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ABSTRACT

The traditional model of bank-led financial intermediation, where banks issue demandable deposits to savers and make informationally sensitive loans to borrowers, has seen a dramatic decline since 1970s. Instead, private credit is increasingly intermediated through arms-length transactions, such as securitization. This paper documents these trends, explores their causes, and discusses their implications for the financial system and regulation. We document that the balance sheet share of overall private lending has declined from 60% in 1970 to 35% in 2023, while the deposit share of savings has declined from 22% to 13%. Additionally, the share of loans as a percentage of bank assets has fallen from 70%to 55%. We develop a structural model to explore whether technological improvements in securitization, shifts in saver preferences away from deposits, and changes in implicit subsidies and costs of bank activities can explain these shifts. Declines in securitization cost account for changes in aggregate lending quantities. Savers, rather than borrowers, are the main drivers of bank balance sheet size, Implicit banks' costs and subsidies explain shifting bank balance sheet composition. Together, these forces explain the fall in the overall share of informationally sensitive bank lending in credit intermediation. We conclude by examining how these shifts impact the financial sector's sensitivity to macroprudential regulation. While raising capital requirements or liquidity requirements decreases lending in both early (1960s) and recent (2020's) scenarios, the effect is less pronounced in the later period due to the reduced role of bank balance sheets in credit intermediation. The substitution of bank balance sheet loans with debt securities in response to these policies explains why we observe only a fairly modest decline in aggregate lending despite a large contraction of bank balance sheet lending. Overall, we find that the intermediation sector has undergone significant transformation, with implications for macroprudential policy and financial regulation.

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1. Introduction

In the traditional model of bank balance sheet intermediation, banks issue demandable deposits to savers and use the proceeds to make informationally sensitive loans to borrowers (Diamond and Dybvig 1983; Diamond and Rajan 2001). Bank capital structure provides incentives for bank managers to screen borrowers and monitor the loan portfolio (Diamond 1984). Depositors' idiosyncratic liquidity demand provides most of the bank funding (Egan et al. 2017). The bank balance sheet perspective of financial intermediation forms the backbone of policy decisions around macroprudential policy, monetary policy, and interventions such as bank bailouts. In this paper we document that the bank balance sheet model of intermediation has seen a dramatic decline in the last half century. We document the secular trends describing this decline. We provide a model that departs from the standard bank-balance sheet framework and use it to decompose the economic forces driving the secular decline. We then use the model to explore the implications of the shift from bank balance sheet banking for the financial system and financial regulation.

We begin by highlighting several key trends. The share of "informationally sensitive lending" (bank balance sheet lending) peaked at roughly 60% in the early 1970s and almost halved to 35% thereafter. Instead, private credit is increasingly intermediated through arms-length transactions where a lender originates and sells the resulting loan through debt securities (e.g., in the securitization market, see Keys et al. 2010, 2013; Buchak et al. 2018 and 2022). The secular decline in the importance of bank balance sheet lending is not limited to loans eligible for securitization by government sponsored entities (GSEs). We also observe a large secular decline among loans that are ineligible for such government guarantees (loans *excluding* mortgages).

Second, on the savers' side, the deposit share of household savings has declined by almost half from 22% to roughly 13%. That is, savers are increasingly allocating their wealth towards other savings technologies like securitized private credit or Treasury securities. Finally, the intermediaries themselves have adjusted their business models. In 1970, loans comprised roughly 70% of bank assets. In 2023, they comprise only 55%. We also find that the large changes in quantities we document were not accompanied by large changes in prices. Observed spreads of deposits, loans and credit securities are largely stable over the period in which quantities moved dramatically. We consider three broad forces that could have given rise to these trends, which we formalize and decompose within a quantitative model.

The first force we consider are technological improvements in issuance of debt *securities* such as securitization and the development of private debt markets. The timing of these changes from the late 1970s to the mid-1990s broadly coincides with a decline in informationally sensitive lending. For example, the period saw a rise in the automation of tasks like loan origination and underwriting, the development of specialized software for complex securities management, and the introduction of the FICO score for assessing creditworthiness. These changes significantly streamlined the securitization process and loan sales, potentially reducing the need for informationally sensitive lending. As we illustrate in the model, such changes can leave spreads in returns paid to *savers (owners)* from securities roughly constant over our sample period, but they decrease the intermediation wedge in returns earned by savers and borrowers.

The second force we consider are changes in saver preferences over holding deposits versus alternate savings technologies, holding the returns on these various savings technologies fixed. This includes developments such as the emergence of money market funds, modern pension funds, and an increased demand for US assets by foreigners during 1980s and 1990s that could all increase the relative demand for debt securities (Caballero and Krishnamurthy 2009). Once more, the majority of these developments transpired during a period marked by a significant decline in the importance of bank balance sheet lending.

Third, we consider government regulation and interventions in the banking sector, which result in implicit costs or subsidies when banks issue deposits, equity, and loans. The regulation of the banking sector has changed significantly over the last half century, from the relaxation of interstate banking, and to several banking and intermediation crises, the most recent one being the regulatory overhaul following the Global Financial Crisis. One can broadly think of changes in regulation as changing the costs or implicit subsidies associated with bank balance sheet lending and bank funding. The implicit costs and subsidies can also include the benefits and changes in the franchise value of bank deposits.

We use a model to decompose the contributions of these forces to the secular decline in the provision of informationally sensitive lending. The model significantly departs from one in which banks issue demandable deposits to savers and use the proceeds to make informationally sensitive loans to borrowers. In addition to deposits, savers can access private debt securities, for example, though investing in CLOs, bonds, or bond funds as well as non-debt securities. The various savings technologies are imperfect substitutes for each other, so even risk-adjusted returns on securities and deposits can differ, resulting in a convenience yield of different securities. Because changes in saver preferences are one of the main forces we are interested in, we estimate these as we describe below. The borrower sector, i.e., firms and households, borrows from various borrowing technologies, including bank-monitored and screened informationally sensitive loans, as well as informationally insensitive loans—debt securities. These loans are imperfect substitutes, suggesting that monitoring can be valuable but is not strictly necessary: borrowers are willing to trade-off monitoring benefits with funding costs.

The intermediation sector consists of banks and non-bank intermediaries. Banks issue deposits and equity and use the proceeds to make informationally sensitive balance sheet loans and hold informationally insensitive securities. Bank-specific activities are costly, for example, monitoring requires labor and capital, and deposit financing requires the provision of services and branches. These costs can change over time as banks become more efficient, but also depend on government regulation which imposes costly restrictions or subsidies such as the generosity of deposit insurance. We also allow for the idea that there are complementarities between the asset and liability side of banking, i.e., we allow the bank's liquidity and capital position to impact its efficiency in making balance sheet loans and issuing deposits.

As in the data, banks are also able to purchase informationally insensitive securities despite not having a comparative advantage in issuing such securities. Broadly, banks invest in securities because they are more liquid than loans, and thus satisfy potential liquidity shocks in the spirit of Diamond and Dybvig 1983). They also invest in securities when their balance sheets are "too large" when their ability to attract deposits and earn rents exceeds the optimal amount of informationally sensitive lending they can provide. There is imperfect competition in the banking sector, and banks earn markups on loans, deposits, and bank equity.

Informationally insensitive debt—debt securities—is issued by both "independent" shadow banks (non-depository institutions) and banks. This originate-to-distribute business model dominates non-bank lending but has also become a significant share of lending by traditional banks (see Buchak et al. 2022). These originators function as pass-through entities, meaning that informationally insensitive loans are fully sold to investors, for example though securitization. The debt securities sector is perfectly competitive, reflecting the ease of entry on the margin. Critically, there is an intermediation wedge between (risk adjusted) returns on securities paid by borrowers and those earned by savers. This wedge is a primitive of the model and measures the technological ability of the financial intermediation sector to issue informationally insensitive loans. For example, when screening technology improves, the wedge shrinks.

We use the model to decompose the secular decline into the main three forces—model primitives—driving it: the intermediation technology wedge, savers' preferences, and government regulation and subsidies. We estimate the primitives in the model using trends in aggregate price and quantity data. The equilibrium comprises prices of saving technologies faced by savers (deposits, securities, and others), costs of informationally sensitive and insensitive loans to borrowers, and quantities of both intermediary funding (bank equity and debt) and private debt issuance. These are jointly determined in the model so each primitive in principle affects all outcomes. Nevertheless, here we briefly discuss the main intuition of how the model decomposes the secular decline in bank balance sheet data into the main driving forces we described above. The securitization technology wedge is broadly identified through increases in quantity of informationally insensitive loans, holding returns on these securities fixed. Intuitively, suppose more firms or households borrow through securities rather than bank balance sheet loans, but security owners receive the same returns. Our model argues that the intermediation wedge shrank resulting in lower borrowing costs all else equal. Saver preferences are identified through changes in savers' portfolio allocations holding returns fixed. Intuitively, if savers allocate more wealth towards securities but the spread between deposits and securities is constant, savers must have a greater preference to own securities because, e.g., they have become less inconvenient to own relative to deposits. Finally, implicit bank subsidies are identified through changes in bank product returns. Intuitively, if banks begin offering higher rates on deposits but demand is fixed, it must be because their actual marginal cost is lower.

Our estimation suggests that securitization technology—particularly in the government-affiliated agency mortgage sector—improved dramatically. Private sector securitization saw significant technological improvement in the 1980s, concurrent with significant improvements in financial information technology, credit scoring, and broader financial sector deregulation that lowered barriers to securitization. Government-affiliated securitization saw dramatic technological improvements from the 1970s, which coincides with the increasing role of GSEs during this time period.[1]

We also find that borrower preferences for holding securities rather than deposits accelerated dramatically during the 1980s. This is broadly consistent with the emergence of money market funds, modern pension funds, and an increased demand for US assets by foreigners during 1980s and 1990s. Finally, implicit subsidies for bank deposits and equity increased significantly following the global Financial Crisis, while concurrently, implicitly costs for bank loans increased (see Buchak et al. 2018).

We first use our model to decompose the observed aggregate changes into changes caused by each force separately. We compare a counterfactual in which each set of primitives, technology, preferences, and subsidies, are held fixed at their beginning-of-sample level, and then sequentially allow each model primitive to evolve as it did in the data. In comparing counterfactual outcomes under these scenarios, our model attributes aggregate changes to our modeled forces.

Our model finds that each force had an important role to play, but along different outcomes. Technological changes are the primary driver in changes to aggregate lending. Intuitively, better technology directly increases output. In contrast, changing borrower preferences and implicit banks' costs and subsidies reallocate intermediation among different sectors and technologies, and their effect on total lending is more muted. We find that with technological changes alone, aggregate lending is 2.5% higher than it otherwise would be. This change is partially offset by the second-order negative effects of shifting preferences—which shift some saver wealth outside of private credit provision altogether—and implicit subsidies—which shift more intermediation towards the less-competitive banking sector. On net, aggregate lending is 50 basis points higher than it would be without the forces we identify in the model.

[1] 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).

Shifting saver preferences are largely responsible for shrinking size of bank balance sheets and the reduction of deposits in the economy. Intuitively, bank balance sheets are large not because they have excellent lending opportunities, but rather because the saver sector demands a large quantity of deposits. Excess deposits are simply invested into securities rather than loans. In consequence, savers, rather than borrowers, are the main drivers of bank balance sheet size. Bank balance sheets are roughly 20% smaller than they would be had borrower preferences remained constant. The impacts of technology (which to a first-order impacts the *borrower* side of the economy), and banks' costs and subsidies (which to a first-order impacts the within-bank allocation of borrowing and lending), have smaller effects on bank balance sheet size.

Shifting implicit banks' costs and subsidies are primarily responsible for the shift in bank balance sheet models, i.e., the falling loan share of bank assets. Bank loans have implicitly become more expensive for banks to issue since the mid-2000s, and as a result, they have shifted towards owning securities rather than issuing loans.

Finally, the forces together explain the fall in the overall share of informationally sensitive credit intermediation. Technology has made securitization a more attractive alternative for borrowers, and shifting borrower preferences towards owning securities has made them a more attractive alternative for savers. Shifting implicit bank subsidies, as discussed above, have caused banks to shift their already-smaller balance sheets towards owning securities rather than issuing loans.

We conclude our analysis by examining how the shifting nature of credit intermediation impacts the financial sector's sensitivity to macroprudential regulation including capital regulation and liquidity regulation. We consider a scenario in which capital requirements are increased dramatically, and evaluate how the intermediation sector would react in 2023 versus how it would react given the 1963 parameters. We find that while raising capital requirements to 25% modestly decreases lending in both economies, the effect in the 1963 economy is much more pronounced: Total lending decreases by 120 basis points, and the loan share of lending decreases by 8%. In contrast, the effect in 2023 is much smaller: Total lending decreases by only 60 basis points, with informationally sensitive lending decreasing by 5.7%.

In both cases, bank balance sheets contract dramatically. However, we only observe a fairly modest decline in aggregate lending, which becomes even more modest at 2023 parameters. This is 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. (2022), 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 due to the "bank balance sheet substitution" margin of adjustment.

The impact of increasing capital requirements on total lending is even more subdued in 2023, given that the technological improvements in securitization mean that better substitutes for bank lending are available to firms. Additionally, increased borrower preferences for securities mean that banks balance sheet loans already comprised a smaller share of financial intermediation, and so the reduction of their balance sheet size is less consequential. Finally, due to changes in implicit costs and subsidies, banks own a larger share of securities, and so their primary margin of adjustment is to sell securities, rather than issue fewer loans.

In summary, the intermediation sector has undergone a dramatic transformation since the mid-20$^{\text{th}}$ century. Bank deposits comprise a smaller proportion of savings, and loans held on bank balance sheets comprise a smaller proportion of borrowing. Additionally, banks' business models have shifted away from the traditional lend-with-deposits model and towards a model in which they lend less and own more securities. We explain these shifts with a combination of improved securitization technology, decreased saver interest in owning deposits, and changing costs and subsidies on bank activities. These changes have important consequences for macroprudential policy and financial regulation as discussed in Section 5.

Our paper is related to the vast literature in financial intermediation and banking that we cannot cover in detail. Within this literature our work is most closely related to work of Buchak et al. (2022, 2023) that emphasizes the importance of recognizing the modern industrial organization of the credit markets. They argue that the bank balance sheet retention and shadow bank substitution margins of adjustments that play a crucial role in the financial intermediation pass-through. Our study takes a broader approach by focusing on the entirety of the private credit market and adopts a long-term perspective to analyze the decline of bank balance sheet lending, its primary drivers, and its implications for macroprudential policy and financial regulation. Our focus on the credit market equilibrium encompassing savers, borrowers, and the financial intermediation sector also connects our work to the recent models focused 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 Landgvoit 2022; Bianchi and Bigio 2022; Davilla and Goldstein 2023). Within this literature our works emphasizes the importance of recognizing the secular decline in bank balance sheet lending, its main drivers, and its equilibrium implications for financial intermediation pass through and macroprudential regulation.

2. Aggregate Credit Market Trends and Declining Informationally Sensitive Lending

2.1 The Main Credit Market Segments

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 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 assets.[2] 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. We observe that 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 on.

The second market segment comprises loans that are not retained by their originators but are instead sold to investors through various *debt securities*. We will consider 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 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. 2022). 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.

We will further differentiate between two sub-sectors within the debt securities sector. The first comprises loans sold through fully privately intermediated securities (e.g., corporate bonds), referred to as *private debt securities*. The second sub-sector includes loans sold through government-backed securities vehicles (e.g., Agency MBS), which we will designate as *government-affiliated debt securities*.

Finally, we note that in addition to US households, there is significant international demand for US assets. Following the end of the Cold War in 1989, there was a notable surge in global interest

[2] 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.

in U.S. securities (Caballero, Farhi, and Gourinchas 2008; Caballero and Krishnamurthy 2009). 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. Several factors contributed to this growth. First, the post-Cold War era witnessed increased globalization and interconnectedness of financial markets. 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. Numerous countries held U.S. assets as part of their foreign exchange reserves, drawn to the liquidity and stability associated with the U.S. financial markets. This additional shift in investor demand could potentially stimulate further development and growth of U.S. debt securities and contribute to the decline in the bank balance sheet lending share.

2.2 Data Sources

Total lending is defined as the outstanding debt of households and non-financial business in the United States. This series is taken directly from the Financial Accounts of the United States database and is defined as Total Credit to the Private Non-Financial Sector.[3]

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 sector from the Financial Accounts of the United States database.[4]

Total debt securities are defined as the aggregate outstanding amount of *Total Lending* less *Informationally sensitive lending*. 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 outstanding amount of Agency- and GSE-backed securities. It is measured directly from the Financial Accounts of the United States.[5]

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.

Note that definitionally,

[3] The series ID is CRDQUSAPABIS.
[4] The series IDs are USCDILA, FBOUSLA, BUSAALA, and CULA.
[5] The series ID is BOGZ1FL893061705Q

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

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.[6]

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.[7]

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.

2.3 Aggregate Lending Trends

We start our analysis by examining the aggregate volume of total lending (outstanding credit) to households and non-financial businesses in Panel (a) of Figure 1. The nominal value of outstanding total lending has shown a remarkable increase, rising from approximately \$0.55 trillion in 1962 to around \$39.7 trillion in 2023. While this series demonstrates growth in most years, we observe a notable decline during the Great Recession. Specifically, the total outstanding volume of lending to households and non-financial businesses decreased from about \$25 trillion in 2008 to approximately \$23.8 trillion by 2011.

Panels (b) and (c) of Figure 1 decompose the outstanding total lending volume into its primary components: informationally sensitive lending and debt securities. Panel (b) specifically showcases 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. Mirroring the trend observed in total lending, there is a noticeable temporary decline in bank balance sheet lending volume during the Great Recession. Importantly, our subsequent exploration

[6] The series IDs are BOGZ1FL703127005Q, BOGZ1FL703130005Q, and BOGZ1FL702150005Q.

[7] The series ID is BOGZ1FL384090005Q.

in the next subsection reveals that the share of informationally sensitive lending became significantly less prominent as a fraction of total lending.

Moving to Panel (c) of Figure 1, we depict 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 ($0.01 trillion) in 1962 to over $25 trillion by 2023. Approximately 40% of this growth is attributed to government-affiliated debt securities (depicted by the dashed line), which surged from zero in 1962 to about $10.4 trillion. The majority of this expansion consists of mortgage-backed securities issued with government guarantees or guaranteed by Government Sponsored Enterprises (such as Fannie Mae or Freddie Mac). Similar to other series, there is a temporary decline in the outstanding volume of debt securities during the Great Recession. Crucially, as we delve into the following subsection, debt securities progressively gain significance over time, supplanting the diminishing proportion of informationally sensitive lending within the overall lending landscape.

2.4 Secular Decline in the Informationally Sensitive Lending Share in Total Lending

The aggregate lending trends examined in the preceding subsection indicate a notable decrease in the proportion of informationally sensitive lending within the total lending landscape. To formalize this observation, Figure 2, Panel (a) depicts informationally sensitive lending ("bank balance sheet lending") as a percentage of the total outstanding lending volume to households and non-financial businesses. The data reveals a substantial decline in the relative importance of informationally sensitive lending, plummeting from approximately 60% at its peak in the 1960s to about 36% by 2023, with the majority of this decline occurring between early 1980s and mid-1990s. Accompanying this decline in informationally sensitive lending, Figure 2 Panel (b) depicts that the deposit share of domestic non-financial sector financial wealth has 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. Finally, while our focus is on the composition of savings and lending, as Figure 2 Panel (c) shows, the fall in deposit-to-wealth ratio takes place in a broader context of a dramatically increasing rising financial wealth-to-GDP ratio

Consistent with the findings of Buchak et al. (2022), 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. This suggests that while shocks to bank capitalization may explain some variability in the relative importance of informationally sensitive lending versus debt securities, as highlighted by Buchak et al. (2022 and 2023), such shocks are unlikely to be the primary driver of the prolonged decline in the informationally sensitive lending share spanning the last few decades.

One potential explanation for the decline in the informationally sensitive lending share is the growth of government-affiliated debt securities, primarily agency mortgage-backed securities, (see also our discussion in the next subsection). Government credit guarantees could facilitate the securitization of mortgages that constitute a substantial share of total lending reducing the need to finance 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 34% 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. 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.

In summary, the evidence presented above suggests that changes in the bank capitalization and its regulatory treatment are unlikely to explain the majority of the 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 loans not eligible for government guarantees suggests that other factors have also played an important role in this trend. In the next subsection, we delve into diverse institutional developments that may play a role in the gradual decrease in the significance of informationally sensitive lending. We will closely examine the timing of these developments in connection with the patterns illustrated in Figures 1 to 3.

2.5 Institutional Developments and Decline in the Informationally Sensitive Lending Share

In this subsection, we delve into several institutional developments that may have played a role in the secular decline of the informationally sensitive lending. 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.

2.5.1 Technological and regulatory 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).

We start with the development in the government affiliated securities market.

In 1968, Federal National Mortgage Association, established in 1938 and known colloquially as Fannie Mae, underwent a transformation when it was split into two entities: Fannie Mae (which retained its government-sponsored enterprise (GSE) status) and Ginnie Mae (Government National Mortgage Association), which became a fully government-owned entity. This allowed Fannie Mae to raise more capital from private investors, giving it the resources to purchase and pool together more conventional mortgage loans. Ginnie Mae became a government agency with a similar mission, though it only guaranteed mortgage backed securities (MBS) backed by loans that were insured by the Federal Housing Authority or the Veteran Administration. The first Ginnie Mae MBS were issued in 1970.

In 1970, Freddie Mac, officially known as the Federal Home Loan Mortgage Corporation, was established. It was created by the federal government to expand the secondary mortgage market and provide more opportunities for homeownership. Like Fannie Mae, Freddie Mac operates as a GSE. Its primary function is to buy mortgages on the secondary market, pool them, and sell MBS to investors. Freddie Mac completed its first mortgage-backed security (MBS) issuance in 1971. Fannie Mae, which did not previously issue MBS, closed its first securitization deal in 1981. Through the 1990s, these entities were given an "affirmative obligation to facilitate the financing of affordable housing for low-income and moderate-income families."

We observe that the government sponsored enterprises entities are limited to securitizing mortgage loans that meet certain eligibility requirements around borrower credit quality, documentation, and importantly, loan sizes falling below the institutionally set conforming loan limit. In the aftermath of the Global Financial Crisis (GFC), there was a substantial increase in conforming loan limits across numerous regions in the US. This adjustment was made as part of broader initiatives aimed at bolstering the housing market. The significant expansion of conforming loan limits broadened the range of loans eligible for securitization, thereby reducing the proportion of informationally sensitive lending in these areas (see Buchak et al. 2024).

Turing to private securities, the corporate bond market has a long history, but it began to develop significantly in the late 19th and early 20th centuries. The corporate bond market experienced significant growth after World War II as the global economy recovered. The demand for financing increased, and corporations turned to the bond market for capital. 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.

The developments in the government affiliated debt securities market broadly coincided with the development in the private securitization market. In the late 1970s, private enterprises initiated the issuance of mortgage-backed securities (MBSs). These MBSs differed from those conforming to the standards set by quasi-government agencies, as they did not adhere to criteria such as loan-size limits and credit risk. [8] We note that this market suffered a very significant contraction following the Global Financial Crisis (see Keys et al. 2013).

The private Commercial Mortgage-Backed Securities (CMBS) market was created in the early 1990s. The concept of securitizing commercial real estate loans, similar to residential mortgage-backed securities (RMBS), gained traction during this period. The first CMBS transactions were completed in 1991, marking the inception of this market. CMBS provided a way for financial institutions to pool and sell commercial mortgage loans to investors in the form of tradable securities, thereby increasing liquidity in the commercial real estate market. Since then, the CMBS market has evolved, experiencing periods of growth and changes in structure over the years.

In the 1980s and early 1990s, the financial intuition also developed a robust market for securitizing consumer loans. Auto loan securitization has grown at a substantial pace since the market's inception in the 1980s. In 1987 financial institutions started issuing securities backed by credit card loans. The profit generated by securitizing credit card loans encouraged banks to extend more subprime credit. In 1993 the first securitization of student debt occurred.

Collateralized Loan Obligations (CLOs) originated in the late 1980s, mirroring the trajectory of other securitization methods, serving as a means for banks to bundle leveraged loans. This allowed them to offer investors an investment vehicle with varying degrees of risk and return.[9]

During the mid-1980s, commercial banks also pioneered the development of Asset-Backed Commercial Paper (ABCP) conduits. Initially designed to enable banks to secure short-term funding off the balance sheet, these programs allowed banks to circumvent capital requirements by keeping certain assets off their balance sheets. The process involved creating a Special Purpose Vehicle (SPV) to hold a pool of financial assets, such as mortgages in the case of REMICs. Subsequently, the SPV issued commercial paper backed by the underlying asset pool. Investors purchasing this relatively short-term and low-risk investment generated revenue for banks. Crucially, since the ABCP conduit was technically owned by a third party unrelated to the bank, it did not qualify as an affiliate of the bank. Through ABCP conduits, banks could generate fee income and address customers' credit needs without the necessity of maintaining the full amount of capital mandated by regulatory bodies for on-balance-sheet lending.

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[8] Private institutions faced a relative cost disadvantage relative to GSEs: (1) investors assume that the US government guarantees all agency MBSs, making these securities much less risky; (2) GSEs are not subject to some Federal, state, and local taxes as well as securities regulations; and (3) GSEs were exempt from reserve and capital requirements.

[9] The inaugural wave of "modern" CLOs, known as "CLO 1.0," focused on income generation through cash flows and emerged in the mid- to late-1990s. This vintage encompassed both high yield bonds and loans, constituting the standard CLO structure until the 2008 financial crisis. Following the crisis, CLO 2.0 emerged in 2010, adapting to the evolving financial landscape by enhancing credit support and shortening the reinvestment period for loan interest and proceeds. Subsequently, CLO 3.0, introduced in 2014, sought to further mitigate risk by eliminating high yield bonds and adhering to new regulations, including the Volcker Rule. In 2020, the Volcker Rule underwent additional amendments, allowing high yield bonds to be reintegrated into CLOs.

Alongside the aforementioned advancements in the securities market, the financial sector also underwent a series of technological innovations. These innovations potentially diminished the necessity for informationally sensitive (bank balance sheet) lending by mitigating informational asymmetries and other associated costs and barriers to issuing debt securities.

First, the advent of computer technology and data processing capabilities that started in 1980s has significantly streamlined the securitization process and loan sales. This includes automation of various tasks involved in loan origination, underwriting, and the creation of securities. Second, the development of specialized software for securitization has allowed financial institutions to model, structure, and manage complex securities more effectively. This software also importantly relies on the use of data and advanced analytics that enabled financial institutions and rating agencies to analyze large volumes of data to assess credit risk more accurately. This, in turn, provided investors with potentially better risk assessment tools. Third, on the consumer side, the FICO score was first introduced in 1989 by the company Fair, Isaac, and Company (now known as FICO). FICO scores are numerical representations of an individual's creditworthiness and became widely used by lenders and investors to assess the risk associated with lending money or extending credit. Fourth, and more broadly, the growth of the securitization market, coupled with the increasing complexity of financial instruments, led to a greater reliance on rating agencies to provide independent evaluations of debt securities. Fifth, the electronic trading platforms have made it easier for investors to buy and sell securitized products. These platforms improve market liquidity and transparency, making it more convenient for market participants to access and trade securitized assets. Finally, developments in on-line loan origination platforms that mainly occurred after the Global Financial Crisis has further facilitated loan origination and sales including by non-banking institutions (Buchak et al. 2018).[10]

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). The evolution of government-affiliated securitization market implies that it may have significantly contributed to the observed decrease in the informationally sensitive lending share, primarily experienced in the 1980s and 1990s. However, as previously mentioned, the developments in the government affiliated securities cannot simply account for significant decline in the informationally sensitive lending share among non-mortgage loans, as the latter are largely ineligible for financing through such securities.

[10] It is important to note that the current wave of financial innovations that includes use of Artificial Intelligence (AI) and machine learning methods in risk management and credit scoring can improve predictive modeling and risk assessment tools. This has the potential to further diminish dependence on informationally sensitive lending (bank balance sheet lending) in the future.

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 (1960s to 1990s).

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

In this subsection, we examine 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. The concept of money market funds was pioneered by Bruce R. Bent and Henry B. R. Brown, who launched the first money market fund, the Reserve Fund, in 1971. The primary objective of money market funds is to provide investors with a vehicle that offers higher yields than traditional savings accounts while preserving capital and maintaining liquidity. The establishment of money market funds introduced a new investment option that allowed households to indirectly invest in debt securities market.

Second, a series of regulatory changes facilitated growth of pension funds through which households can acquire and finance debt securities. The Employee Retirement Income Security Act (ERISA) of 1974 established guidelines for the management and operation of pension funds, ensuring the protection of participants' rights and benefits. The regulatory framework provided by ERISA has contributed to the growth of pension funds. Tax Reform Act of 1986 introduced provisions that enhanced the attractiveness of defined contribution plans, such as 401(k) plans. These plans became popular among employers and employees, leading to the growth of individual retirement accounts (IRAs) and contributing to the expansion of pension fund assets including debt securities.

Third, following the end of the Cold War in 1989, there was a notable surge in global interest in U.S. securities. 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. Several factors contributed to this growth. First, the post-Cold War era witnessed increased globalization and interconnectedness of financial markets. 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. Numerous countries held U.S. assets as part of their foreign exchange reserves, drawn to the liquidity and stability associated with the U.S. financial markets. This additional shift in investor demand could potentially stimulate further development and growth of U.S. debt securities and contribute to the decline in the bank balance sheet lending share.

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 mid-1990s.

2.5.3 Regulations, subsidies, and implicit costs in bank intermediation

In this subsection, we explore various regulatory changes that could impact the relative cost of intermediation on bank balance sheets, thereby contributing to the decline in the informationally sensitive lending share.

The Tax Reform Act was enacted in 1986, allowed for the creation of REMICs, which were SPVs that could issue collateralized mortgage obligations (CMOs) and have them qualify as asset sales. This effectively increased the cost of bank balance sheet lending relative to loan sales.

The savings and loan crisis that began in the late 1970s and peaked in the late 1980s and early 1990s also heightened the relative costs of bank balance sheet lending. The Financial Institutions Reform and Recovery Act of 1989 established the Resolution Trust Corporation to address failed thrift institutions. 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).

3. Structural Model of the Lending Market

The preceding section outlines three main factors that could contribute to the diminishing significance of informationally sensitive bank lending. First, advancements in technology related to the issuance of debt securities, such as securitization, may streamline the process of selling loans and reduce various frictions, consequently diminishing the reliance on informationally sensitive bank balance sheet lending. Second, changes in the costs or subsidies associated with banks issuing deposits, equity, and loans—inclusive of various regulatory factors—might also play a role in steering this shift. Lastly, shifts in saver preferences regarding the choice between holding deposits and opting for alternative savings technologies could drive an increased demand for debt securities, leading to a relative decline in bank balance sheet lending.

We formalize these alternatives in a structural model. We focus on secular trends and therefore abstract from business-cycle frequency effects that would necessitate a dynamic model such as dynamic considerations around intermediary capital levels or a household consumption-savings decision. The model is therefore a series of static economies.

A. Model Setup

A.1. Savers

The saving sector represents all net savers in the economy. They include, for example, saving households, non-profits, and for-profits with excess wealth. They are endowed with aggregate planned savings wealth M_s, which they invest fully into savings technologies. There are several savings technologies available: (1) bank deposits, (2) bank equity, (3) privately intermediated securities (e.g., corporate bonds), (4) securities intermediated through government-affiliates (e.g., agency mortgage-backed securities), and (5) other assets (e.g., equity or treasury securities). These technologies are imperfect substitutes for one another. Imperfect substitutability arises, for example, because bank deposits provide transaction services that corporate bonds do not, or because households have a desire to diversify their asset holdings.

Savers purchase technology j at endogenous price p_j at the start of the period. The technology pays 1 at the end of the period. Thus, the return for savings technologies is $r_j = 1/p_j - 1$. There is no risk in the model, and so we interpret the returns as being risk-adjusted. We assume that saver utility over their consumption of savings technologies is given by the following CES aggregator:

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

Q_j^s is the quantity of savings type j, α_j is the utility weight on type j, and $\sigma_s > 1$ is the elasticity of substitution, where $\sigma_s \to \infty$ means the savings technologies are perfect substitutes.

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:

$$Q_j^s = \alpha_j p_j^{-\sigma_s} M_s / P_s \tag{S.3}$$

where P_s is the usual CES price index, $P_s = \sum_j \alpha_j p_j^{1-\sigma_s}$. The saving sector consumes all proceeds of their investment at the end of the period.

A.2. Borrowers

The borrower sector 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 M_b which they use to repay what they borrowed at the start of the period. Borrowers have three borrowing technologies j available: (1) informationally sensitive loans (j=s), (2) informationally insensitive privately intermediated loans (j=Ip), and (3) informationally insensitive loans intermediated through the government-affiliated sector (j=Ig). These technologies are imperfect substitutes. For example, some borrowers may have projects that require monitoring (informationally sensitive loans), while other borrowers may have projects for which there is a specific government mandate to lend and securitize (e.g., conforming mortgages).

Borrowers receive 1 unit of credit and repay the endogenous price p_j at the end of the period. The return for a borrowing technology is thus $r_j = p_j/1 - 1$.[11] We assume that borrower utility over their consumption of borrowing technologies is given by the following CES aggregator:

$$u_b = \left(\sum_j \beta_j^{\frac{1}{\sigma_b}} Q_j^{b\,\frac{\sigma_b - 1}{\sigma_b}} \right)^{\frac{\sigma_b}{\sigma_b - 1}} \tag{B.1}$$

Where parameters are defined analogously with savers' demand. As above, Q_j^b is the quantity of borrowing type j, β_j is the utility weight on type j, and $\sigma_b > 1$ is the elasticity of substitution.

The borrower's problem is as follows:

[11] Broadly "savings" technologies cost "p" today and return 1 tomorrow. "Borrowing" technologies cost 1 today and return p tomorrow. This helps keeps demand functions symmetric across the sectors, i.e., demand curves are downward sloping in price.

$$\max_{\{Q_j\}} u_b \text{ s.t. } \sum_j p_j Q_j \leq M_b \tag{B.2}$$

This leads to borrower demand for product j:

$$Q_j^b = \beta_j p_j^{-\sigma_b} M_b / P_b \tag{B.3}$$

where P_b is the CES price index, $P_b = \sum_j \beta_j p_j{}^{1-\sigma_b}$.

A.3. Financial intermediaries

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. This sector comprises three primary types of intermediaries: (1) bank intermediaries who originate informationally sensitive loans that they retain on their balance sheets, (2) originate-to-distribute intermediaries, encompassing shadow banks and banks issuing informationally insensitive loans sold through private debt securities, and (3) originate-to-distribute intermediaries, including shadow banks and banks issuing informationally insensitive loans sold through government-affiliated debt securities. We refer to (1) as "banks" even though empirically, depository institutions may engage in (2) and (3) as a separate line of business (see Buchak et al. 2022). Our empirical analysis and model interprets banks engaged in these business lines as non-banks.

A.3.1. Banks

Banks provide informationally sensitive loans to the borrower sector that they retain on their balance sheets. Banks also provide bank deposits and bank equity to the saver sector. Excess cash (deposits plus equity minus loans) is invested in non-bank savings technologies (securities or the outside option). The bank is indifferent between these technologies beyond their price.

There are frictions in the production of borrowing and saving technologies. In particular, paying back depositors costs the bank $1 + p_d\Delta_d$. Paying back equity holders costs the bank $1 + p_e\Delta_e$. Similarly, a bank owed p_l by informationally sensitive borrowers receives $p_l + \Delta_l$ on repayment. These bank intermediation wedges, $(\Delta_d, \Delta_e, \Delta_l)$, allow us to capture things like deposit subsidies or regulatory costs including the franchise value of bank deposits, benefits of holding liquid securities, and links between bank equity financing and loan provision. We specify these wedges below. 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 that makes the bank indifferent between holding all three.

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 borrowing costs. The banker's profit is as follows:

$$\Pi^{\text{Bank}} = -Q_d(1 + p_d\Delta_d) - Q_e(1 + p_e\Delta_e) + Q_l(p_l + \Delta_l) + Q_s \tag{I.1}$$

Here Q_j is the quantity of each product provided. Q_s and p_s refer to the total quantity of securities owned (private securitizations, government-affiliated securitizations, and other assets) at the common price p_s required to be equalized in equilibrium.

The bank chooses the quantity of deposits and equity to issue to the saver sector, the quantity of informationally sensitive loans to issue to the borrower sector, and the quantity of securities to purchase. The bank's balance sheet must balance, i.e., $Q_d p_d + Q_e p_e = Q_l + Q_s p_s$. The bank faces the downward-sloping demand curves (S.3) and (B.3) and takes securities prices as given when making these decisions. The banker's problem is as follows:

$$\max_{Q_d, Q_e, Q_l, Q_s} \Pi^{Bank} \text{ s.t. } Q_d p_d + Q_e p_e = Q_l + Q_s p_s \tag{I.2}$$

We specify the bank intermediation wedges as follows:

$$\begin{aligned}
\Delta_d &= \delta_d^1 + \delta_d^2\left(\frac{Q_s p_s - \phi Q_d p_d}{Q_d p_d}\right)^{1/2} \\
\Delta_l &= \delta_l^1 + \delta_l^2\left(\frac{Q_e p_e - \xi A}{A}\right)^{1/2} \\
\Delta_e &= \delta_e^1
\end{aligned} \tag{I.3}$$

Δ_d relates the cost of providing deposits. That is, with $\delta_d^2 < 0$, the cost of providing deposits is decreasing in the ratio of securities to deposits in excess of a statutory requirement $\phi Q_d p_d$, approximately the liquidity coverage ratio. This relation captures the idea that the bank faces the possibility of deposit outflows and that it needs liquid securities (as opposed to loans) to meet this demand. Δ_l relates the benefit of lending to the bank's capitalization. That is, with $\delta_d^2 > 0$, a better-capitalized bank receives effectively more repayment per loan. This captures the alignment of incentives between equity and proper screening and monitoring of bank lending. Δ_e represents the possible additional costs (or benefits) associated with the bank's equity funding.

A.3.2. 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 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.

There are two originate-to-distribute sub-sectors solving analogous problems. 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).

As with banks, there are technological frictions in shadow bank intermediation. In particular, on repayment of an informationally insensitive private-sector loan, an originate-to-distribute intermediary receives $p_{Ip} - \Delta_{Ip}$, and on repayment of an informationally insensitive government affiliated loan, an originate to distribute intermediary receives $p_{Ig} - \Delta_{Ig}$.

Here, $\Delta_I > 0$ captures, for example, losses due to adverse selection or poor ex-post monitoring. The originate-to-distribute intermediary (OTD Lender) issues Q_I informationally insensitive loans and Q_s securities. Its profit is:

$$\Pi^{\text{OTD Lender}} = -Q_s + Q_I(p_I - \Delta_I) \quad \text{(I.4)}$$

The OTD lender's balance sheet identity requires that $Q_s p_s = Q_L$, and so the OTD lender's problem is as follows:

$$\max_{\mathrm{Q_I}} Q_I(p_I - \Delta_I - 1/p_s) \quad \text{(I.5)}$$

We assume that the OTD intermediation is perfectly competitive.

A.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.

B. Equilibrium

B.1. Equilibrium definition

Equilibrium in the model is a set of prices for the savings technologies $(p_d, p_e, p_{sp}, p_{sg}, p_0)$ and the borrowing technologies (p_l, p_{Ip}, p_{Ig}) where the saver sector maximizes utility (S.1-3), the borrower sector maximizes utility (B.1-3), the bank manager maximizes profits (I.1-3), the OTD lenders maximize profits (I.4-5) and earn zero profits in equilibrium, and p_0 is given exogenously.

Additionally, markets must clear. In particular, the quantity of bank equity and bank deposits demanded by savers equals the quantity of bank equity and bank deposits issued by banks. The quantity securities issued by the OTD lending sectors must equal the quantity of securities owned by the saver and bank sector. Finally, the quantity of informationally sensitive loans demanded by the borrower sector must equal the quantity of informationally sensitive loans provided by the bank sector.

B.2. Key pricing equations

The first-order conditions from the bank's problem and the OTD lenders' problems imply the following pricing relations. Letting $(D, E, L, S, A) = (Q_d p_d, Q_e p_e, Q_l, Q_s p_s, Q_d p_d + Q_e p_e)$ denote the value of deposits, equity, loans, securities, and total assets, respectively, from the bank problem one has:

$$r_d = \left(\frac{\sigma_s - 1}{\sigma_s}\right)\left[1 + r_0 - \frac{1}{2}\delta_d^2\left(1 - \frac{S}{D}\right)\left(\frac{S - \phi D}{D}\right)^{-1/2} - \frac{1}{2}\delta_l^2\left(\frac{L}{A}\right)\left(\frac{E}{A}\right)\left(\frac{E - \xi A}{A}\right)^{-1/2} - \delta_d^1 - \delta_d^2\left(\frac{S - \phi D}{D}\right)^{1/2}\right] - 1 \tag{E.1}$$

$$r_e = \left(\frac{\sigma_s - 1}{\sigma_s}\right)\left[1 + r_0 - \frac{1}{2}\delta_d^2\left(\frac{S - \phi D}{D}\right)^{-1/2} + \frac{1}{2}\delta_l^2\left(\frac{L}{A}\right)\left(\frac{D}{A}\right)\left(\frac{E - \xi A}{A}\right)^{-1/2} - \delta_e^1\right] - 1 \tag{E.2}$$

$$r_l = \left(\frac{\sigma_b}{\sigma_b - 1}\right)\left[1 + r_0 - \frac{1}{2}\delta_d^2\left(\frac{S - \phi D}{D}\right)^{-1/2} - \delta_l^1 - \delta_l^2\left(\frac{E - \xi A}{A}\right)^{1/2}\right] - 1 \tag{E.3}$$

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

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

From the OTD lenders' problem, one has:

$$r_{Ip} = r_{sp} + \Delta_{Ip} \tag{E.6}$$

$$r_{Ig} = r_{sg} + \Delta_{Ig} \tag{E.7}$$

C. Model Estimation

There are a set of parameters defining saver and borrower preferences, as well as a set of parameters defining the financial intermediation sector, which we must determine. The structure of our model allows us to do this largely separately. We begin by utilizing time-series returns data and bank balance sheet data, together with equilibrium pricing equations E.1-5, to estimate down key bank intermediation parameters. We then use data on quantity and prices to calibrate borrower demand, saver demand, and shadow bank intermediation frictions. As the statutory liquidity and capital requirements, we use $\xi = 4\%$ and $\phi = 5\%$, respectively. [12]

C.1. Bank intermediation parameters

We begin by imposing an econometric model on pricing equations E.1-5. 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, $\{\Delta_{\mathrm{sp}}, \Delta_{\mathrm{sg}}\}$. Additionally, we impose the following structural assumptions:

$$\begin{aligned} \delta_{d,t}^1 &= \overline{\delta_d^1} - \epsilon_{d,t} \\ \delta_{e,t}^1 &= \overline{\delta_e^1} - \epsilon_{e,t} \\ \delta_{l,t}^1 &= \overline{\delta_l^1} + \epsilon_{l,t} \end{aligned} \tag{Est. 1}$$

[12] https://www.bis.org/basel_framework/chapter/LCR/40.htm

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

We interpret these $\left(\epsilon_{d,t}, \epsilon_{e,t}, \epsilon_{l,t}\right)$ 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).

With these assumptions, we aim to identify seven parameters: $\left(\sigma_s, \sigma_b, \overline{\delta_d^1}, \overline{\delta_e^1}, \overline{\delta_l^1}, \delta_d^2, \delta_l^2\right)$. As instruments we use those suggested by ordinary least squares. That is, we use where relevant, $\{r_0, S/D, L/A, D/A, E/A\}$. This yields 12 moment conditions. We implement our estimation as a feasible two-stage GMM estimation.

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 run our GMM estimation on the part of the sample where all data are observable, quarterly, from 1984-2023. Having estimated these structural parameters, we also recover the time series of epsilons. We then obtain backfilled returns data by backfilling the first measured epsilon and calculating the implied returns given the estimated structural parameters. The results of this estimation are shown in Table 1, Panel (a) together with standard errors. We discuss the estimation results below. Figure 4, panel (a) shows the return spreads used in the estimation, and panel (b) shows the structural error terms.

C.2. Borrower, saver, and shadow bank parameters

Having obtained (σ_s, σ_b) in the previous stage, we are left to determine saver and borrower preferences α_j and β_j, borrower and saver endowments M_s and M_b, and securitization frictions Δ_{Ip} and Δ_{Ig}. We do this with price and quantity data.

Saver preferences: We normalize $\alpha_d = 1$. Then, with demand equation (S.3), the time series of price and quantity data exactly determines the time series of saver preference parameters and endowment $(\alpha_{0,t}, \alpha_{e,t}, \alpha_{sp,t}, \alpha_{sg,t}, M_{s,t})$. Thus, the saver preference parameters are reported relative to savers demand for deposits.

Borrower preferences and OTD intermediation frictions: Jointly determining borrower preferences and OTD intermediation frictions is more complicated because we do not observe actual rates on informationally insensitive loans made by the OTD sectors. Rather, we observe only the ultimate rates that savers receive. Nor do we observe data about the production process (e.g., marginal costs) that would allow us to directly measure Δ_{Ip} and Δ_{Ig}. Consequently, changes in the quantity of loans demanded could be driven either by shifting preferences (β_{Ip} or β_{Ig}) or by unobservable changes in price due to changes in intermediation frictions.

We impose the following normalization. First, as was the case with savers, we (innocuously) normalize $\alpha_l = 1$ over the entire sample. We next assume that $\Delta_{Ip,0} = \Delta_{Ig,0} = 0$. This allows us, in a given period, to exactly determine $\left(\beta_{Ip}, \beta_{Ig}, M_{b,0}\right)$ We then assume that this structural preference parameter is fixed over our entire period. Then, for subsequent periods, quantities and (observed) prices exactly determine $\left(\Delta_{Ip,t}, \Delta_{Ig,t}, M_{b,t}\right)$ We choose as our initial period 1984, which is the first period in which we observe all data. Using the backward-filled returns data, we can also extend our estimation into the period before 1984. [13]

Observe first that this normalization imposes that we attribute changes in the quantities of informationally insensitive loans in the economy that are unexplained by changes in *securities* prices to changes in the implicit cost of securitization and not to changes in borrower preferences. This assumption in effect imposes that the composition of financeable projects is largely fixed over time, i.e., that there are not fewer projects whose characteristics call for informationally sensitive lending, but rather, the quality of informationally insensitive lending improves. Observe further that the time series of these frictions $(\Delta_{Ip,t}, \Delta_{Ig,t})$ is measured relative to the time t=0 friction. Thus, a "negative" friction should be interpreted as a cost improvement in securitization rather than an absolute cost advantage of securitization.

Table 1, panel (b) shows the static demand parameters, $\left(\alpha_0, \beta_s, \beta_{Ip}, \beta_{Ig}\right)$. Figure 4, panel (c) shows the implicit intermediation frictions $\Delta_{Ip,t}, \Delta_{Ig,t}$ relative to the 1984 base period. Panel (d) shows saver preferences over savings technologies.

C.3. Estimation results

Bank intermediation parameters: We begin by discussing the bank intermediation parameters. These parameters are estimated using the GMM approach described above. The elasticities of substitution for savers and borrowers, σ_s and σ_b, respectively, are 7.50 and 8.03. Intuitively, these

[13] For robustness we redo the estimation with 1994 and 2004 as base year and show that the directional trends are unchanged (see Appendix A.1)

values are estimated through the pass-through of outside option rates r_0 with deposit and loan rates. If there is perfectly elastic substitution across savings (borrowing) technologies, an increase in the outside option rate of 1% should be passed-through 1-to-1 as an increase in the deposit (loan) rate. Because there is an imperfect passthrough, our estimation concludes that these technologies are not perfect substitutes. The elasticity estimate for borrowing is broadly in line with Buchak et al. (2022), which estimates a price elasticity of 6.5 for mortgage borrowers, even though the identification procedure differs significantly from those settings.

Next, for the parameters of Δ_d, we estimate that $\delta_d^2 = -0.39$. The interpretation is that the cost of providing deposits is lower when the bank has a better liquidity position. Intuitively, when the bank possesses relatively few liquid assets, 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. $\overline{\delta_d^1}$ should be interpreted as a level shifter so that given the mean level of excess liquidity, predicted deposit rates match measured deposit rates.

Next, for the parameters of Δ_l, we estimate that $\delta_l^2 = 0.18$. $\delta_l^2 > 0$ implies that consistent with theoretical suggestions, better-capitalized banks are more productive in informationally sensitive lending. 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 1.7 percentage points.[14] As above, $\overline{\delta_l^1}$should be interpreted as essentially a regression constant, as is $\overline{\delta_e^1}$.

The remaining intermediation parameters, $(\epsilon_{d,t}, \epsilon_{e,t}, \epsilon_{l,t})$ are the time-varying residuals, which we interpret as implicit costs or subsidies to banks. We offer this interpretation because of a revealed preference argument: Banks price deposits, equity, and loans as if the marginal cost of providing them differs from the baseline cost that can be explained by outside option funding rates and the state of the bank's balance sheet. Intuitively, when a bank offers higher deposit rates than the model predicts, we attribute this to an implicit subsidy on bank deposits. As discussed above, these quantities are signed so that a positive number implies an implicit subsidy.

These values are shown in Figure 4, Panel (b). We highlight the increase in $\epsilon_{d,t}$ and $\epsilon_{e,t}$ since the financial crisis. This increase is consistent with banks receiving higher implicit "too-big-to-fail" subsidies for both their deposits and their equity in the post-crisis period. At the same time, our estimation reveals a rise in the implicit cost of loans, $\epsilon_{l,t}$, aligning with the heightened regulatory burden on bank lending introduced after the Global Financial Crisis (Buchak et al., 2018).

Securitization wedges: The time-varying securitization wedges for private- and government-sector informationally sensitive loans, $(\Delta_{Ip,t}, \Delta_{Ig,t})$ capture implicit spreads between payments that

[14] $(\sqrt{14\% - 4\%} - \sqrt{9\% - 4\%}) \times 0.18 = 1.7\%$

savers receive from securities and payments that borrowers make to the non-bank intermediation sector. Under our assumption that the OTD intermediation sector is perfectly competitive, these wedges capture net costs, e.g., technological, or regulatory, that make informationally sensitive lending more expensive.

These wedges are identified as follows. Given returns that savers receive from securities, borrower price elasticities, and borrower preferences over informationally sensitive and insensitive loans (discussed below), there is an implicit price differential between what savers receive and what borrowers pay that rationalizes borrower quantities. For instance, the model would attribute a positive gap between what a no-wedge model would predict and the actual informationally insensitive lending that occurs in the data to a positive price wedge. In essence, the model rationalizes lower market shares with higher implicit prices.

These wedges correspond intuitively to levels of financial technology that facilitates securitization, changes in regulation that made securitization more viable, and finally, in the case of the government wedge, direct subsidies or government support for these sectors (in particular, the conforming mortgage sector). These wedges are shown in Figure 4, panel (c). As discussed, these values are normalized to the 1984, meaning that their 1984 values are definitionally zero, with values above zero corresponding to higher implicit costs and values below zero corresponding to lower implicit costs.

Beginning with the private securitization wedge, shown in blue, we note that the wedge is flat before the 1980s and then shows a modest decline during the 1980s, leveling out thereafter. The decline in the 1980s corresponds to a time of rapid technological development in finance (see Section 2). For example, the rapid investment in financial information technology, and the rise of consumer and commercial credit scoring. It also corresponds to a period of significant financial deregulation which likely facilitated the transition away from a traditional banking towards a model with greater reliance on originate-to-distribute.

The government-associated securitization wedge, shown in red, declines dramatically over the entire sample until the 2000s. As we discussed in Section 2.4, this decline corresponds to Fannie Mae, Freddie Mac, and Ginnie Mae's growing importance in the US housing market. In particular, in 1970, the Federal Home Loan Mortgage Corporation, commonly known as Freddie Mac, was established by the federal government with the aim of expanding the secondary mortgage market and enhancing homeownership opportunities. The inaugural issuance of Freddie Mac's MBS took place in 1971. In 1968, Fannie Mae underwent a transformation, dividing into two entities: Fannie Mae (retaining its government-sponsored status) and Ginnie Mae (Government National Mortgage Association), which became a fully government-owned entity. The first Ginnie Mae MBS were issued in 1970, while Fannie Mae's first securitization deal occurred in 1981. In the 1990s, these entities were given an "affirmative obligation to facilitate the financing of affordable housing for low-income and moderate-income families." These changes, merely summarized here, are representative of the 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.

Saver and borrower preferences: Finally, we discuss the parameters of savers' and borrowers' demand functions. First, recall that elasticities of substitution are estimated in our GMM procedure, essentially by measuring interest rate pass-through from the outside option holding to rates for the bank-intermediated savings and borrowing technologies.

The rest of our demand estimation imposes static normalizations on some parameters and allows others to vary through time.

For borrower preferences, as above we allow the overall market size $M_{b,t}$ to vary exogenously through time. The relative demand coefficients on borrowing technologies are calibrated once as of 1984. Demand for informationally sensitive loans are normalized at 1, while demand for private and government securities are found to be 1.17 and 0.27, respectively.

For savers, we normalize the coefficient on deposits, $\alpha_0 = 1$, so that other preferences are measured relative to deposit demand. This leaves demand for the outside option security, bank equity, private securities, and government-associated securities to vary over time, as well as the overall quantity of savings technologies demanded, $M_{s,t}$. $M_{s,t}$ is essentially an exogenous scalar that rationalizes total market size. The technology-specific demand parameters are identified by rationalizing observed asset holdings given prices. That is, if prices relative to deposits stay the same but portfolio shares rise, the model rationalizes this increase as an outward shift of demand.

Figure 4, panel (d) shows these coefficients for the two most critical assets, private and government-affiliated securities. These values are normalized to 0 in 1984, and so the chart shows how the demand for private securities (in blue) and government securities (in red) has changed through time relative to deposits. The figure shows a large increase in demand for both private and government securities from mid 1980s. Demand preferences for private securities spike dramatically going into the financial crisis, and then fall dramatically thereafter, remaining fairly constant for the rest of the sample period. Observe that our model interprets the financial crisis as a period in which *demand* for private securitizations decreased, and in which the *technology* around producing them decreased somewhat (relative decrease of private securitization wedge). As 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 this market's collapse.

We note that this change of saver preferences towards debt securities during 1980s to 2000s is broadly consistent with several developments that we discussed in Section 2.5.2. First, the money market funds were first established in the 1970s. The establishment of money market funds introduced a new investment option that allowed households to indirectly invest in debt securities market. Second, the regulatory framework implemented during 1970s and 1980s has contributed to the growth of pension funds. In particular, the Tax Reform Act of 1986 introduced provisions that enhanced the attractiveness of defined contribution plans, such as 401(k) plans. These plans became popular among employers and employees, leading to the growth of individual retirement accounts and contributing to the expansion of pension fund assets including debt securities. Finally, following the end of the Cold War in 1989, there was a notable surge in global interest in U.S. securities.

4. Decomposing the Secular Lending Trends

We first use the model to decompose the observed secular trends. In particular, we ask how three forces: (1) changes in securitization technology $(\Delta_{Ip}, \Delta_{Ig})$, (2) changes in saver preferences, $(\alpha_0, \alpha_e, \alpha_{sp}, \alpha_{sg})$, and (3) changes in the implied costs and subsidies to banks for issuing or holding assets, $(\epsilon_d, \epsilon_e, \epsilon_l, \Delta_{sg}, \Delta_{sp})$ separately explain what we observe in the data.

A. Impacts in 2023

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., technology, preferences, and bank costs and subsidies (epsilons) are set to what the model implies in 1963, and calculate counterfactual 2023 outcomes under this scenario. That is, we simulate a counterfactual 2023 intermediation sector where these forces have been held fixed since 1963 but other parameters of the economy. While we will frequently refer to this as the "1963 scenario," observe that other parameters, such as total market sizes, are allowed to vary to their 2023 levels. 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.

To preview our findings at a high level, our model highlights the impact of three main forces since 1963: First, intermediation technology in the informationally insensitive lending sector has improved. 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 slightly 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 5 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 securitization technology alone generates roughly an 2.5% 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 modestly more total lending, which rises 50 basis points 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 25% relative to the baseline parameters. Technology and preferences are the dominant forces in the overall change, although all three forces work against informationally sensitive lending. Improvements in informationally insensitive intermediation naturally draw borrowers towards this substitute source of financing, contributing approximately 8% 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 14%. Finally, rising implicit costs of making informationally sensitive loans further reduces quantities (by about 6%).

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 13% lower) than it would otherwise. As we discussed above, technology and preferences are the dominant forces in the overall change, although all three forces work against informationally sensitive lending.

Panel (d) examines bank balance sheet size. Technological improvements in securitization reduce bank balance sheet size by roughly 4%. 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 more than a 20% decrease in bank balance sheet size to changes in borrower preferences. Finally, these two changes are somewhat offset by changes in implicit banks' costs and subsidies, particularly on deposits, which cause bank balance sheets to be roughly 9% 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 4 percentage points. Technological improvements in securitization lead banks to hold more securities relative to informationally sensitive loans, accounting for roughly a 3 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 6 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 A2 shows that changes since 1963 have had a largely offsetting impact on overall bank capitalization. Capital ratios rose on net roughly 60 basis points versus the baseline counterfactual where these forces were held fixed at 1963 levels. Technological improvements 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 increased securitization technology but mostly by decreased saver preferences to hold deposits. As above, these two trends are partially offset by rising implicit deposit subsidies.

To summarize, technological improvements in securitization have increased aggregate private lending and reduced the importance of informationally sensitive bank balance sheet lending. 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.

B. Impacts over time

The preceding analysis considered only the impacts on the latest period. Figure 6 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 securitization technology. This is a key point of our paper: technological improvements 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 technological change. This plot shows that the primary impact of technology 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).

The decrease in the quantity of informationally sensitive lending, as illustrated in panel (b), isn't solely due to one dominant factor. Instead, a combination of technology, preferences, and bank subsidies collectively influence the decline in this share. 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 technological and preference 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 advancements in securitization technology, notably the development of the government-affiliated debt securities market, coupled with a shift in investor demand away from deposits towards alternative assets. It is noteworthy that this shift in demand away from deposits aligned with the emergence of money market funds, modern pension funds, and an increased demand for US assets by foreigners during 1980s and 1990s (Section 2.4). It is also worth acknowledging that changes in implicit bank subsidies and costs do appear to exert some 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.

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, improvements in securitization technologies largely cancel out these subsidies.

On the other hand, the informationally sensitive share of bank balance sheets, shown in Appendix A3, is tied much more directly to changes in implicit costs and subsidies on bank lending. The intuition with these findings is that technology and saver preferences largely moved deposits off balance sheets, without dramatically altering the decisions that banks themselves make given their balance sheet's size. In contrast, reduced subsidies or increased costs for informationally sensitive lending primarily alter how the bank allocates its balance sheet capacity.

To summarize the findings in this section, we find that each of our forces was separately important in different outcomes. Technological change has been the primary driver of changes in total lending. Saver preferences have been the primary driver of the sizes of bank balance sheets. These two forces together account for majority of the decline in the informationally sensitive lending shares. Changes in implicit subsidies or costs to banks' loans have been the primary driver of how banks allocate their balance sheet capacity.

C. 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.[15] 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. These results are shown in Figure 7, where blue bars represent the 2023 impacts and orange bars represent the impacts under the 1963 parameters.

We first study the impact of capital and liquidity requirements on total lending in panel (a) of Figure 7. 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 120 basis points in 1963, whereas it reduces lending by only 60 basis points in 2023--a 2x reduction in sensitivity. Similarly, raising liquidity requirements to 20% reduces lending by more than 160 basis points in

[15] 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.

1963, while it reduces lending by roughly 90 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.

What accounts for the smaller aggregate response under the 2023 parameters? In both scenarios, banks react to capital regulations by dramatically contracting their bank balance sheet lending (panel (b)). Along with this decline we observe a large decline in bank balance sheet size (panel (c)). Notably, in both the 1963 and 2023 situations, banks respond to the 25% increase in capital requirements by reducing their balance sheets by approximately 25%. Despite this significant reduction in the size of the bank balance sheet and the quantity of informationally sensitive lending, we only observe a fairly modest decline in aggregate lending (panel a), which becomes even more modest at 2023 parameters.

First, this is 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. (2022), 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. The impact of increasing capital requirements (or liquidity requirements) on total lending is even more subdued in 2023, given the enhanced securitization technology 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 70%, versus 60% 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. As shown in panel (b), increased capital requirements reduce informationally sensitive lending quantities by nearly 20% under 1963 parameters, as compared to roughly 15% under 2023 parameters. 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.

Finally, panel (d) shows that in response to regulatory changes, in effect, higher capital requirements reduce the bank's competitive advantage in owning assets on balance sheet. In the case of securities, the saver sector is a good substitute for owning these assets directly. In the case of loans, there is no substitute. Thus, as bank balance sheet capacity becomes more expensive, they lose securities to the saver sector and focus on assets that only they can own. Consequently, banks adjust their asset mix from informationally insensitive securities to informationally sensitive loans as capital requirements increase. In the 2023 case, due to the saver sector's higher preferences for owning securities, this shift is more dramatic. Indeed, increased capital requirements induce an increase of nearly 10% in loan share on bank balance sheets in the 2023 case, whereas it induces roughly an 8% increase in the 1963 case. On the other hand, increasing liquidity requirements reduces loans as a share of bank assets, since banks shift the composition of their assets away from informationally sensitive illiquid loans towards more liquid securities.

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, improvements in securitization technology 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

We document that the traditional model of bank-led financial intermediation, where banks issue demandable deposits to savers and make informationally sensitive loans to borrowers, has seen a dramatic decline over last several decades. The balance sheet share of private lending has declined from 60% to 35%, while the deposit share of savings has declined from 22% to 13%. This secular decline in the importance of bank balance sheet lending has occurred both among loan segments where there is an active government affiliated securitization market (agency mortgages), as well as among loans that are ineligible for such government guarantees (loans excluding mortgages). Additionally, the loan share of bank assets has fallen from 70% in 1970 to 55% in 2023.

We develop a structural equilibrium model of credit intermediation to investigate whether advancements in securitization technology, changes in saver preferences steering away from deposits, and fluctuations in implicit subsidies or costs related to bank activities can account for the observed shifts. Technological advancements in securitization primarily contribute to changes in overall lending quantities, while evolving saver preferences explain the decline in the deposit share. Additionally, implicit costs and subsidies associated with banks elucidate the evolving composition of bank balance sheets. Collectively, these factors help explain the decrease in the overall proportion of informationally sensitive bank lending in credit intermediation. In conclusion, we examine the repercussions of these shifts on the financial sector's responsiveness to macroprudential regulation. Although elevating capital or liquidity requirements results in decreased lending in both historical (1960s) and contemporary (2020s) scenarios, the impact is less pronounced in the latter period due to the diminished role of banks in credit intermediation.

Our findings suggest a substantial transformation in the intermediation sector, carrying implications for macroprudential policy and financial regulation. First, the 2023 bank failures underscored yet again the fundamental issue of banking vulnerability rooted in the high financial leverage employed by banks (Jiang et al. 2023). The high leverage of banks is largely byproduct of safety nets embedded in insured deposit funding and ability of banks to issue money like claims (Jiang et al. 2020). The ongoing regulatory discussion including Basel III endgame aims to address this vulnerability by considering increased capital requirements for the banks. The critics of such proposals express concerns that the increase in bank capital requirements will have large adverse effects on aggregate lending and the broader economy.

In this regard, our analysis suggests that banks nowadays are much less important for provision of credit than they used to be. Our structural model indicates that increasing bank capital requirements would have only modest adverse effects on aggregate lending and it will mainly lead to reallocation of credit from bank balance sheets towards debt securities. This aligns with previous studies emphasizing that considering the modern industrial organization of the credit market, which includes the ability of intermediaries to sell loans, results in much more muted effects of capital regulation on aggregate lending (Jiang et al. 2020; Buchak et al. 2022 and 2023). Our paper demonstrates that this insight applies to the entire lending market, encompassing all loans to households and non-financial businesses, and has first order quantitative importance.

Second, and closely related, our analysis underscores the importance of considering lenders' ability to sell their loans and developments in the debt securities market when evaluating any policy targeting credit. A policy analysis that neglects these adjustment margins and solely focuses on bank balance sheet lending may lead to faulty inferences. For example, our results illustrate that the influence of bank capital requirements on aggregate lending is considerably less severe than what could be inferred solely by examining the response of bank balance sheets, especially when solely relying on bank call report data (see also Buchak et al. 2022, 2023). In this regard it is critical for any regulatory policy analysis of the credit market to collect and analyze lending data beyond that available from bank balance sheets.

More fundamentally, our paper speaks to the shifting boundaries of intermediation sector. It indicates that banks are becoming increasing less important in credit intermediation and aggregate lending. One could argue that banks may still play an important role in loan origination and monitoring. We have two observations in this regard. First, our analysis focuses on the declining importance of *bank balance sheet lending*. It is possible that banks have retained some distinct advantages in loan origination and monitoring. However, our findings indicate that there are substitutes available that have increasingly diminished the role banks play in *financing* of lending. As we discussed above this shift has substantial policy implications, signaling a reduced impact of bank deposit funding and associated capital regulations on aggregate lending. Second, in numerous credit market segments, non-banks now originate and service a substantial portion of loans—a trend that has markedly intensified over the past two decades (Buchak et al., 2018, 2022; Seru 2019). This further indicates a gradual erosion of banks' "specialness" in loan origination and servicing.

We note that the current wave of financial innovations that includes use of Artificial Intelligence (AI) and machine learning methods can further erode the remaining benefits of informationally sensitive bank balance sheet lending. This implies that regulatory policy analysis should shift its focus away from banks and towards the debt securities markets and non-bank intermediation, where a majority of lending activities currently take place.

References

Atkeson, A. G., A. d'Avernas, A. L. Eisfeldt, and P.-O. Weill, 2018, Government Guarantees and the Valuation of American Banks, *NBER Macroeconomics Annual*.

Barth, J., G. Caprio, and R. Levine, 2012, The Guardians of Finance: Making them Work for Us, Cambridge: MIT Press.

Begenau, J., and T. Landvoigt, 2022, Financial Regulation in a Quantitative Model of the Modern Banking System, *Review of Economics Studies* 89, 1748–1784.

Bianchi, J., and S. Bigio, 2022, Banks, Liquidity Management and Monetary Policy, *Econometrica* 90, 391-454.

Brunnermeier, and Y. Sannikov, 2014, A Macroeconomic Model with a Financial Sector, *American Economic Review* 104, 379-421.

Corbae D., and P. D'Erasmo, 2021, Capital Buffers in a Quantitative Model of Banking Industry Dynamics, *Econometrica* 89, 2975–3023. 7

Buchak, G., G. Matvos. T. Piskorski, and A. Seru, 2018, Fintech, Regulatory Arbitrage and the Rise of Shadow Banks, *Journal of Financial Economics* 130, 453-483.

Buchak, G., G. Matvos. T. Piskorski, and A. Seru, 2022, Beyond the Balance Sheet Model of Banking: Implications for Bank Regulation and Monetary Policy, forthcoming in the *Journal of Political Economy*.

Buchak, G., G. Matvos. T. Piskorski, and A. Seru, 2023, Aggregate Lending and Modern Financial Intermediation: Why Bank Balance Sheet Models are Miscalibrated, forthcoming in the *NBER Macroeconomics Annual.*

Caballero, R. J., E. Farhi, and P.-O. Gourinchas, 2008, An Equilibrium Model of 'Global Imbalances' and Low Interest Rates, *American Economic Review*, 358–393.

Caballero, R. J., and A. Krishnamurthy, 2009, Global Imbalances and Financial Fragility, *American Economic Review* 99, 584–588.

Corbae, D., and P. D'Erasmo, 2021, Capital Buffers in a Quantitative Model of Banking Industry Dynamics, *Econometrica* 89, 2975-3023.

Davilla, E., and I. Goldstein, 2023, Optimal Deposit Insurance, forthcoming in the *Journal of Political Economy*.

Diamond, and P. H. Dybvig, 1983, Bank Runs, Deposit Insurance, and Liquidity, *Journal of Political Economy* 91, 401-419.

Diamond, D. W., 1984, Financial Intermediation and Delegated Monitoring, *Review of Economic Studies* 51, 393-414.

Diamond, D.W., and R. G. Rajan, 2001, Liquidity Risk, Liquidity Creation, and Financial Fragility: A Theory of Banking, *Journal of Political Economy* 109, 287-327.

Egan, M., A. Hortaçsu, and G. Matvos, 2017, Deposit Competition and Financial Fragility: Evidence from the US Banking Sector, *American Economic Review* 107, 169-216.

Elenev, V., T. Landvoigt, and S. Van Nieuwerburgh, 2021, A Macroeconomic Model with Financially Constrained Producers and Intermediaries. *Econometrica* 89, 1361-1418

Gennaioli, N., A. Shleifer, and R. W. Vishny, 2013, A Model of Shadow Banking, *Journal of Finance* 68, 1331–1363.

He, Z., and A. Krishnamurthy, 2013, Intermediary Asset Pricing, *American Economic Review*, 103, 732-70.

Jiang, E., G. Matvos, T. Piskorski, and A. Seru, 2020, Banking without Deposits: Evidence from Shadow Bank Call Reports, NBER working paper.

Jiang, E., G. Matvos, T. Piskorski, and A. Seru, 2023, Monetary Tightening and U.S. Bank Fragility in 2023: Mark-to-Market Losses and Uninsured Depositor Runs?, NBER working paper.

Keys, B. J., T. Mukherjee, A. Seru, and V. Vig, 2010, Did Securitization Lead to Lax Screening? Evidence from Subprime Loans, *Quarterly Journal of Economics*, Volume 125, 307–362.

Keys, B., Piskorski, T., Seru, A., Vig, V., 2013. Mortgage financing in the housing boom and bust. In Glaeser, E., Sinai, T. (Ed.), Housing and Financial Crisis. University of Chicago Press, pp. 143-204.

Laeven, L., and F. Valencia, 2008, Systemic Banking Crises: A New Database, IMF Working Paper No. 08/224, Washington: International Monetary Fund.

Laeven, L., and F. Valencia, 2010, Resolution of Banking Crises: The Good, the Bad, and the Ugly," IMF Working Paper No. 10/44, Washington: International Monetary Fund.

Ordonez, G., 2018, Sustainable Shadow Banking, *American Economic Journal: Macroeconomics* 10, 1-25.

Peterson, M. A., and R. G. Rajan, 1994, The Benefits of Lending Relationships: Evidence from Small Business Data, *Journal of Finance* 49, 3-37.

Petersen, M. A., Rajan, R. G., 2002, Does Distance Still Matter? The Information Revolution in Small Business Lending, *Journal of Finance*, 57, 2533-2570.

Piskorski, T., Seru, A., Vig, V., 2010. Securitization and distressed loan renegotiation: Evidence from the subprime mortgage crisis. *Journal of Financial Economics 97*, 369-397.

Piskorski, T., Seru, A., Witkin, J., 2015, Asset quality misrepresentation by financial intermediaries: Evidence from the RMBS market. *Journal of Finance* 70, 2635-2678.

Rajan, R., A. Seru, and V. Vig, 2014, The Failure of Models that Predict Failure: Distance, Incentives, and Defaults, *Journal of Financial Economics* 115, 237-260.

Seru, Amit, 2019, Regulating banks in the era of fintech shadow banks, Andrew Crockett Memorial Lecture, Bank for International Settlements.

Stein, J. C., 2002, Information Production and Capital Allocation: Decentralized versus Hierarchical Firms. *Journal of Finance* 57, 1891-1921.

Xiao, Kairong, 2020. Monetary Transmission through Shadow Banks, *The Review of Financial Studies* 33, 2379-2420.

Table 1: Static Parameter 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

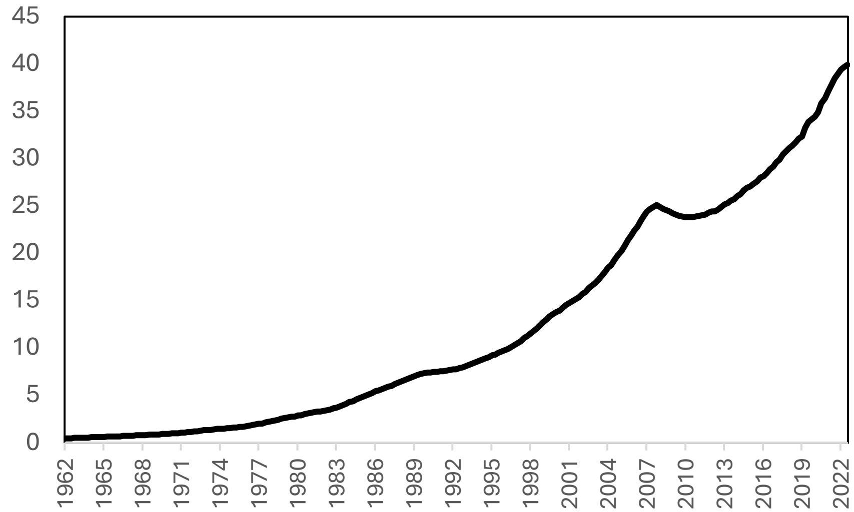
Parameter	Value	Std Error
ξ	0.04	-
ϕ	0.05	-
σ_s	7.50	(0.81)
$\underline{\sigma_b}$	8.03	(1.03)
δ_d^1	0.28	(0.10)
$\underline{\delta_d^2}$	-0.39	(0.09)
$\underline{\delta_e^1}$	0.45	(0.13)
δ_l^1	0.44	(0.08)
δ_l^2	0.18	(0.05)

Panel B: Persistent structural demand parameters

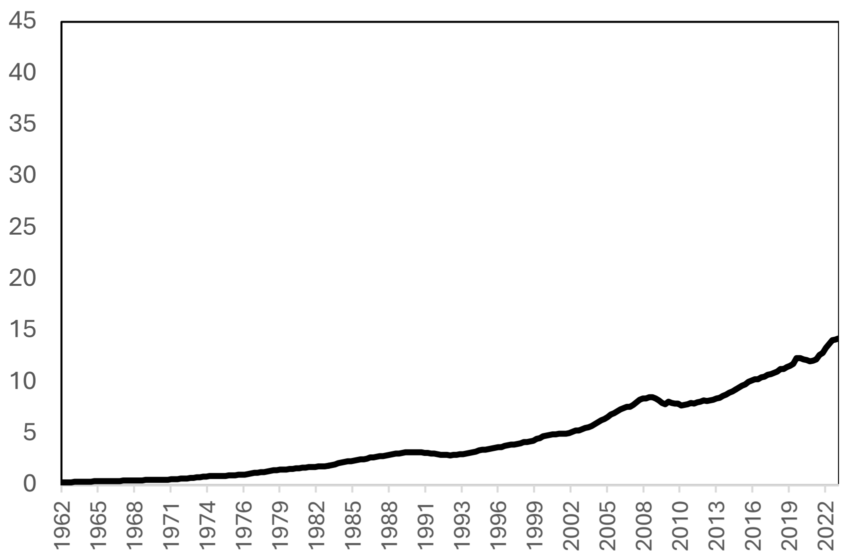
Parameter	Value
α_d	1 (normalization)
β_s	1 (normalization)
β_{Ip}	1.17
β_{Ig}	0.27

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

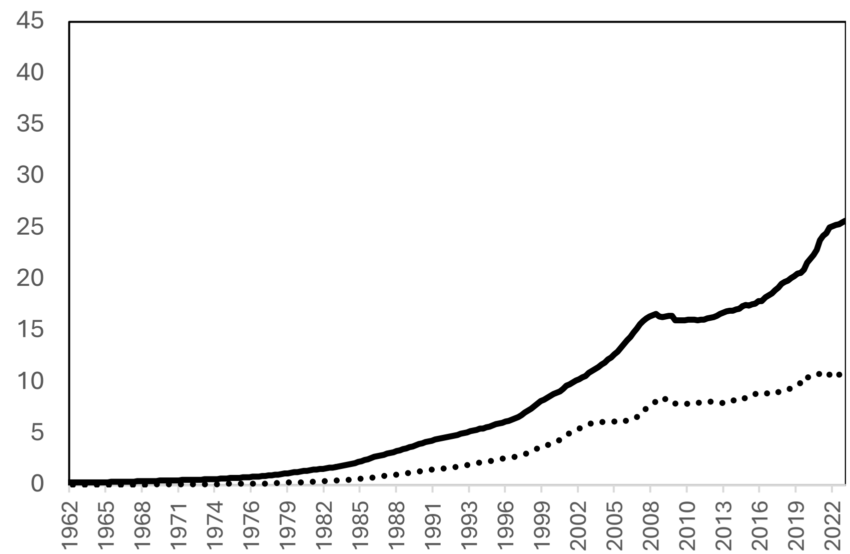
Panel (a) of this figure illustrates the evolution of the outstanding volume of total lending to households and non-financial businesses. Panel (b) and (c) break down the total lending into its two primary funding segments: informationally sensitive loans (bank balance sheet loans) displayed in panel (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



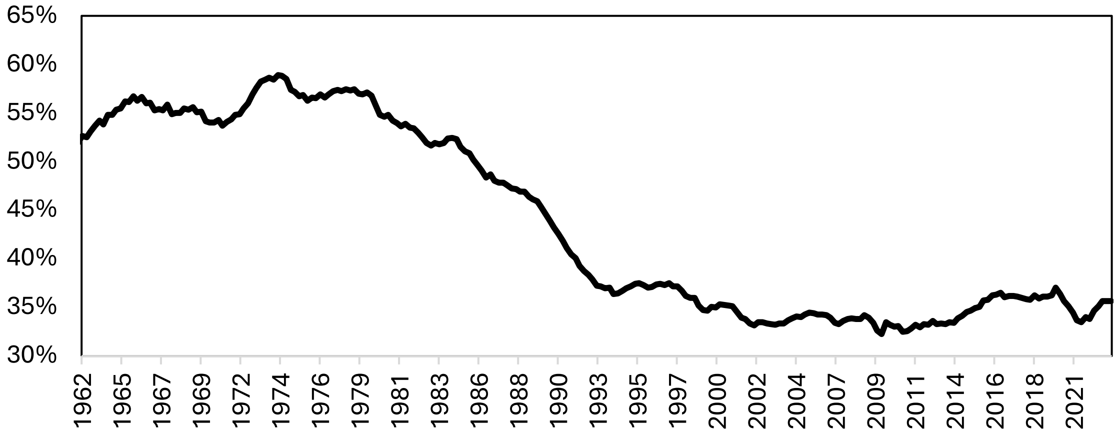
(b) Informationally sensitive lending



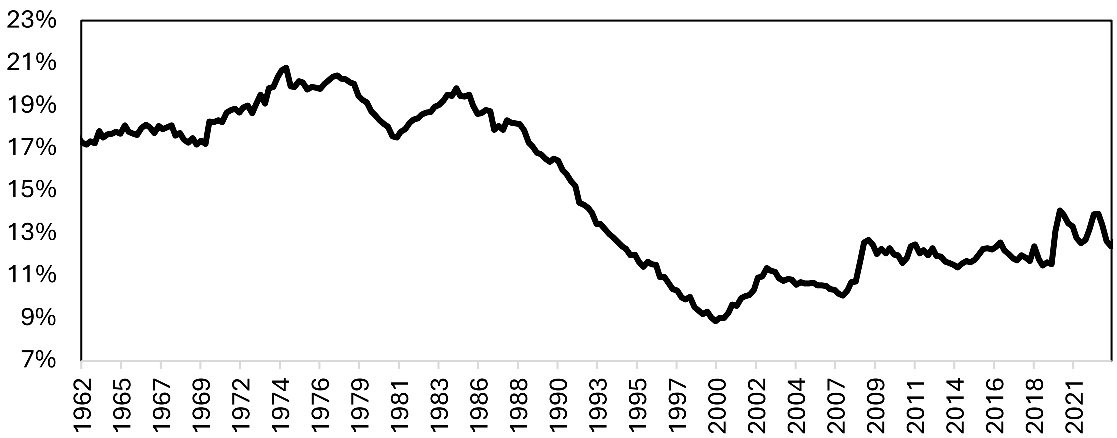
(c) Debt securities

Figure 2: Informationally Sensitive Lending, Deposit, and Wealth Share

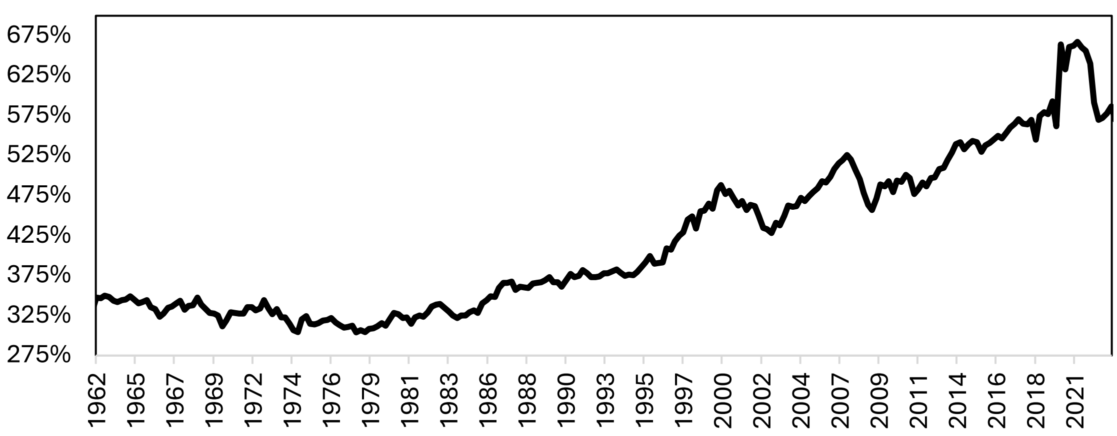
This figure illustrates the evolution of the informationally sensitive lending and ("bank balance sheet lending") deposit share. Panel (a) shows total bank balance sheet lending as a percentage of the total outstanding lending volume to households and non-financial businesses. Panel (b) shows the total 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 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



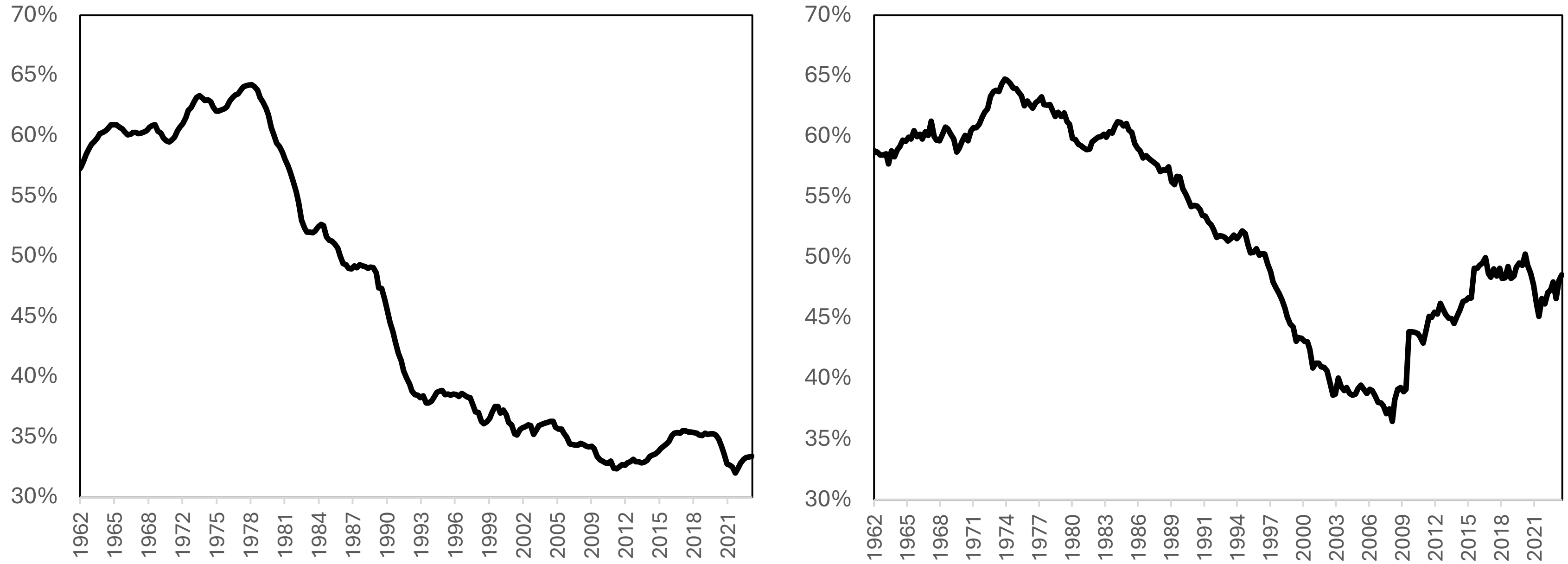
(b) Deposit share of domestic non-financial sector financial assets



(c) 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 outstanding loans, excluding mortgages. *Data Sources:* The Financial Accounts of the United States, the Federal Reserve System.

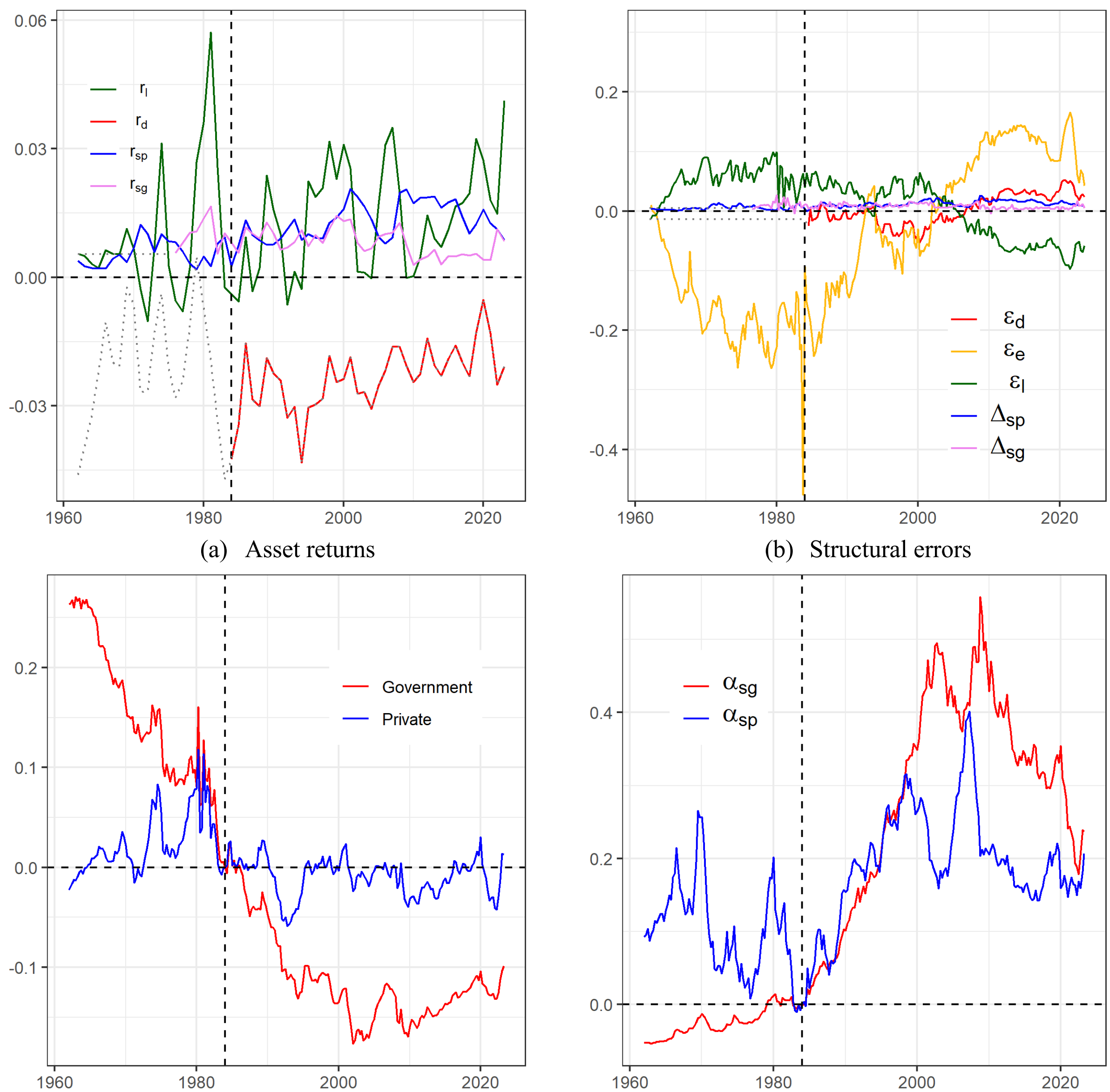


(a) Mortgages

(b) All loans ex mortgages

Figure 4: Time-varying Structural Parameters

This table shows the time-varying structural parameters. Panel (a) shows asset return spreads over the outside option. Backfilled returns using the estimated model are shown with dotted lines. Panel (b) shows the structural errors terms, which correspond to banks' regulatory costs and subsidies. Backfilled error terms are shown with dotted lines. Panel (c) shows the intermediation wedges reflecting changes in the securitization technology on government (red) and private sector (blue) informationally insensitive borrowing, relative to the normalization of 0 at 1984. A higher number means a more disadvantageous wedge. Panel (d) shows borrower preferences over various savings technologies, with the preference over the outside option savings technology normalized to 1.



(a) Asset returns

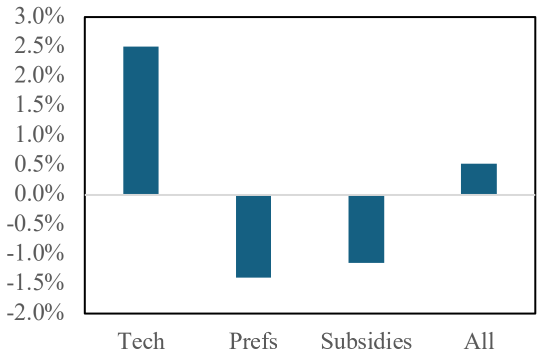
(b) Structural errors

(c) Securitization wedges

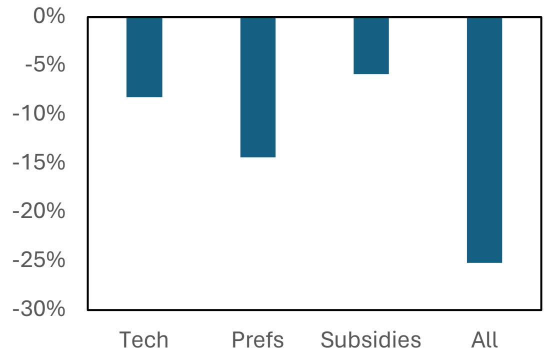
(d) Saver preferences

Figure 5: Decomposition of Changes

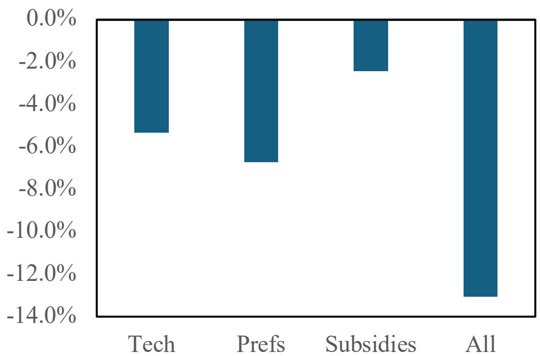
This figure decomposes changes in financial intermediation into changes in intermediation technology, saver preferences, and implicit subsidies. Each chart shows the change in the relevant measurement versus a baseline scenario in 2023 where technology, preferences, and intermediation wedges ("subsidies") are set to their 1962 level. "Tech" sets the technological intermediation parameters to the 2023 level. "Prefs" sets saver preferences to their 2023 level. "Subsidies" 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 5.3% drop in the informationally sensitive lending share.



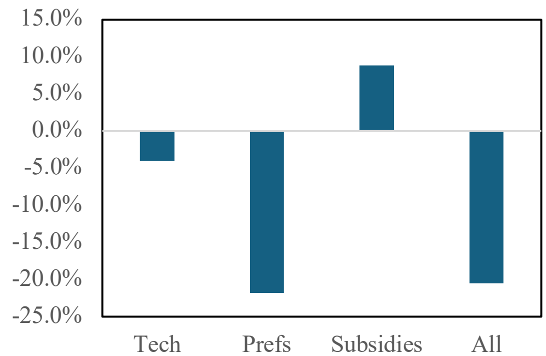
(a) % changes in total lending



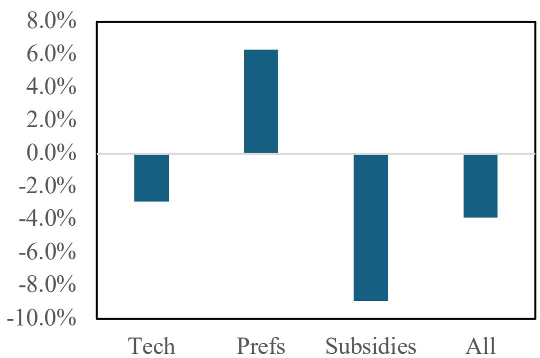
(b) % change in bank balance sheet lending



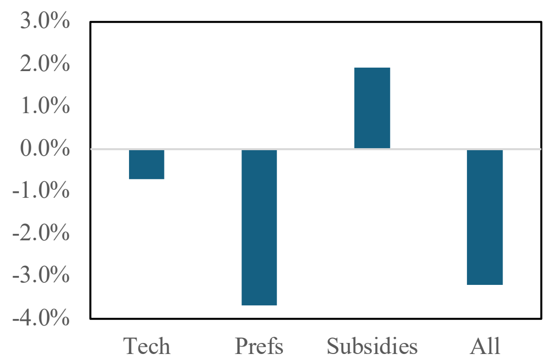
(c) change in info sensitive lending share



(d) % change in bank assets



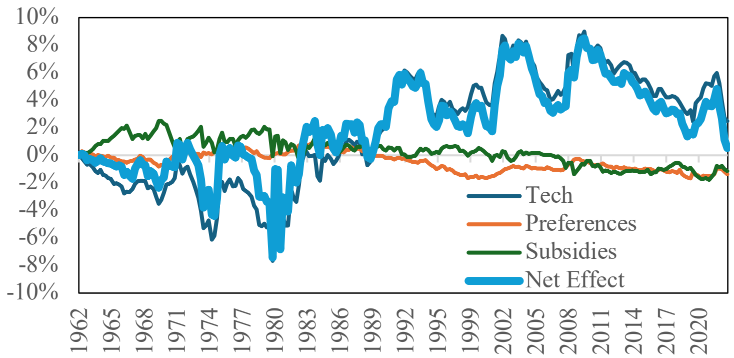
(e) change in loan share of assets



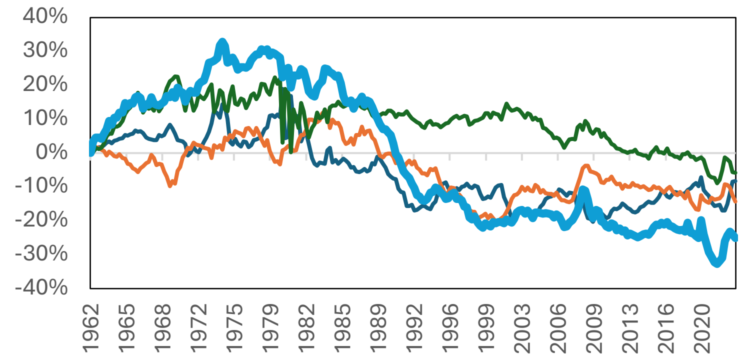
(f) change in deposit share of savings

Figure 6: Decomposition over Time

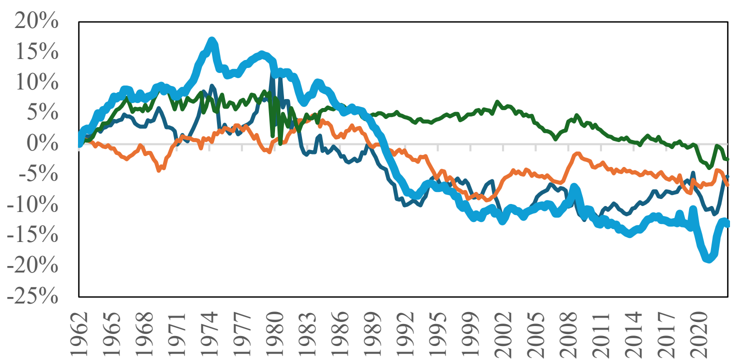
This figure shows the decomposition in changes in financial intermediation trends into changes in intermediation technology, saver preferences, and implicit subsidies over time. The exercise is the same as that presented in the previous figure. Each chart shows the change in the relevant measurement versus a baseline scenario in which technology, preferences, and subsidies are held constant at their 1963 level. "Tech" allows intermediation technology to change through time. "Preferences" allows saver preference parameters to change through time. "Subsidies" allows subsidies 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.



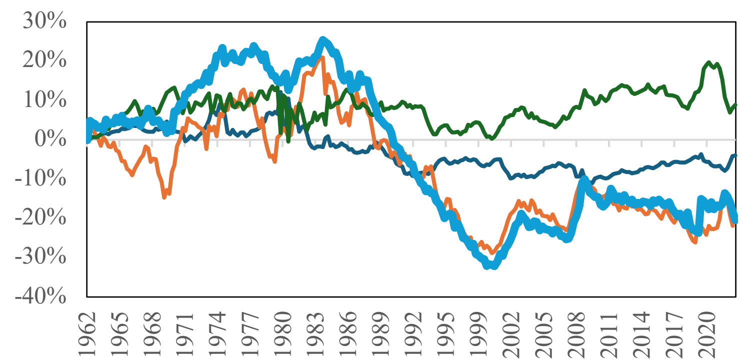
(a) % change in total lending



(b) % change in bank balance sheet lending



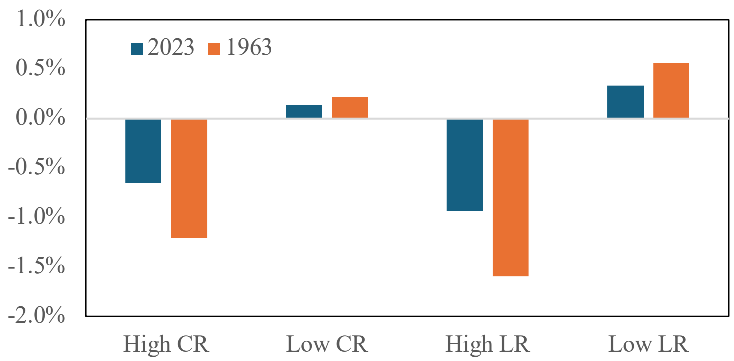
(c) change in info sensitive lending share



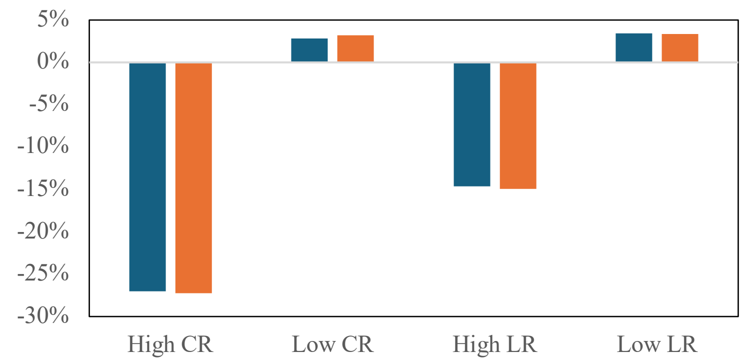
(d) % change in bank assets

Figure 7: Counterfactual Capital and Liquidity Requirements

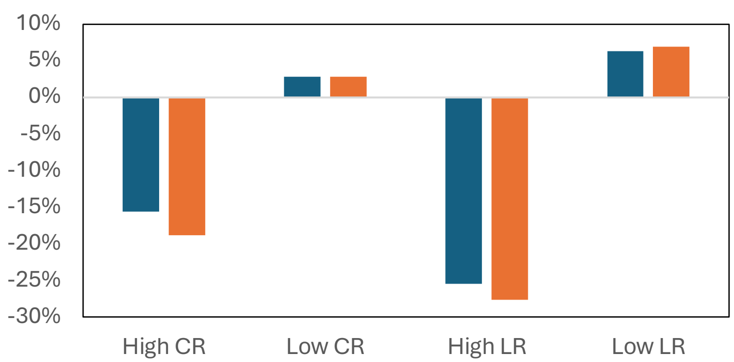
This figure shows the counterfactual impact of high (25%) and low (0%) capital requirements and high (25%) and low (0%) liquidity requirements in the actual (2023, in blue) and historical (1963, in orange) regimes using the calibrated model. Each bar shows changes versus the associated baseline, that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



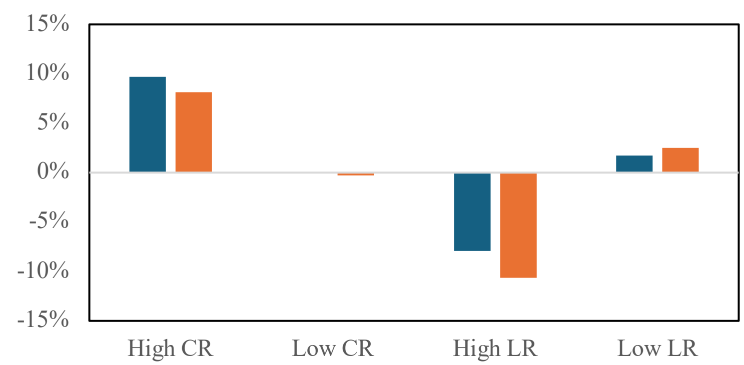
(a) % change in total lending



(b) % change in bank balance sheet lending



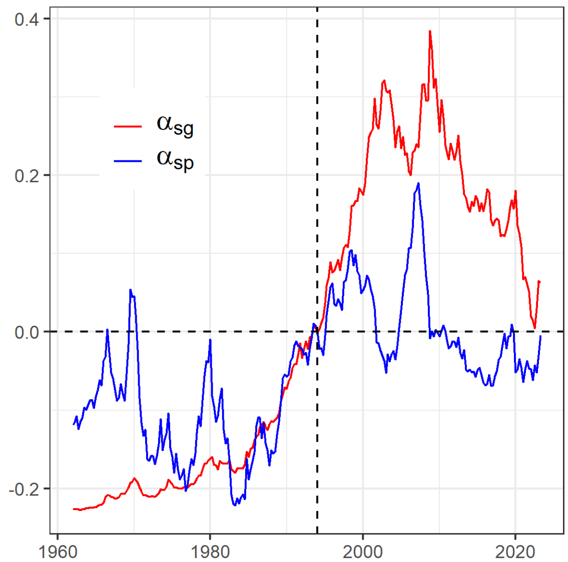
(a) % change in bank assets



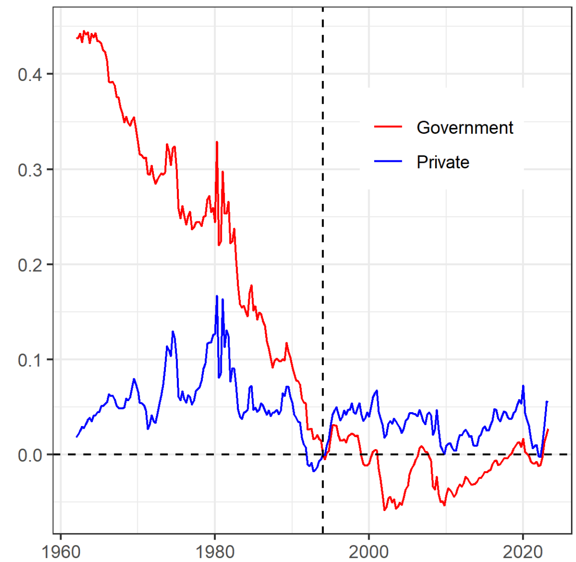
(c) change in loan share of bank assets

Appendix A.1: Robustness with Starting Year

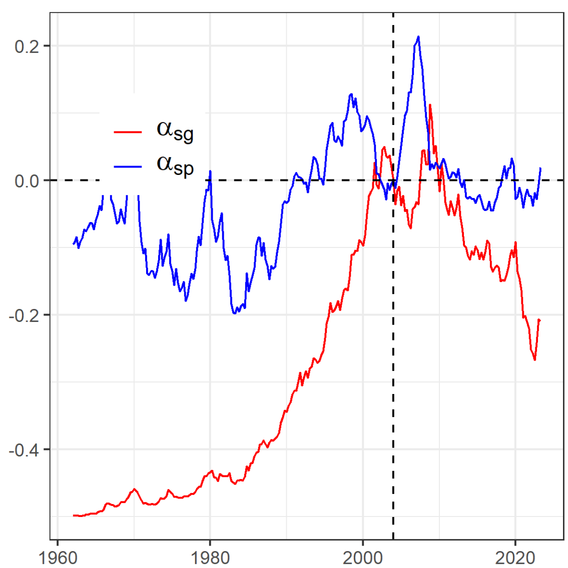
This figure shows how the time-varying demand parameters and intermediation wedges change with different base normalization years. The baseline estimation assumes that intermediation wedges are zero as of 1984, estimates the static demand parameters as of that year, and then calculates the time-varying intermediation wedges relative to that year. This robustness section shows saver demand parameters and intermediation wedges using 1994 and 2004 as base years. Panels (a) and (b) show the results for 1994. Panels (c) and (d) show the results for 2004. Panels (a) and (c) show saver demand parameters. Panels (b) and (d) show intermediation wedges.



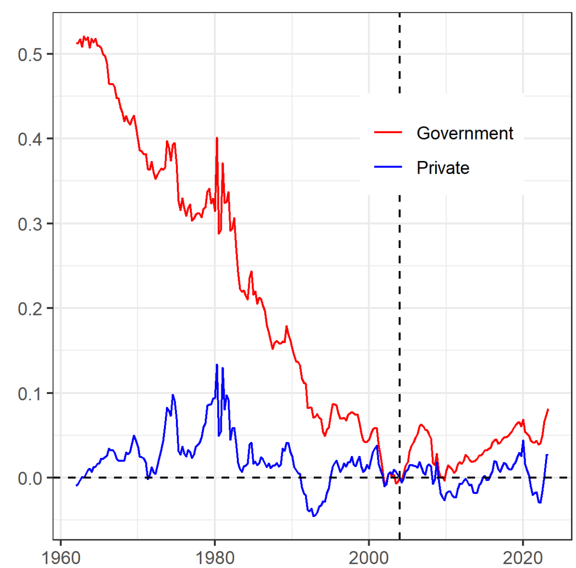
(a) Saver demand parameters, 1994 base



(b) Intermediation wedges, 1994 base



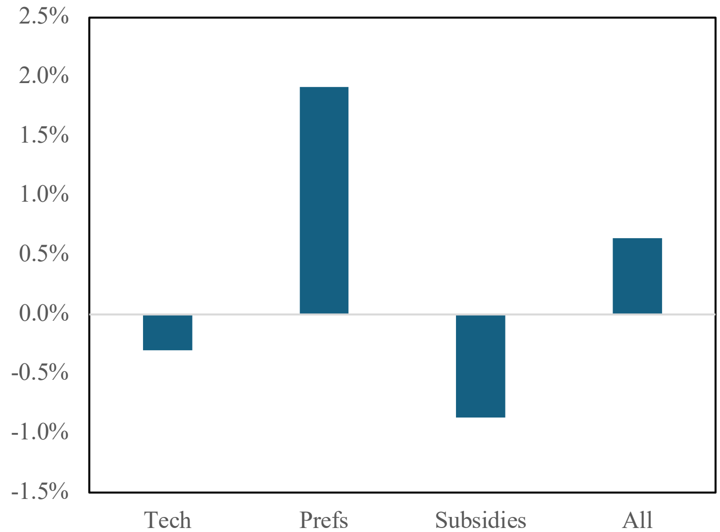
(c) Saver demand parameters, 2004 base



(d) Intermediation wedges, 2004 base

Appendix A2: Decomposition of Changes in Bank Capital Ratios

This figure decomposes changes in bank capitalization into changes in intermediation technology, 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 A3: 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 intermediation technology, saver preferences, and implicit subsidies over time. The exercise is the same as that presented in Figure 6. The chart shows the change versus a baseline scenario in which technology, preferences, and subsidies are held constant at their 1963 level. “Tech” allows intermediation technology to change through time. “Preferences” allows saver preference parameters to change through time. “Subsidies” allows bank subsidies (or costs) to change through time. “Net effect” shows the actual data.