL753065503Q
31	Banks in U.S.-Affiliated Areas; Commercial Mortgages	BOGZ1FL743065505Q
32	U.S.-Chartered Depository Institutions; Farm Mortgages	BOGZ1FL763065633Q
33	Foreign Banking Offices in the U.S.; Farm Mortgages	BOGZ1FL753065603Q
34	Nonfinancial Corporate Business; Debt Securities	NCBDBIQ027S
35	Nonfinancial Business; Other Loans and Advances	BOGZ1FL143169005Q
36	Nonfinancial Business; Depository Institution Loans N.E.C.	BOGZ1FL143168005Q
37	Private Depository Institutions; Total Financial Assets	BOGZ1FL704090005Q
38	Private Depository Institutions; Total Liabilities	BOGZ1FL704190005Q
39	Private Depository Institutions; Checkable Deposits	BOGZ1FL703127005Q
40	Private Depository Institutions; Total Time and Savings Deposits	BOGZ1FL703130005Q
41	Private Depository Institutions; Federal Funds and Security Repurchase Agreements	BOGZ1FL702150005Q
42	Private Depository Institutions; Agency- and GSE-Backed Securities	BOGZ1LM703061705Q
43	Private Depository Institutions; Corporate and Foreign Bonds	BOGZ1LM703063005Q
44	Domestic Nonfinancial Sectors; Total Financial Assets	BOGZ1FL384090005Q

Using these raw series, we calculate the following derived series:

Panel B: Derived Series

Series description	Series definition (numbers refer to raw series)
Bank loans to financial intermediaries	1 + 2 + 3 + 4
Home mortgages (depository)	6 + 7+ 8 + 9
Home mortgages (GSEs)	10 + 11
Private consumer credit	12 – 13
Consumer credit (depository)	14 + 15
Other household credit	16 + 17
Commercial mortgages (incl' farm, multifamily)	18 + 19 + 20
Commercial mortgages (depository)	27 + 28 + 29 + 30 + 31 + 32 + 33
Commercial mortgages (GSEs)	21 + 22 + 23 + 24 + 25 + 26
Non-mortgage business debt	34 + 35 + 36
Household debt	5 (1-4 family mortgages) + Private consumer credit + Other household credit
Household debt (depository)	Home mortgages (depository) + Consumer credit (depository) + 16 (other depository)
Business debt	Commercial mortgages + Non-mortgage business debt
Business debt (depository)	Commercial mortgages (depository) + 36 (depository institution business loans)
Total private credit	Household debt + Business debt
Bank loans	Household debt (depository) + Business debt (depository)
Mortgages	5 (1-4 family mortgages) + Commercial mortgages
Mortgages (depository)	Home mortgages (depository) + Commercial mortgages (depository)
Non-mortgage credit	Total private credit – mortgages
Non-mortgage credit (depository)	Bank loans – mortgages (depository)
Bank deposits	39 + 40 + 41
Total bank securities	37 (Total financial assets) – Bank loans
Bank equity	37 (Total financial assets) – 38 (Total liabilities)
Total non-GSE private securities	Total private credit – Bank loans – Home mortgages (GSE) – Commercial mortgages (GSE)
Saver private securities	Total non-GSE private securities – 43 (bank corporate securities)
Saver government securities	Home mortgages (GSE) + Commercial mortgages (GSE) – 42 (bank GSE securities)
Saver other securities	44 (Non-financial sector financial assets) – Bank deposits – Bank equity – Saver private securities – Saver government securities
Borrower info-sensitive loans	Bank loans
Borrower info-insensitive (private)	43 (bank corporate securities) + Saver private securities
Borrower info-insensitive (government)	42 (bank GSE securities) + Saver government securities

Appendix A.4. Estimation Moments

This table lists the moments used in the GMM estimation for the intermediation parameters. The exponents on the capital and liquidity ratios correspond to terms that enter the return equations E.1-3. The moments are as follows:

Moment
$E[\epsilon_d]$
$E[\epsilon_l]$
$E[\epsilon_e]$
$E[\epsilon_d \times TreasuryQty]$
$E[\epsilon_d \times ExcessLiquidityRatio^{.5}]$
$E[\epsilon_d \times ExcessLiquidityRatio^{-.5}]$
$E[\epsilon_d \times ExcessCapitalRatio^{.5}]$
$E[\epsilon_l \times TreasuryQty]$
$E[\epsilon_l \times ExcessLiquidityRatio^{-.5}]$
$E[\epsilon_l \times ExcessCapitalRatio^{.5}]$
$E[\epsilon_e \times TreasuryQty]$
$E[\epsilon_e \times ExcessLiquidityRatio^{-.5}]$
$E[\epsilon_e \times ExcessCapitalRatio^{-.5}]$