Bailing out (Firms') Uninsured Deposits: A Quantitative Analysis

N. Aaron Pancost* and Roberto Robatto†

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Abstract

We analyze the effects of (not) bailing out uninsured deposits in a quantitative, general equilibrium model in which firms' deposits are valued for their safety and uninsured deposits might be bailed out by the government. We calibrate our model around two novel facts: first, firms and other non-household depositors hold more uninsured deposits than households, and second, uninsured depositors have been bailed out in 94% of bank failures. Our results suggest negligible real effects of not bailing out uninsured deposits in 2023: although riskier deposits reduce firms' ability to engage in production, they also induce a substitution away from deposits and towards investment in productive capital, increasing employment. We also find roughly zero real effects of moving to a 100% deposit insurance regime.

Keywords: uninsured deposits, bailouts, firms' investments, idiosyncratic risk, safe assets
JEL Classifications: E20, G21, G32

*University of Texas at Austin, McCombs School of Business. Email address: aaron.pancost@mccombs.utexas.edu

†University of Wisconsin-Madison, Wisconsin School of Business. Email address: robatto@wisc.edu

1 Introduction

The failure of Silicon Valley Bank (SVB), Signature Bank (Signature), and First Republic Bank (First Republic) has turned the spotlight back on the resilience of the financial sector, the design of banking regulation, and the effects of bank failures on the economy. Much has been made of the government's decision to ensure that depositors suffer no losses from these failures, even on their uninsured deposits. Although in the case of SVB and Signature, this bailout was achieved via a "systemic risk exception," the complete coverage of uninsured deposits is actually quite common. Out of more than 500 bank failures after the collapse of Lehman Brothers in September 2008, in which the Deposit Insurance Fund bore losses, the FDIC imposed losses on uninsured deposits only 30 times, that is, for 6% of the failures.

In this paper, we analyze how bank failures and the bailout of uninsured deposits affect macroeconomic outcomes, focusing in particular on firms' reactions. We motivate the focus on firms' outcomes with two observations. First, the two largest banks that failed in 2023—SVB and First Republic—catered their deposits mostly to firms, rather than households, and the Federal Reserve stated that bailing out the uninsured deposits at SVB was meant to prevent many disruptions, including the objective to "minimize any impact on businesses [...] and the economy."[1] Second, we show that the other main set of depositors in the U.S.—households—hold fewer uninsured deposits than firms and other non-household depositors, both as share of their own holdings and as a fraction of total uninsured deposits.

Specifically, we investigate how firms and the macroeconomy would have responded if the government had *not* bailed out uninsured depositors during the banking crisis of 2023. We focus on the implications that arise from the role of bank deposits as "safe assets" (Gorton and Pennacchi, 1990; Dang et al., 2017). Because bailouts affect the riskiness of deposits, the safety benefits of such assets influence both firms' production decisions and broader economic outcomes.

To answer this question, we calibrate a quantitative general equilibrium model of financial regulation that builds on a growing literature (Van den Heuvel, 2008; Davydiuk, 2019; Begenau, 2020; Begenau and Landvoigt, 2022; Corbae and D'Erasmo, 2021; Elenev, Landvoigt

[1] See https://www.federalreserve.gov/newsevents/pressreleases/monetary20230312a.htm.

and Van Nieuwerburgh, 2021; Dempsey, 2022). A common feature of these models, which we also incorporate in ours, is that deposit insurance and other government guarantees interact with banks' limited liability, inducing banks to grow too large and to take on too much risk. We extend the model of Pancost and Robatto (2023)—the only quantitative general equilibrium model of banking regulation incorporating firms' deposit demand—by introducing a deposit insurance limit, as well as a chance that uninsured deposits will be bailed out, that is, made whole when banks fail. We model our counterfactual as an unexpected reduction in the probability that the government bails out uninsured deposits, that occurs at the same time as a large shock to the rate of bank failures.

Our main result is that financial frictions that prevent firms from quickly adjusting their balance sheet and financial position (Jermann and Quadrini, 2012) counteract the negative impact of a reduction in the bailout of uninsured deposits. To understand this result, consider the extreme case where firms simply cannot distribute dividends or repay their debts for some time after a policy change. The reduction in the bailout probability makes deposits riskier, which in turn increases the attractiveness of alternative uses of funds. However, because of the friction, the only alternative is to increase investment in physical capital, and with it, labor demand. Quantitatively, the tension is between the reduction in economic activity triggered by the lower safety of deposits and the effects of the financial frictions that prevent firms from quickly adjusting their balance sheet, thereby increasing investments and employment. In our quantitative assessment, these forces largely offset each other, resulting in a negligible impact on the economy.

We begin our analysis by documenting three novel stylized facts about bank failures, the bailout of uninsured deposits, and firms' and households' holdings of insured and uninsured deposits. First, we show that the FDIC resolution methods lead to consistent bailouts of uninsured depositors—and more so after 2008—even though the FDIC is required by law to resolve failed banks using a "least-cost approach." On average, 0.64% of banks failed every year between 1986 and 2008, but the default rate of banks in which uninsured deposits experienced losses is only 0.19%. The gap widens after 2008: the default rate is 0.47%, and the default rate with losses on uninsured deposits is a mere 0.03%. In other words, uninsured deposits have been bailed out in 70% of bank failures between 1986 and 2008, and in 94% after 2008. Second, firms and other non-household depositors make up the vast majority of aggregate uninsured deposits, mostly because uninsured deposits make up a much higher fraction of their deposit holdings. That is, while only 21% of households' deposits are on average uninsured (as of 2019), 56% of the deposits of firms and other non-household depositors are uninsured. We also show that the share of uninsured deposits has been increasing over time for all depositors, and more so for firms and non-households. Finally, we document the various methods by which depositors can increase their insurance coverage beyond the $250,000 FDIC limit and show that households mainly do so by holding deposits in multiple banks, insuring about $350,000 per person on average.

We then present the model. Firms face idiosyncratic risk, which induces volatility in their cash flows and the value of their productive assets. Deposits held by firms are beneficial because they reduce such volatility, mitigating the negative effects of the idiosyncratic risk. In the event of a bank failure, firms know that their insured deposits are fully protected, and they are also aware that uninsured deposits are fully repaid with high probability.

In our quantitative assessment, we simulate the 2023 banking crisis using a shock that results in a sharp increase in bank failures, and we perform our counterfactual by adding a policy change that reduces the probability that uninsured deposits are bailed out. We perform this experiment in two versions of the model. In a version with no frictions that prevent firms from quickly adjusting their balance sheets, large negative effects arise: output drops on impact by 0.5%, investment by 2.5%, and employment by 0.7%. In the full model with financial frictions calibrated to match the data, however, the effects on output are an order of magnitude smaller, and investments and employment actually increase slightly. Overall, the full model displays a response that is economically negligible and effectively nil.

We also use the model to analyze the real effects of moving to a 100% deposit insurance regime. We find that given the extremely low bank default rate with losses on uninsured deposits, deposits in the U.S. are effectively already almost 100% insured, and that insuring the remaining small fraction of deposits produces almost no real effects. We do find a small financial re-allocation effect: after the change, a small fraction of deposits move from being held by households to being held by firms—the total stock of deposits is nearly unchanged. This effect is driven by the fact that, since before the change firms hold more uninsured deposits than households, they value the move to full insurance more than households do, and increase their deposit demand in response.

Although our current model does not allow firms to invest in financial assets other than deposits, we conjecture that including such assets would not substantially alter our results. For example, firms and households might also hold Treasury securities, in addition to deposits, to satisfy their demand for safe and liquid assets. However, so long as the supply of Treasuries does not increase in response to the shocks and other policy changes, all agents in the economy that hold deposits will likely increase their demand for Treasuries. The resulting decrease in Treasury yields implies only small effects on agents' holdings of these assets. Hence, investing in physical capital will likely remain the main alternative use of funds for firms, and we expect little differences in our quantitative results.

Our model can be used to do more than explore the counterfactual implications of forcing uninsured depositors to realize more losses. First, the model can be used to compute the welfare effects of the reduction in the bailout probability, by comparing the two resulting steady-states and the transition from one to the other. Since the real impact of the policy change is limited, it could very well be beneficial if it reduces banks' moral hazard generated by government guarantees and limited liability. More generally, our model can be used in a quantitative analysis of the optimal degree of deposit insurance, both in terms of the deposit insurance limit and the probability that uninsured deposits are bailed out.

Our work is closely related to Dávila and Goldstein (2023), who provide quantitative guidance for the determination of the degree of deposit insurance. There are, however, several important differences. We incorporate firms' deposits and the possibility of bailouts of uninsured deposits, and we frame the analysis in a quantitative, dynamic setting that gives rise to important novel distinctions between short- and long-run effects of policy changes. In addition, Dávila and Goldstein (2023) focus on bank runs in the tradition of Diamond and Dybvig (1983), whereas bank failures in our model are drive by fundamentals as in Allen and Gale (1998) and we focus on the role of deposits as safe assets.

Our paper is part of a growing literature related to the U.S. banking crisis of 2023. Benmelech, Yang and Zator (2023) show that bank branch density (i.e., the ratio of bank branches to deposits) has significantly declined over the past decade, and stock prices of banks with lower branch density declined more after the collape of SVB and First Republic, as such banks experienced larger outflows of uninsured deposits. Chang, Cheng and Hong (2023) provide some stylized facts about the cross-section of banks' holdings of uninsured deposits and explain such facts with a novel theory that relates firms' holdings of uninsured deposits with banks' risk-taking behavior. Jiang et al. (2023) show that banks' mark-to-market losses triggered by increase in interest rates in 2022 are large and expose many banks to the risk of runs by uninsured depositors. Relatedly, Orame, Ramcharan and Robatto (2023) note that the balance-sheet regulations that allow banks to avoid marking to market their securities were introduced for macroprudential reasons, are akin to a reduction in capital requirements, and have a large impact on the pass-through of monetary policy to bank lending. Allen et al. (2023*a*) build on Allen et al. (2023*b*) and estimate resolution costs for the FDIC of over $200 billion if the banks identified by Jiang et al. (2023) were to fail, which is well in excess of its fund. Cookson et al. (2023) investigates social media's role in the run on SVB and the subsequent distress of other regional banks. Drechsler et al. (2023) show that the uninsured deposit franchise poses a risk management dilemma, as a bank cannot simultaneously hedge its interest rate and liquidity risk exposures.

2 Deposit insurance in the U.S.: institutional details and stylized facts

We begin by providing some institutional details and novel facts about the FDIC insurance of bank deposits and resolution of failed banks. We summarize the evidence that we provide in three main stylized facts:

- Fact 1. Uninsured deposits are usually fully bailed out, especially since 2008.
  - Out of more than 500 banks that failed between October 2008 and 2022, the FDIC has used a resolution method that imposes losses on uninsured deposits only 30 times, or for 6% of the failures, down from 30% of failures in the period 1986–2008.

- Fact 2: Firms and other non-household depositors hold more uninsured deposits than households.
  - Firms and other non-household depositors held 78% of the stock of uninsured deposits in 2019, while household held only 22%.
  - Relative to their own holdings, the share of insured deposits in 2019 was 44% for firms and other non-household depositors, down from 77% in 1992. For households, the share was 79% in 2019, down from 89% in 1992.
- Fact 3. Households exploit FDIC rules to increase their effective deposit insurance limit.
  - In the last year of our sample (i.e., 2019), individuals with large holdings of deposits had on average almost $350,000 in insured deposits, despite the $250,000 FDIC insurance limit, mainly by holding multiple accounts at different banks.

The remainder of this section considers each of these facts in turn.

2.1 Fact 1: Bailing out Uninsured Deposits

Despite the attention paid to the recent wave of depositor bailouts, uninsured depositors rarely realize losses when their banks fail, especially since the 2008 financial crisis. To understand why, we must consider the FDIC's resolution process for failed banks, and how it has changed over time.

When a bank fails, it is taken over by the FDIC, which then begins the resolution process. Typically, the FDIC sells the bank to another financial institution or liquidates it by selling the assets and repaying depositors and other liability holders. If a failed bank is sold, the sale could include all or a fraction of the assets, all the deposits (including the uninsured ones) or only the insured deposits, and a possible agreement in which the FDIC shares losses on certain assets with the acquirer.

The resolution process is represented in Figure 1. The FDIC collects bids from financial institutions that might be interested in acquiring all or part of a failed bank, and then chooses the bid that imposes the least cost to the FDIC. If all the bids entail costs for the

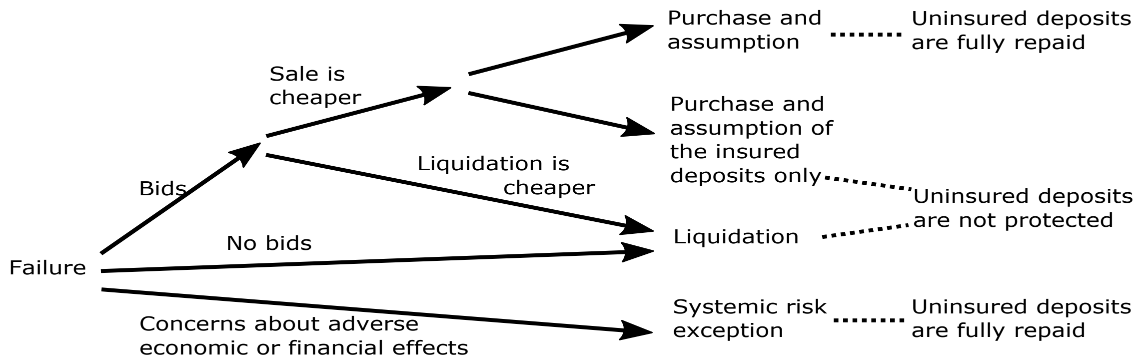


Figure 1. Resolution process of failed banks.
The figure shows how the FDIC resolves failed banks. Liquidation can be implemented in various ways such as deposit payouts (in which the FDIC pays the depositors directly), insured deposit transfer (in which a bank serves as a paying agent for the FDIC), or through the setup of a deposit insurance national bank.

FDIC that exceed the cost associated with liquidating the bank, the FDIC is required by law to choose the liquidation option, as it imposes fewer costs for taxpayers. Liquidation is also chosen if no institution submits bids to acquire the failed bank.

The resolution method determines whether uninsured deposits are fully repaid or experience losses. Uninsured deposits experience losses in two cases: if a failed bank is resolved with a sale that includes the transfer of only insured deposits—what is referred to as a purchase and assumption of insured deposits only—or if it is liquidated.[2] If instead the failed bank is resolved with a sale that includes the transfer of the uninsured deposits—simply referred to as a purchase and assumption—the uninsured deposits do not experience losses. Additionally, even if the bank is not sold, the FDIC can fully protect uninsured deposits if the systemic risk exception is invoked, as it was the case for SVB and Signature.

Figure 2 shows that resolution methods that impose losses on uninsured deposits are used infrequently. The figure plots the deposit-weighted bank default rate over time, distinguishing between three types of resolutions: banks that are liquidated (black area), those that are sold but in which only insured deposits have been acquired (in gray), and those that are resolved with a full bailout of uninsured deposits (dotted area). The overall default rate was

[2]In a sale of a failed bank that includes the transfer of the insured deposits only, the deposits transferred to the acquirer are limited to those that are insured; for the uninsured portion, account holders receive a claim on future dividends financed with the sales of the assets of the bank. We thank the FDIC staff in the Division of Resolutions & Receiverships for a useful conversation about these procedures.

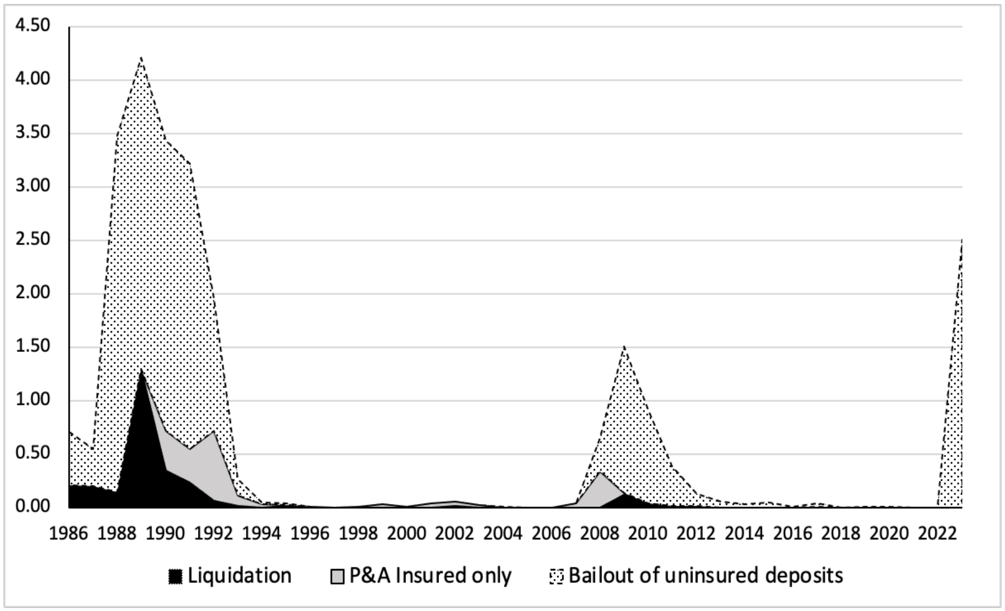


Figure 2. Default rate by resolution
The figure plots the bank default rate between 1986 and 2023 weighted by deposits, distinguishing between liquidation (black area), purchase and assumption of insured deposits only (gray area), and resolutions in which uninsured deposits were bailed out (dotted area).

very high during the Savings and Loan crisis, the 2008 financial crisis, and the 2023 crisis. In the years between these crises, the default rate is close to zero.

Figure 2 also shows that over time, the FDIC has changed its usage of various resolution methods, increasing the fraction of uninsured deposits that are bailed out. During the Savings and Loan crisis, the FDIC resolved a substantial fraction of banks with a method that imposes losses on uninsured deposits: either liquidation (until about 1990) or purchase and assumption limited to insured deposits only (until about 1992). After that, the FDIC substantially reduced its use of liquidation, because liquidation imposes strain on the operation capacity of the FDIC and, thus, is considerably costly (FDIC, 2017). Purchase and assumptions that involve only insured deposits were still used in many cases between the early 1990s and 2008, but their usage has declined to nearly zero after 2008.

Table 1 reports some sub-sample statistics from the data. We focus on the years between 1986 and 2022, as we will focus on this time period to calibrate the model of Section 3, and we also provide data for the first two quarter of 2023 for completeness.[3] Panel A of Table 1

[3]We could extend some of our calculations back to 1980, but not before, because many earlier failures were recorded in a way that does not distinguish whether uninsured depositors experienced losses at failed

Panel A: Yearly default rate, %						
	Unweighted		Weighted by assets		Weighted by deposits	
	All banks	w/losses on uninsured	All banks	w/losses on uninsured	All banks	w/losses on uninsured
1986-2008q3	0.64	0.19	0.70	0.16	0.81	0.20
2008q4-2022	0.47	0.03	0.17	0.01	0.23	0.01
1986-2022	0.58	0.13	0.49	0.10	0.59	0.13
2023*	0.06	0.00	2.25	0.00	2.51	0.00

Panel B: Yearly default rate, banks with losses on uninsured deposits as a ratio of all banks, %			
	Unweighted	Weighted by assets	Weighted by deposits
1986-2008q3	29.7	22.6	24.4
2008q4-2022	5.7	5.6	6.0
1986-2022	22.1	20.4	21.5
2023	0.00	0.00	0.00

Table 1. Bank default rates

Panel A displays the yearly average default rate; Panel B displays the ratio of the default rate conditional on uninsured deposits experiencing losses, relative to the unconditional default rate. Assets and deposits are as of the last Call Report before the failure date. *: 2023 default rates are computed using data for quarter 1 and 2 only, and assuming no failures in quarter 3 and 4. See the Appendix for details about the sample construction.

shows that, between 1986 and 2022, 0.58% of banks failed every year on average. If one weights the default by assets or deposits, the default rate is 0.49% or 0.59%, respectively.

The bailout of uninsured deposits at failed banks is extremely common. The default rate conditional on uninsured deposits experiencing a loss is 0.13% for the entire sample, which is much smaller than the 0.58% unconditional default rate. When weighting by assets or deposits, the figure is similar at 0.10% and 0.13%, respectively. Panel B of Table 1 computes the ratio of the default rates (i.e., the default rate conditional on losses on uninsured deposits, relative to the unconditional default rate). For the full sample, this ratio is 22.1%, and a

banks or not. The appendix provides more detail about the sample construction.

nearly identical result is obtained when weighting by assets or deposits.

A striking fact from both Table 1 and Figure 2 is that the bailout of uninsured deposits increased dramatically with the onset of the 2008 crisis. We divide our sample choosing the end of the third quarter of 2008 as the cutoff, which corresponds approximately to the failure of Lehman Brothers. In the pre-Lehman period (i.e., between 1986 and the third quarter of 2008), the yearly bank default rate conditional on uninsured deposits experiencing a loss was 0.19%, but this figure drops to 0.03% in the post-Lehman period (i.e., between the fourth quarter of 2008 and 2022). The results are nearly identical if one weights default rates by assets or deposits. Panel B shows that the ratio of failures in which uninsured deposits experienced a loss dropped from from about one-quarter to about 6%.

It is an open question *why* the FDIC has gradually stopped imposing losses on uninsured deposits. Liquidating a failed bank by selling its assets is typically costly because the FDIC is not as efficient as the private sector at managing and liquidating banks' assets—especially as bank failures tend to be clustered in crisis times, in which liquidation of many banks would require the FDIC to quickly expand its staff. Hence, the resolution of failed banks has mostly been conducted through sales to other financial institutions, especially since 2008. Most sales take the form of a purchase and assumption that includes the uninsured deposits. That is, the sale of a failed bank that includes only insured deposits is used infrequently.

However, while it is understandable that the FDIC is averse to liquidating failed banks, the question remains why the purchase of a failed bank by another bank often includes full payment on uninsured deposits. With such a transaction, either the acquiring bank or the FDIC must assume the associated losses on the bailout of uninsured deposits. A complete analysis of this issue is outside the scope of this paper, but we briefly discuss some possible conjectures. Banks that bid to acquire a failed institutions could bid only for the insured deposits, but in practice they do so very infrequently or higher bids are submitted to purchase uninsured deposits. If acquiring banks find it profitable to bail out the uninsured deposits, the value generated by such deposits must be big enough to offset the bailout costs. Uninsured depositors are often wealthy households or firms, which might generate large revenues through other products. Alternatively, there could be synergies between acquiring both assets and uninsured deposits of a failed bank.[4] Another possibility is that sales of failed banks are designed by the FDIC in a way that reduces the likelihood of receiving bids in which the acquirer is interested only in the insured deposits—for instance, by focusing on potential buyers that are more likely to purchase all the liabilities.

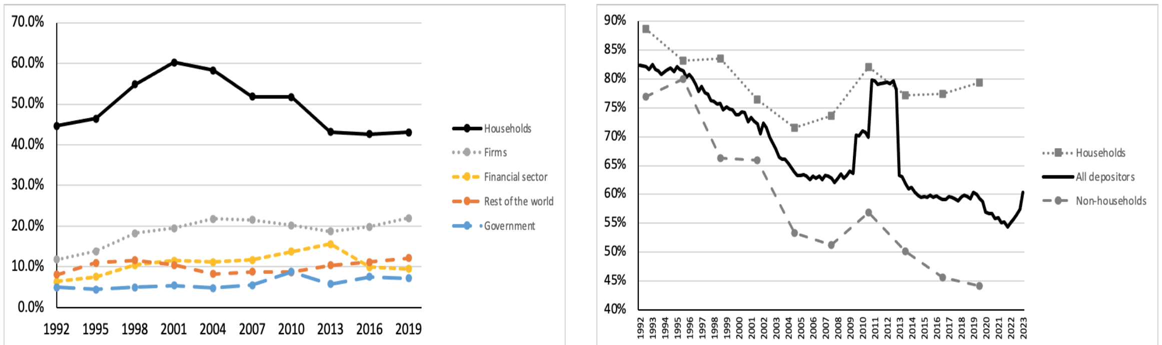
2.2 Fact 2: Non-Households Hold Most Uninsured Deposits

Our second stylized fact is that the majority of uninsured deposits are held by non-household depositors, including firms. To establish this fact, we use data from the Flow of Funds and the Survey of Consumer Finance (SCF). The design of the SCF in particular allows us to compute the fraction of households' deposits that are insured and uninsured, as we explain below. For the other classes of depositors, we cannot separate firms out from other non-household deposit holders (which include financial institutions, foreigners, and governments). Furthermore, because there are no systematic micro-level data that can be used to precisely disentangle deposits into insured and uninsured, we estimate the insurance coverage for firms and other non-household depositors from aggregate data, subtracting out total insured deposits held by households as computed from the SCF.

Among households, uninsured deposits are typically held by the wealthy, and the SCF is well-suited to analyze this group because it includes not only a random sample of U.S. households but also a second sample of wealthy households identified on the basis of tax returns, as well as weights to combine the two samples (see e.g. Heathcote, Perri and Violante, 2010). For each household surveyed by the SCF, we use account-level data, including dollars amounts, the identity of the bank, and of the owner(s) of each account. Because the FDIC insurance coverage depends on amount, bank, and owner(s) (see Section 2.3 below for details), the SCF data allows us to estimate the amount of households' deposits that are insured and those that are uninsured.

Although total deposits are held in roughly equal proportions by household and non-household depositors, the latter hold a significantly higher fraction of uninsured deposits. The left panel of Figure 3 plots the evolution of the deposits held by households, firms,

[4] For instance, if a bank has made loans to firms and such firms hold uninsured deposits, imposing losses on the uninsured deposits would hinder firms' ability to repay the loans.



(a) Ownership of deposits (b) Insured deposits, percent

Figure 3. Insured and uninsured deposits
The left panel plots the holdings of deposits of households, firms, financial institutions, foreigners, and governments. For each group, the figure reports the holdings as a fraction of deposits at domestic branches of FDIC-insured banks. The right panel plots the holdings of uninsured deposits for all depositors (solid line), households (dotted line), and non-households (dashed line), as a percent of the total holdings of the respective group.

financial institutions, foreigners, as well as federal, state, and local governments, as a share of deposits at domestic branches of FDIC-insured banks, between 1992 and 2019.[5] Households typically hold between 40% and 60% of the total stock of deposits; the next largest group of depositors are firms (i.e., nonfinancial businesses); their deposit holdings have nearly doubled from 12% in 1992 to 22% in 2019, in line with the increase in the holdings of cash-like assets documented by Bates, Kahle and Stulz (2009). Other non-household depositors, such as financial institutions, foreigners, and government entities together make up a substantial share of non-household deposits, though (apart from the financial sector until 2013) their share of the total is relatively stable over time.[6]

The right panel of Figure 3 shows the fraction of deposits that are insured. This fraction has trended steeply downwards over time, especially for firms and other non-household depositors. The black solid line plots the fraction of all deposits that are insured, and is based on aggregate data provided by the FDIC. Insured deposits dropped from about 82% in 1992

[5]We exclude deposits held at foreign branches, which are not insured. We start our sample in 1992 because detailed SCF data that allows us to compute households' insured and uninsured deposits are not available in previous waves of the SCF, and we end it in 2019 because it is the last available year in which SCF data are available.

[6]Other account holders (not shown) include nonprofit institutions, with holdings stable at about 4% throughout the entire sample, and domestic hedge funds, for which data are available only since the end of 2012, and whose holdings have been 1% or less.

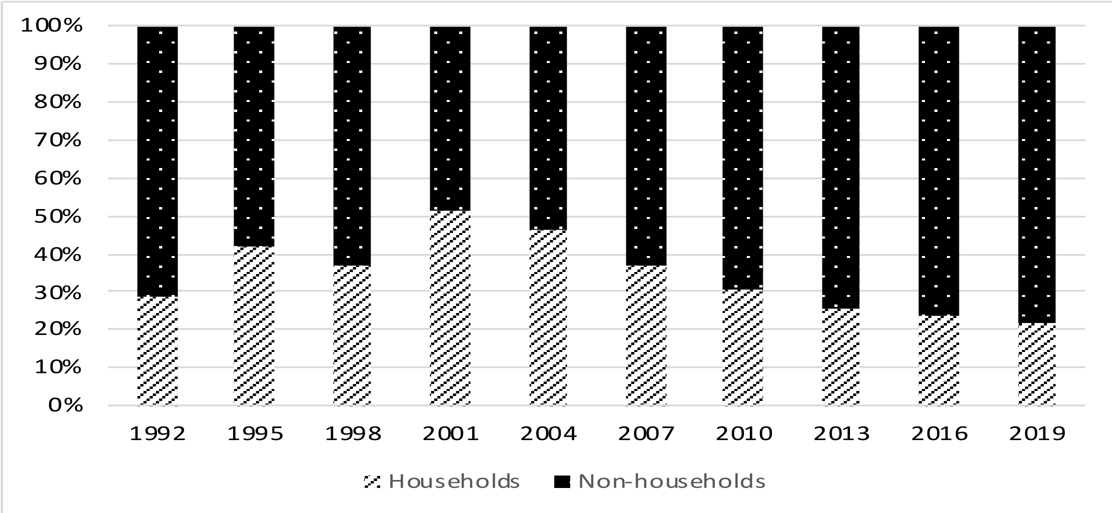


Figure 4. Uninsured deposits by owner
The figure plots the fraction of total uninsured deposits that are held by household and non-household depositors.

to 60% in 2023.[7] The households' share of insured deposits was 79% in 2019, down from 89% in 1992. For firms and other non-household depositors, the share of insured deposits was only 44% in 2019, down from 77% in 1992.[8]

Figure 4 shows that firms and other non-household depositors hold most of the uninsured deposits. Households held about 30% of all uninsured deposits in 1992. The figure increased to about 50% in 2001, as households' share of total deposits increased, and then decreased after. As of 2019, households' total holdings of uninsured deposits were only 22% of the stock of uninsured deposits, despite total households' holdings of deposits was 43%. Hence, firms and other non-household depositors held most of the uninsured deposits. Even if we were to restrict attention to only firms and households, our estimates imply that firms hold most of the uninsured deposits, that is, 58% of the uninsured deposits jointly held by firms and households.

[7] The increase in the fraction of insured deposits around the time of 2008 financial crisis is related to the increase of the deposit insurance limit from $100,000 to $250,000 and the government interventions that provided temporary insurance to deposits of any amount on certain transaction accounts until the end of 2012.

[8] We do not have data to provide a further breakdown of the holdings of uninsured deposits of firms, governments, financial institutions, and foreigners. However, as noted in Section 2.3, governments can insure up to twice as much as firms, suggesting that the share of uninsured deposits for governments might be lower than that of other non-household depositors and, thus, that of firms might be higher.

2.3 Fact 3: Effective FDIC Deposit Insurance Limit

Our third stylized fact is that even though the deposit insurance limit is $250,000, households with large deposit holdings are able to achieve significantly more coverage, primarily through holding accounts at multiple banks. Although it is possible for households—though not, in general, firms—to increase their deposit insurance coverage at a single bank by exploiting FDIC rules, it appears that on average they do not do so. To establish these facts, we describe the actual FDIC rules regarding deposit insurance coverage, which are somewhat more complex than a flat coverage limit at $250,000.

The FDIC provides insurance up to $250,000 *per depositor*, *per FDIC-insured bank*, and *per ownership category*. The qualifiers *per depositor* and *per FDIC-insured bank* are rather straightforward. If a bank account has multiple owners, the insurance limit is applied per depositor. For instance, a married couple that jointly owns a single deposit account at a bank is insured up to $500,000 (i.e., $250,000 per depositor). Similarly, the $250,000 is computed per bank, so that a single depositor with accounts at two banks can insure $500,000 by splitting her deposits across both banks.

The qualifier *ownership category* is mostly relevant for households. For the purpose of computing the deposit insurance limit, the FDIC considers single accounts, joint accounts, trust accounts, and certain retirement accounts separately.[9] Consider as an example a married couple with deposits at a single bank. The couple can obtain insurance up to $1,000,000 in total, or $500,000 each, by opening three separate accounts: two individual accounts ($250,000 insurance per depositor, or $500,000 in total) and a single joint account (another $500,000, as explained above).

Unlike households, firms are effectively limited to $250,000 in coverage per bank because they generally have a single ownership category.[10] Of course, firms can—like households—increase their effective deposit insurance coverage by holding deposits at multiple banks.

In the remainder of this section, we show that although households can exploit FDIC

[9] Revocable and irrevocable trust accounts are separate ownership categories in our sample, but all trust accounts will be part of a single ownership category starting April 1, 2024; for additional details, see https://www.fdic.gov/news/press-releases/2022/pr22004.html.

[10] For local governments, time and savings deposits are insured separately from demand deposits in some cases, so that the limit can reach $500,000 per bank, and uninsured deposits might be collateralized by assets held by the banks.

Year	FDIC limit ($)	Effective limit ($)	Effective limit w/o ownership category ($)
1992	100,000	145,937	143,410
1995	100,000	163,290	157,762
1998	100,000	149,240	145,855
2001	100,000	140,215	136,869
2004	100,000	156,727	153,442
2007	100,000	142,307	138,883
2010	250,000(*)	392,958	385,585
2013	250,000	341,665	337,752
2016	250,000	356,061	349,483
2019	250,000	354,891	348,287

Table 2. Deposit insurance limit.
The table displays the FDIC insurance limit and the effective insurance limit for households. The latter is calculated as the average amount of insured deposits for household members with positive holdings of uninsured deposits. (*) Between October 14, 2008, and December 31, 2012, the Transaction Account Guarantee Program provided full insurance on non-interest bearing transaction accounts.

rules to increase their coverage above $250,000 at a single bank, in practice the main means by which they increase their coverage is through ownership at multiple banks.

From 1992 to 2019, households' average effective deposit insurance coverage is always higher than the statutory limit. The first column of Table 2 reports the statutory FDIC limit per bank, depositor, and ownership category. We use account-level data from the SCF to estimate the average *effective deposit insurance coverage* for household members with positive holdings of uninsured deposits, and report the results in the second column. By holding deposits at multiple banks and in accounts categorized under different ownership categories, households have been able to effectively increase by about 50% the amount of deposits that are covered by insurance, in comparison to the statutory FDIC limit.

Households achieve the higher effective deposit insurance coverage documented in Table 2 mainly by holding accounts at multiple banks. The last column in Table 2 shows the effective limit calculated by ignoring the distinction between ownership categories. The results are nearly identical to those listed in the second column: the difference is about $3,500 on average when the insurance limit was \$100,000, and about \$6,000 on average under the \$250,000 limit. While we will not use this result in our model, we report it here because it is relevant to quantitatively analyze the trade-off highlighted by the FDIC about the possible options to reform deposit insurance (FDIC, 2023): the FDIC notes that reducing the number of ownership categories would simplify the resolution process but also reduce the effective insurance on deposits. In contrast, our results suggest that the reduction in the effective insurance from reducing the number of ownership categories would be minimal.

Finally, we provide a few results about the attitude toward insured and uninsured deposits of households, exploiting the cross section of our data. Account owners with intermediate holdings of deposits are those that are marginal with respect to the decision to take actions to increase their insurance coverage. For household members with less than \$1,000,000 in deposits, every additional dollar of deposit results on average in 71 cents of uninsured deposits and 29 cents of insured deposits. We obtain this result by regressing the household members' holdings of uninsured deposits on total deposits, and focusing on 2019.[11] Households with more deposits (i.e., greater than \$1,000,000) do not increase their insurance coverage as they accumulate more deposits: every additional dollar of deposits results in 99.96 cents additional uninsured deposits, as of 2019. These two results suggest that any higher compensation earned on uninsured deposits (relative to the insured ones) does not fully offset the risk associated with holding uninsured deposits, and that costs associated with managing a large number of deposit accounts—which would be required to have insurance on deposits holdings of more than \$1,000,000—outweigh the concerns about the risk of holding uninsured deposits.

3 Model

In this section, we describe our quantitative general equilibrium model which we use to construct the counterfactual dynamics under a reduced bailout probability. The model is an extension of Pancost and Robatto (2023) that allows for both partial deposit insurance and a positive probability that uninsured deposits at failed banks will be bailed out.

[11] The coefficient is highly significant with a t-statistic of 23.72, after adjusting for the effects of imputations and replicates of the SCF.

Time is discrete and infinite. There are four types of agents in the economy: firms, banks, households, and the government. Firms are subject to idiosyncratic risk and are run by a manager that holds an undifferentiated stake in the firm she runs. Despite the fact that individual firms will grow or shrink depending on the realizations of their idiosyncratic shocks, we construct the firm side of the model carefully in order to maintain aggregation to a representative firm, which keeps the model tractable and allows us to combine (i) rich firms' dynamics with (ii) banks and financial regulation, in (iii) a general equilibrium setting. The last feature is particularly important to recover the effects of shocks and policy changes that operate through prices such as the return on deposits or wages, in line with the arguments in Begenau (2020) and Pancost and Robatto (2023).

Before describing the model in detail in the next sections, we highlight the main novel elements of the model. We focus on how we model deposit insurance and the possible bailouts of uninsured deposits. To maintain tractability, we assume that the government insures a fraction ϕ of firms' deposits and a fraction ϕ^h of households' deposits. Assuming that deposit insurance applies to a fraction of deposits is necessary to ensure that the model aggregates up to a representative firm and a representative household. Imposing a dollar limit on deposit insurance would imply that the distributions of wealth across both firms and household become endogenous state variables, leading to significant modeling complications (Krusell and Smith, 1998). We are working to address these complications in a subsequent draft.

To model the possible bailout of uninsured deposits, and in line with the discussion of Section 2, we assume that in the event of a bank failure, uninsured deposits are fully repaid with probability f; with probability $1 - f$ they are subject to an endogenous haircut that depends on the failed banks' recovery rate. The probability f is a simple way to capture the various elements that lead the FDIC to use a resolution method that guarantees the full repayment of uninsured deposits. In our main counterfactual experiment, we reduce f to simulate a scenario in which the FDIC suddenly and unexpectedly reduces the probability of bailing out uninsured deposits.

Bailouts and deposit insurance are distinct policies from the point of view of depositors who are unable to perfectly diversify across banks. In particular, if banks fail with probability

p_t, the gross return on deposits held by a firm is a random variable $\hat{R}_t^d$ given by[12]

$$\hat{R}_t^d = \begin{cases} R_{t-1}^d & \text{with probability } 1 - p_t + p_t f \\ R_{t-1}^d \left[\phi + (1-\phi)(1-\nu_t)\right] & \text{otherwise,} \end{cases} \tag{1}$$

where R_{t-1}^d is the gross return that was promised to depositors at time $t-1$ and ν_t is the haircut on uninsured deposits that are not bailed out. To understand this expression, note that banks in our model offer a promised return R_{t-1}^d, but this return is paid if the bank does not fail (i.e., with probability $1-p_t$) or, conditional on failure, if the uninsured deposits are bailed out (i.e., with probability $p_t f$). Otherwise, if the bank fails and the uninsured deposits are not bailed out, the firm experiences a losses on its deposits. The fraction ϕ of deposits that are insured are fully repaid, but the fraction $1-\phi$ that is uninsured is subject to a haircut ν_t that is determined endogenously and depends on the liquidation value of the failed bank's assets; see equation (16) in Section 3.5.

The risk inherent in equation (1) between earning the promised rate R_{t-1}^d and the reduced, failed-bank rate $R_{t-1}^d \left[\phi + (1-\phi)(1-\nu_t)\right]$ is idiosyncratic: any depositor who is fully diversified across banks will only care about the average return on deposits

$$R_{t-1}^d \Big(1 - p_t + p_t \left[\phi + (1-\phi) f + (1-\phi)(1-f)(1-\nu_t)\right]\Big) \tag{2}$$

which, in the case of either full deposit insurance ($\phi = 1$) or guaranteed bail-outs ($f = 1$) is simply R_{t-1}^d. The three terms multiplying p_t reflect the three things that can happen at failed banks. That is, for each dollar of deposits, a fraction ϕ is insured, with probability f the remaining $1-\phi$ fraction is bailed out, and with probability $1-f$ the remaining $1-\phi$ fraction is hit with the haircut ν_t.

If all depositors could diversify across banks, the distinction between deposit insurance ϕ and bailouts f would not matter in equilibrium: investors would only care about the average deposit return given by equation (2). Changes in ϕ or f would result in exactly-offsetting changes in the equilibrium promised rate R_{t-1}^d and, thus, would have no real effects.

[12]For households, the expression is the same but with the term ϕ^h to capture the fraction of uninsured households' deposits, which can be different from the fraction ϕ for firms.

However, we assume that firms cannot diversify their deposits across banks. As discussed in Section 2, anecdotal evidence shows that many firms had massive deposit accounts at SVB and other banks that failed; the most notable example is Roku, which had almost $500 million in deposits at SVB (Maruf, 2023). More generally, in Section 2 we estimate that 56% of firms' deposits in the U.S. are uninsured. Because firms are also subject to uninsurable idiosyncratic risk that affect their productive assets and their output, the idiosyncratic risk inherent in equation (1) matters for firms' decisions and affects firms' investments and labor demand.

3.1 Firms

There is a continuum of firms in the economy that are subject to multiple sources of risk: aggregate risk that affects their output, idiosyncratic risk that affects output and their productive assets, and idiosyncratic risk arising from the possibility that the firm's bank defaults and its uninsured deposits are not bailed out. As discussed at the beginning of Section 3, each firm is run by a manager that holds an undifferentiated stake in the firm she manages. Shareholders (i.e, households) hold shares in all the firms in the economy and, thus, are not directly impacted by the firms' idiosyncratic risk.

As in Pancost and Robatto (2023), we assume that shareholders (i.e., households) decide the firms' dividend policies, whereas managers are in charge of all other firms' decisions. This is motivated by the results of La Porta et al. (2000), who find that dividend policies in countries with good legal protections—such as the United States—are consistent with shareholders' preferences.

At time t, the manager running firm i oversees an amount a_t^i of firms' assets, which are allocated to productive investments (i.e., physical capital) or bank deposits:

$$k_t^i + d_t^i \leq a_t^i. \tag{3}$$

The promised return on deposits is R_t^d. However, if the bank where the deposits are held fails at $t+1$, some deposits might be subject to losses. As discussed in Section 3, we assume that a fraction ϕ of deposits are insured, and that a fraction $1-\phi$ are uninsured. In case of bank failure, the uninsured deposits are bailed out anyway with probability f. If the uninsured deposits are not bailed out (i.e., with probability $1-f$), they are subject to a haircut ν_{t+1}.

The manager also borrows b_t^i from banks, in the form of a loan with interest rate r_t subject to the borrowing constraint

$$b_t^i \leq \xi k_t^i, \tag{4}$$

with $0 < \xi < 1$. Bank loans are used for productive investments, so that the total physical capital used for production by firm i is $k_t^i + b_t^i$.

At $t+1$, after the realization of aggregate productivity A_{t+1}, the manager chooses labor l_{t+1}^i with wage w_{t+1}, and then production takes place. Output is given by

$$y_{t+1}^i = A_{t+1} z_{t+1}^i \left(k_t^i + b_t^i\right)^\gamma \left(l_{t+1}^i\right)^{1-\gamma}$$

where z_{t+1}^i is a firm-specific, idiosyncratic productivity shock taking value z^L and z^H with probability $1-p_z$ and p_z. The idiosyncratic shock z_{t+1}^i is realized after all firms' decision about physical capital and labor have been made. That is, the amount $r_t b_t^i$ that the firm has to repay to the bank and the wage bill $l_{t+1}^i w_{t+1}$ cannot be made contingent on the realization of z_{t+1}^i.

After production, the total amount of resources available to the firm is

$$x_{t+1}^i = y_{t+1}^i + (1-\delta) z_{t+1}^i k_t^i - w_{t+1} l_{t+1}^i - r_t b_t^i + \hat{R}_{t+1}^d d_t,$$

where $\hat{R}_{t+1}^d$ is the realized return on depsits defined in Equation (1). We make two observations about x_{t+1}^i. First, capital k_t^i is also hit by the idiosyncratic shock z_{t+1}^i, making it a risky asset. Second, we assume that $\hat{R}_{t+1}^d$ is realized after production takes place (i.e., the firm learns whether its bank defaults and its uninsured deposits are subject to losses after the realization of the idiosyncratic shock z_{t+1}^i), so that the manager's hiring decision choices are made while there is still uncertainty about the realized return on deposits.

The wealth x_{t+1}^i is then used for external payouts or retained inside the firm. Specifically, a fraction α_{t+1}^i of wealth is paid out as dividends to shareholders (π_{t+1}^i) and compensation to the manager (c_{t+1}^i), and a fraction $1-\alpha_{t+1}^i$ is retained. Thus, we have

$$\pi_{t+1}^i + c_{t+1}^i \leq \alpha_{t+1}^i x_{t+1}^i.$$

The funds retained in the firm and carried to the next period are

$$a_{t+1}^i = \left(1-\alpha_{t+1}^i\right) x_{t+1}^i - \frac{\varphi}{2} x_{t+1}^i \left(\alpha_{t+1}^i - \bar{\alpha}\right)^2, \tag{5}$$

where the term $\frac{\varphi}{2} x_{t+1}^i \left(\alpha_{t+1}^i - \bar{\alpha}\right)^2$ denotes a dividend adjustment cost (Jermann and Quadrini, 2012).

The manager is compensated, at $t+1$ with a fixed component that is proportional to firms' size a_t^i at t (i.e., a compensation that does not depend directly on the choices taken by the manager) and through an equity stake that allows her to earn a fraction of the dividends. Hence, the manager compensation at $t+1$ is

$$c_{t+1}^i = \kappa \left[\theta_f a_t^i + \theta_e \alpha_{t+1}^i x_{t+1}^i\right]. \tag{6}$$

The parameter κ scales the total compensation, and the parameters θ_e and θ_f govern the relative importance of the fixed and equity compensation.[13]

Managers' objective is to maximize their stream of utility from consumption. We assume that managers have log utility.[14] The manager of firm i solves

$$V_t^m\left(a_t^i\right) = \max_{k_t^i, d_t^i, b_t^i} \beta E_t \left\{ \max_{l_{t+1}^i} \log c_{t+1}^i + V_{t+1}^m \left(a_{t+1}^i\right) \right\}$$

where c_{t+1}^i is given by (6) and a_{t+1}^i is given by (5).

We can now characterize the manager's choices. We conjecture that the borrowing constraint (4) is binding, and we verify it numerically in our simulations. The optimal choices of the manager are proportional to firms' wealth, that is, $k_t^i = \phi_t^k a_t^i$ and $l_t^i = \phi_t^l a_t^i$, where ϕ_t^k

[13] We can also add an option-like component to the manager compensation, as in Glover and Levine (2017).

[14] The analysis remain tractable if managers have a more general CRRA or Epstein-Zin utility—in future drafts, we plan to extend the analysis to a more general utility function to more precisely calibrate the managers' risk aversion and elasticity of intertemporal substitution.

and ϕ_t^l are independent of a_t^i and, thus, the same for all managers, and solve the first-order conditions

$$\mathbb{E}_{z,\hat{R}^d}\left\{\Lambda_t^m\left[(1-\gamma)\,A_t z_t^i\,(1+\xi)^\gamma\left(\frac{\phi_{t-1}^k}{\phi_t^l}\right)^\gamma - w_t\right]\right\} = 0$$

and

$$\mathbb{E}_t\left\{\Lambda_{t+1}^m\left[\gamma A_{t+1} z_{t+1}^i\,(1+\xi)^\gamma\left(\frac{\phi_{t+1}^l}{\phi_t^k}\right)^{1-\gamma} + z_{t+1}^i\,(1-\delta) - r_t\xi - \hat{R}_{t+1}^d\right]\right\} = 0,$$

where Λ_t^m is the manager's marginal utility of consumption, given by

$$\Lambda_t^m = \frac{\theta_e \alpha_t^i}{\theta_f + \theta_e \alpha_t^i R_t^i\left(\phi_{t-1}^k, \phi_t^l\right)} + \frac{\beta}{1-\beta}\frac{1}{R_t^i\left(\phi_{t-1}^k, \phi_t^l\right)}.$$

and $R_t^i\left(\phi_{t-1}^k, \phi_t^l\right)$ is the return on the wealth a_t^i of firm i:

$$R_{t+1}^i\left(\phi_t^k, \phi_t^l\right) = A_{t+1} z_{t+1}^i\left[\phi_t^k\,(1+\xi)\right]^\gamma\left(\phi_{t+1}^l\right)^{1-\gamma} - w_{+1}\phi_{t+1}^l - r_t\xi\phi_t^k + z_{t+1}^i\,(1-\delta) + \hat{R}_{t+1}^d\left(1-\phi_t^k\right).$$

The choices of deposits is also proportional to a_t^i and, using the budget constraint (3), is given by $d_t^i = a_t^i\left(1-\phi_t^k\right)$.

A key feature of the results is that the manager's choices are independent of the parameter κ that scales the level of the compensation paid to the manager. For our quantitative analysis, we consider the limit as $\kappa \to 0$, implying that all the resources devoted to consumption are consumed by households. This is motivated by the fact that the fraction of managers in the economy is small, relative to overall size of the population. In addition, this assumption facilitates our work in progress in which we perform welfare and policy analyses, as we can evaluate total welfare in the economy by focusing only on the welfare of households.

3.2 Banks

We assume that a continuum of banks are founded each period t with equity n_t; each bank borrows deposits $d_t = d_t^h + d_t^f$ from firms and households (where d_t^f and d_t^h are the firms' and households' deposits, respectively), and invests in loans to firms b_t. The returns from banks' investment are subject to idiosyncratic shocks, which are meant to capture the fact that banks are unable to perfectly diversify their investments, so that some banks face losses on their own investments. In particular, because banks are subject to limited liability, some banks fail each period.

Each bank lends its physical capital b_t to firms, and after production takes place at $t+1$, firms return the undepreciated fraction $1-\delta$ plus a return r_t. The resources $b_t\left(1-\delta+r_t\right)$ returned by firms are then hit by the idiosyncratic shock ε, which is distributed according to the cumulative distribution function $F_{t+1}(\varepsilon)$, with $E\left(\varepsilon\right)=1$. We assume that $F_t(\varepsilon)$ is lognormal with time-varying variance σ_t; see Section 3.6 for the specification of the law of motion of σ_t.

As a result, banks' profits at $t+1$ are given by the cash flow $\varepsilon b_t\left(1-\delta+r_t\right)$ net of the repayment $R_t^d d_t$ to depositors, where R_t^d is the gross return on deposits. Thus, banks solve the problem

$$\max_{b_t,\, d_t} \; E_t \int_{\underline{\varepsilon}_{t+1}}^{\infty} \left\{\varepsilon b_t\left(1-\delta+r_t\right)-R_t^d d_t\right\} dF_{t+1}\left(\varepsilon\right) \tag{7}$$

subject to the budget and capital requirement constraints:

$$b_t = d_t + n_t \tag{8}$$

$$n_t \geq \zeta b_t. \tag{9}$$

where ζ is the capital requirement, and $\underline{\varepsilon}_{t+1} \equiv \frac{R_t^d d_t}{b_t(1-\delta+r_t)}$ is the threshold of the idiosyncratic shock ε below which a bank defaults. Because the return on deposits will always be less than the return on bank's capital, the capital requirement constraint (9) will always be binding.

To characterize the return on equity, we note that households can diversify their equity holdings across banks, and failed banks return zero to their equity holders. Thus, the return on bank equity R_{t+1}^n is given by

$$R_{t+1}^n = \frac{1}{n_t}\int_{\underline{\varepsilon}_{t+1}}^{\infty} \left\{\varepsilon b_t\left(1-\delta+r_t\right)-R_t^d d_t\right\} dF_{t+1}\left(\varepsilon\right). \tag{10}$$

When a bank fails, it is taken over by the government, which repays insured deposits and might or might not bailout uninsured deposits. The fraction p_{t+1} of banks that fail at time

$t+1$ is given by

$$p_{t+1} = \int_{-\infty}^{\varepsilon_{t+1}} dF_{t+1}(\varepsilon). \tag{11}$$

The details of the resolution process of failed banks is described in Section 3.5.

3.3 Households

Households are infinitely-lived agents who consume c_t, save in the form of bank equity n_t and deposits d_t^h, and supply labor l_t. As in Van den Heuvel (2008) and Begenau (2020), households gain some direct utility from their deposit holdings. To maintain the representative agent framework and thus the tractability of the model, we follow Gertler and Kiyotaki (2015) by assuming that each household consists of a large "family" in which each member has access to a deposit account at a specific bank in the economy. Family members with deposits at a bank that remains solvent or that is bailed out benefit from the liquidity value of deposits (in the form of a utility benefit) whereas members with accounts at banks that fail without bailout get only a fraction of the liquidity value that depends on the share of insured deposits. In addition, because the members pool their wealth at the end of the period, they are effectively risk-neutral with respect to the idiosyncratic risk that affects the return on deposits. In work in progress, we are considering how to relax this assumption to expose households to the risk that their uninsured deposits are not bailed out.

Households own both banks and firms; from the former they receive a return R_{t+1}^n on their holdings of bank equity, while from the latter they receive a fraction of total firm wealth α_t as a dividend. As discussed in Section 3.1, households' choose the firms' dividend policies α_t^i in their role as firms' shareholders. A household that starts with wealth a_t^h solves the problem

$$V_t^h\left(a_t^h\right) = \max_{c_t, l_t, n_t, d_t^h, \{\alpha_t^i\}, l_t} \frac{c_t^{1-\gamma_c} - 1}{1-\gamma_c} + \hat{\psi}_{t+1} \frac{\left(d_t^h/c_t\right)^{1-\gamma_d}}{1-\gamma_d} - \chi \frac{l_t^{1+\frac{1}{\eta}}}{1+\frac{1}{\eta}} + \beta E_t \left\{V_{t+1}^h\left(a_{t+1}^h\right)\right\} \tag{12}$$

where γ_c, γ_d, and η parameterize risk aversion, the curvature of the deposit utility benefits, and the Frisch elasticity of labor supply, respectively, and

$$\hat{\psi}_{t+1} = \psi \left[1 - p_{t+1} + p_{t+1} f + \phi^h \left(1 - \left(1 - p_{t+1} + p_{t+1} f\right)\right)\right]$$

is the product of a parameter ψ that governs the utility benefit of deposits and the fraction of deposits that are fully repaid—either because the bank is solvent, the uninsured deposits are bailed out, or if the bank fails and is not bailed out, because a fraction ϕ^h of deposits are insured. The households' problem is subject to the budget constraint

$$c_t + n_t + d_t^h \leq a_t^h + w_t l_t + \pi_t^f + T_{t+1}^{acq} - T_t \tag{13}$$

and the law of motion of wealth

$$a_{t+1}^h = n_t R_{t+1}^n + d_t^h \hat{R}_{t+1}^d. \tag{14}$$

At time t, the household has access to its wealth a_t^h, its labor income $w_t l_t$, the profits received from firms π_t^f, and the lump-sum transfers T_{t+1}^{acq} that represent the profits generated by the purchase of banks that are liquidated at a fire-sale value (see Section 3.5), net of the lump-sum taxes T_t paid to the government. These resources are allocated to consumption c_t, deposits d_t^h, and investment in bank equity n_t. Wealth at $t+1$, a_{t+1}^h, is the sum of the gross return on banks' equity $n_t R_{t+1}^n$ and deposits $d_t^h \hat{R}_t^d$.

3.4 Labor Market

To produce accurate short-term dynamics in the labor market, we introduce wage rigidities in line with the evidence provided by the macro-labor literature (Shimer, 2005; Gertler and Trigari, 2009; Gertler, Huckfeldt and Trigari, 2020). We assume that households supply labor in a competitive market, but wages are rigid and adjust slowly over time according to the formulation

$$w_t = \omega \, w_{t-1} + (1 - \omega) \, w_t^f. \tag{15}$$

The parameter ω indexes the degree to which wages are sluggish and depends on last period's wages w_{t-1}, and w_t^f is the flexible wage that would prevail absent wage rigidities and that is determined by the households' first-order condition

$$w_t^f \Lambda_t = \chi l_t^{1/\eta},$$

where Λ_t is the households' marginal utility of consumption. The formulation in Equation (15) is similar to the one that Gertler, Huckfeldt and Trigari (2020) derive in a framework in which wage rigidities are microfounded through infrequent renegotiations.

3.5 Government

Following the literature that studies financial regulation in quantitative general equilibrium models, we assume that the government consists of a bank resolution mechanism that is financed by lump-sum taxes. Our novelty is that when a bank fails and is taken over by the government, only a fraction of the deposits are repaid—as opposed to all the deposits as in other papers in the literature. Specifically, the government pays off the insured deposits and, in addition, bails out the uninsured deposits with probability f.

We model the bank resolution mechanism along the lines of how the FDIC resolves failed banks in practice. As noted in Section 2, a failed bank can either be liquidated or sold to another bank. If a liquidation occurs, the FDIC reimburses insured deposits immediately, and it becomes one of the claimants of the resources recovered through the liquidation of the assets, together with uninsured deposits (and possibly other liability holders). The FDIC and uninsured deposits have the same priority, meaning that losses must be shared equally by these two groups of claimants. If a bank is sold, uninsured deposits might or might not be guaranteed.

In the model, we define ν_{t+1} to be the haircut imposed on the uninsured deposits that are not bailed out. We assume that the haircut is the same for all the banks that fail, that is, as if we were considering an "average" failed bank. Given the above discussion about the resolution of failed banks, we have

$$(1-\nu_{t+1})\int_{-\infty}^{\varepsilon_{t+1}} R_t^d d_t dF_{t+1}(\varepsilon) = \int_{-\infty}^{\varepsilon_{t+1}} \varepsilon b_t \left(1-\delta+r_t-\Upsilon^{tot}\right) dF_{t+1}(\varepsilon), \tag{16}$$

where Υ^{tot} captures the bankruptcy cost associated with the liquidation of a failed bank. As discussed below, however, we will assume that only a fraction of such costs are deadweight losses for the society, and we will parameterize such losses with $\Upsilon^{dwl} \leq \Upsilon^{tot}$. The difference between the bankruptcy costs Υ^{tot} and the deadweight losses Υ^{dwl} represents a gain for the acquirer of the failed banks (Granja, Matvos and Seru, 2017) which are then redistributed lump-sum to households; see the term T_{t+1}^{acq} in Equation (14).

Finally, any remaining loss is borne by the government, which finances its operations through lump-sum taxes. Thus, the government budget constraint is given by

$$T_{t+1} = \nu_{t+1}\left[\phi + (1-\phi)\, f\right] \int_{-\infty}^{\varepsilon_{t+1}} R_t^d d_t \, dF_{t+1}(\varepsilon), \tag{17}$$

where the left-hand side is the total amount collected from households through taxes, and the right-hand side is the total amount paid to depositors at failed banks to make insured deposits whole and to bailout a fraction f of uninsured deposits at failed banks.

3.6 Aggregate risk

There are two aggregate shocks in the model: the productivity of firms, A_t, and the variance σ_t of the idiosyncratic bank shock ε. We assume that these two variables follow a VAR(1) process in logs:

$$\begin{bmatrix} \log A_t \\ \log \sigma_t \end{bmatrix} = (\boldsymbol{I}-\boldsymbol{\rho}) \begin{bmatrix} \log \bar{A} \\ \log \bar{\sigma} \end{bmatrix} + \boldsymbol{\rho} \begin{bmatrix} \log A_{t-1} \\ \log \sigma_{t-1} \end{bmatrix} + \boldsymbol{\Sigma}\vec{\boldsymbol{\varepsilon}}_t, \tag{18}$$

where $\bar{A}, \bar{\sigma} > 0$, $\boldsymbol{\rho}$ is a 2×2 matrix of drift parameters, $\boldsymbol{\Sigma}$ is a 2×2 positive definite covariance matrix, and $\vec{\boldsymbol{\varepsilon}}_t \sim \mathbb{N}\left(\vec{0}, \boldsymbol{I}\right)$ is a 2×1 standard normal random vector.

3.7 Aggregate resource constraint and deadweight losses of bank default

When describing the resolution of failed banks in Section 3.5, we introduced a default cost Υ^{tot} that reduces the recovery value of the assets of failed banks; see Equation (16). A fraction $\Upsilon^{dwl} \leq \Upsilon^{tot}$ of the assets of the failed bank is a deadweight loss that reduces the resources available to society. The aggregate resource constraint is given by

$$c_t + i_t + \Upsilon^{dwl} \int_{-\infty}^{\varepsilon_t} b_{t-1}\, dF_t(\varepsilon) + \frac{\varphi}{2} x_t (\alpha_t - \bar{\alpha}) \leq A_t (k_{t-1} + b_{t-1})^{\gamma} l_t^{1-\gamma}. \tag{19}$$

The left-hand side includes, in addition to the deadweight losses of default, consumption c_t, investments $i_t = (k_t + b_t) - (1-\delta)(k_{t-1} + b_{t-1})$, and the dividend adjustment costs. In our quantitative analysis, we follow the standard practice of defining the gross domestic product as the sum of consumption and investments.

4 Calibration and simulation

We now calibrate the model and simulate it using standard perturbation methods. We then conduct our main counterfactual analysis in Section 5, in which we ask what would have happened had regulators not bailed out uninsured deposits during the banking crisis of 2023.

Table 3 presents the value of the parameters that we use for our quantitative analysis. We set each period in the model to be one year, and we calibrate the model using data from 1986 to 2019. We begin our sample in 1986 because most regulations that prevented banks from paying interests on their deposits were phased out by 1985 (Gilbert, 1986), and end it in 2019 to avoid the effects of COVID-19.[15]

The top panel of Table 3 includes the parameters that we pre-set based on values commonly employed in the literature or external evidence. We further divide these parameters in two sets. First, we follow the calibration in Pancost and Robatto (2023) to set the values

[15] Extending the data sample to 2022 increases the volatility of employment and of firms' deposits, but has little effects on the value of the other data moments we use as targets. This is likely to reinforce our main result about the effects of the reduction in the default probability because matching the higher volatility of deposits requires an increase the frictions that prevent firms from adjusting their dividends.

Panel A: Pre-Set Parameters					
Parameter	Value	Parameter	Value	Parameter	Value
η	1	γ	0.3	$\bar{A}$	1
β	0.95	γ_c	3	$E\{z^i\}$	1
δ	0.1	ρ_A	0.95	χ	1
$\bar{\alpha}$	0.05	κ	0	γ_d	1.4
θ_e	1	θ_f	0.0297		
f	0.94	ϕ	0.43	ϕ^h	0.79
Υ^{tot}	0.1579	Υ^{dwl}	0.045	ζ	0.0913

Panel B: Parameters chosen to match data moments			
Parameter	Value	Moment Target	Moment Value
z^l	0.80	Deposit premium, $R^f - R^d$	0.91%
ξ	0.276	Firms' deposits/GDP	14%
ψ	0.001675	Households' deposits/GDP	25%
$\bar{\sigma}$	0.033825	Average bank default rate	0.64%
σ_σ	0.1245	Volatility of bank default rate	1.18
ρ_σ	0.8575	Autocorrelation bank default rate	0.86
ω	0.6628	Vol(employment)/vol(GDP)	0.72
σ_A	0.0123	Volatility $\log$ GDP	1.56%
p_z	0.91355	Continuers employment growth	2.50%
φ	1.022	Vol(firm deposits)/vol(GDP)	4.00

Table 3. Calibrated Parameter Values. All volatilities are computed by taking logs and applying the HP-filter with parameter 100, both in the model and in the data.

of η, β, δ, $\bar{\alpha}$, θ_e, γ, γ_c, ρ_A, θ_f, γ_d, and κ, and we normalize $\bar{A}$, $E\{z^i\}$, and χ to one. Second, we use the evidence discussed in Section 2 to set the bailout probability f to 94.5%, the share of insured firms' deposits ϕ to 43%, and the share of insured households' deposits ϕ^h to 79%. To set the liquidation costs and the deadweight losses of bank default, we follow the approach of Elenev, Landvoigt and Van Nieuwerburgh (2021) and use the evidence in Bennett and Unal (2015) to set the liquidation cost parameter Υ^{tot} to 15.79% and the deadweight loss parameter Υ^{tot} to 4.5%, based on data about the total resolution costs and the total receivership expenses of failed banks, respectively, weighted by assets. The capital requirements is set at the average level of equity capital to assets in our sample, that is, 9.19%. This is also nearly identical to the level at the end of 2022.

The bottom panel of Table 3 lists the values of the parameters that are chosen to match selected data moments. To do so, we follow the approach and definitions in Pancost and Robatto (2023) and extend their data sample (which ends in 2010) to 2019. Because of a trend in firms' deposits as a fraction of GDP, we use the last observation as the target. Similarly, there is a trend in households' deposits as a fraction of GDP until 2001, so we start the sample in 2001 to compute this target.

5 Counterfactual analysis: The 2023 banking crisis and the reduction in bailout probability

Our main objective is to show what would have happened had regulators not bailed out uninsured deposits during the banking crisis of 2023. We thus use the calibrated model to compute the impulse responses to two shocks: a *default shock* that temporarily increases the default rate of banks, to produce the 2023 banking crisis, and a *reduced bailout shock* that permanently lowers the probability f that the government bails out the uninsured deposits of failed banks.

We include the default shock in all our experiments, but we include the reduced bailout shock only in some of them. This allows us to gauge the effects of what would have happened with or without the change in bailout probability. Finally, we run some experiments in which we shock a version of the economy in which we set the dividend adjustment cost φ to zero, to highlight the key role played by this friction.

5.1 The magnitude of the default and reduced bailout shocks

To produce the 2023 banking crisis in the model, we subject the economy to the following default shock. Starting from the economy in steady state, we set the second element of $\vec{\varepsilon}_t$ (i.e., the shock to σ_t) to 0.48, inducing the failure of 3.65% of banks in the economy. We choose this value to match the failure that took place in the first and second quarter of 2023 (which account for 2.3% of the assets of FDIC-insured banks) as well as half of the at-risk banks identified by Allen et al. (2023*a*) (which account for 1.35% of the assets of FDIC-insured banks).[16] We add the add-risk banks to account for the uncertainty related to the banks that could fail in 2023—our model is calibrated at yearly frequency, and this draft has been written before the end of 2023. More importantly, adding the at-risk banks mitigates our main result about the effects of reducing the bailout probability, thereby producing more conservative estimates. In comparison to bank failure in recent times, the 3.65% figure we use is the highest since at least 1986 but is similar in magnitude to the 3.5% figure observed in 1989, that is, at the peak of the S&L crisis.

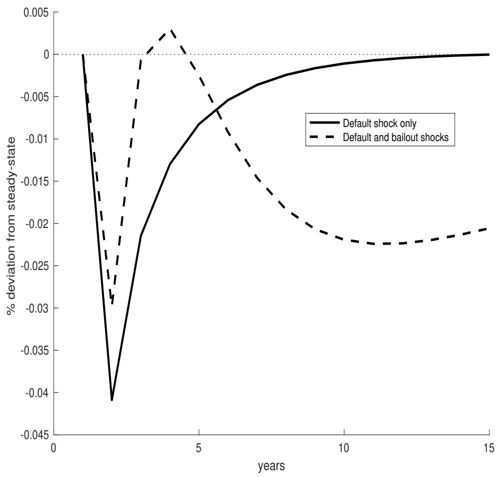
To model the reduced probability of bailout, we reduce f from the baseline value of 94% down to 35%. The calibrated 94% value of f arises as the byproduct of institutional features such as legal restrictions to which the FDIC is subject, and the design of the process through which the FDIC sells failed banks. To arrive at a new value for f of 35%, we note that had there be no bailouts at all in 2023, the asset-weighted ratio of banks receiving a bailout from September 2008 to the first quarter of 2023 would have been 35%.

5.2 Results

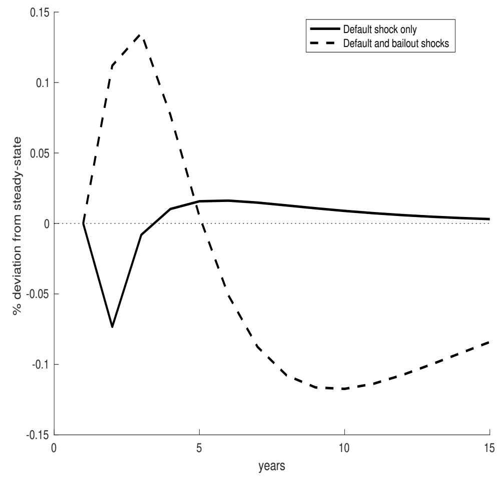
In Figure 5 we compute the dynamic responses of output, investment, employment, and consumption in two cases. First, the solid line shows the dynamics of an economy that is subject to the default shock, but in which regulators keep the bailout rate of uninsured deposits f unchanged. Second, the dotted line considers the case in which the default shock is coupled with a permanent reduction of the probability f that uninsured deposits will be bailed out in the event of a bank failure.

The shock to bank failure rates, on its own, produces a very mild recession in this economy. Output, investments, and consumption, drop by about 0.04%, 0.075%, and 0.03% on impact, respectively. Employment increases by about 0.05%, and this result arises because the default shock produces deadweight losses that reduce the resources available in the economy, and similar to standard real business cycle (RBC) models, the response of households is

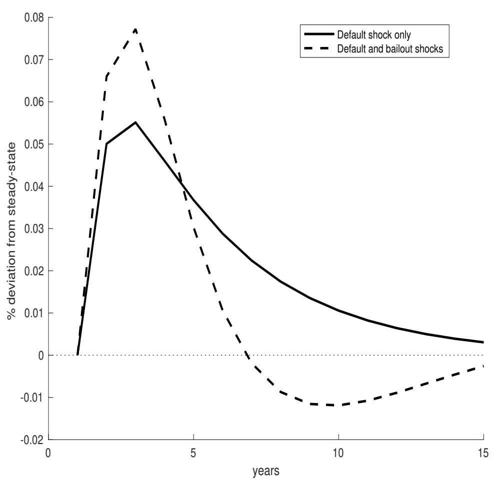
[16] The set of at-risk banks identified by Allen et al. (2023*a*) is very similar to that of Jiang et al. (2023).



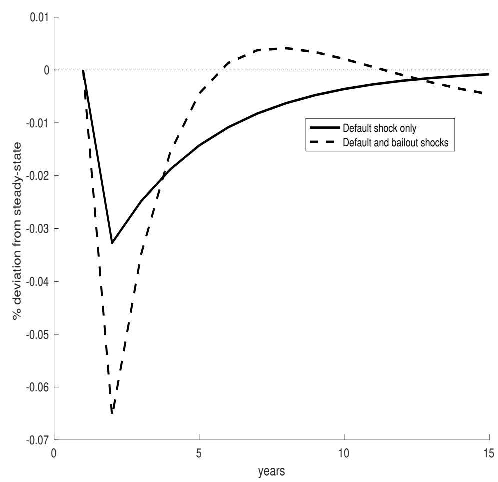
(a) Output



(b) Investment



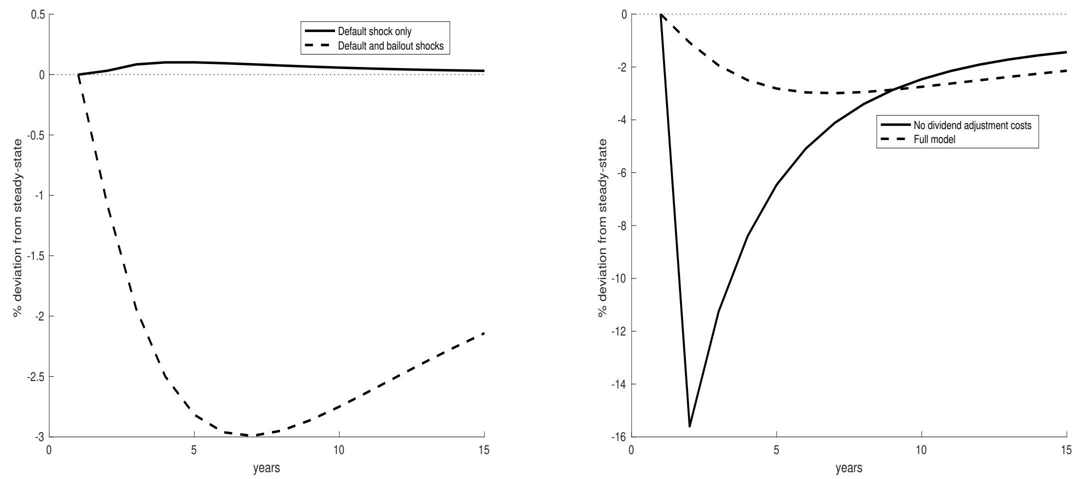
(c) Employment



(d) Consumption

Figure 5. Response to the default and reduced bailout shocks

The figure plots the dynamics of output (top left panel), investment (top right panel), employment (bottom left panel), and consumption (bottom right panel) in percent deviations from steady state. The solid lines in each figure plot the dynamics for the baseline case where there is only a shock that increases the probability of bank default; the dotted lines plots dynamics with the shock that increases the probability of bank default and the shock that permanently reduces the probability f that uninsured deposits are bailed out.



(a) Default and bailout shocks

(b) Full model vs. no dividend adj. cost

Figure 6. Dynamics of Firms' Deposits
The figure plots the dynamics of firms' deposits in percent deviations from steady state. The left panel plots the response to the increase in the banks' default rate (solid line) and to the joint increase in banks' default rate and reduction in bailout probability (dotted line). The left panel considers both shocks and plots the dynamics for the fully calibrated model with dividend adjustment costs (dotted line) and of a version of the model in which we shut down the dividend adjustment cost (solid line).

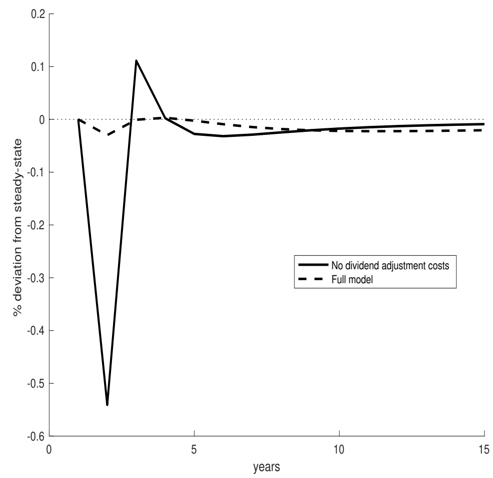
to decrease both consumption and leisure (i.e., increase employment), as both consumption and leisure are normal goods. Overall, these effects are very small. The deadweight losses from default do have an impact on the economy, but because the default rate is slightly less than 4% and deadweight losses are 4.5%, such losses are not large. In addition, because the bailout probability is set at $f = 94\%$, the bank failures have little impact on the safety of deposits. Indeed, firms' deposits are essentially unchanged, and in fact, they increase slightly as shown in the left panel of Figure 6.

When we add the bailout shock to the default shock (dotted lines in Figure 5), we observe that the reduction in the bailout probability f offsets the effects of the default shock on output and investments and amplifies those on employment and consumption. The effect on investments more than offset the drop caused by the banking crisis, resulting in an overall increase in investment. To understand these results, consider the effects in comparison to the baseline case with only the default shock. Relative to such a baseline, firms' investments increase, and this increase is achieved at the economy-wide level through lower consumption and an increase in labor.

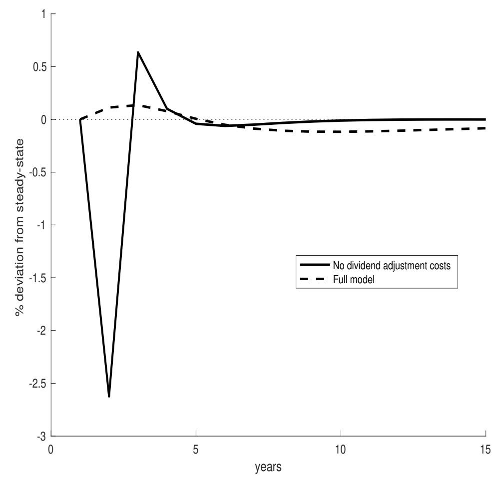
The higher investments when the economy is subject to both shocks is the result of a shift of firms' resources from deposits to productive capital. After production, firms' resources can be paid out as dividends, saved in the form of deposits, or invested in productive capital. However, because of the dividend adjustment cost (Jermann and Quadrini, 2012), most resources are kept inside the firms. Hence, because the negative shock to f makes deposits less attractive, firms redirect some of their resources toward investments. Figure 6 shows that firms' deposits do not drop on impact, in line with this interpretation. Eventually firms do adjust deposits, in response to their higher riskiness, but this effect takes several years. We also note that the dividend adjustment cost is important to match the volatility of firms' deposits in the data. Without such a cost, the model would produce a too-low volatility of firms' deposits. The adjustment cost, by reducing the volatility of dividends, increases that of resources that are held inside the firms as deposits, reconciling the model with the empirical evidence.

To see the importance of the dividend adjustment costs in driving the dynamics of investments, Figure 7 plots the response to the default and bailout shocks for both the full model (i.e., with the dividend adjustment cost φ calibrated to match the volatility of firms' deposits) and a version of the model in which we shut down the dividend adjustment cost (i.e., $\varphi = 0$). The solid line shows that with no dividend adjustment costs, the impacts on the economy are much bigger: output drops by 0.5%, investments drop by 2.5%, and labor declines by almost 0.7%. The dotted lines show the results in the full model that includes the adjustment costs (i.e., they are the same as the dotted line in Figure 5). The presence of adjustment costs offsets the drop in output, investments, and employment, resulting in movements in these quantities that are economically close to zero. Differently, the drop in consumption is amplified, but the magnitudes are very small (-0.02% at the trough without adjustment cost versus -0.06% in the full model).

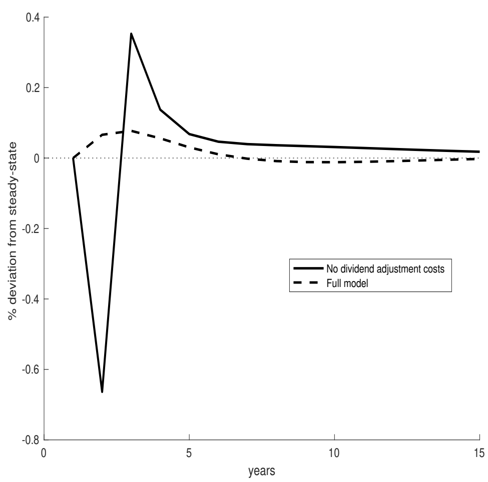
The logic of the results is again related to the use of firms' resources. Absent dividend adjustment costs, firms return cash to shareholders, or stepping a bit outside the model, firms could also use the deposits to repay some of their debt. Indeed, the right panel of Figure 6 shows that firms' deposits drop by almost 16% on impact in the model with no dividend



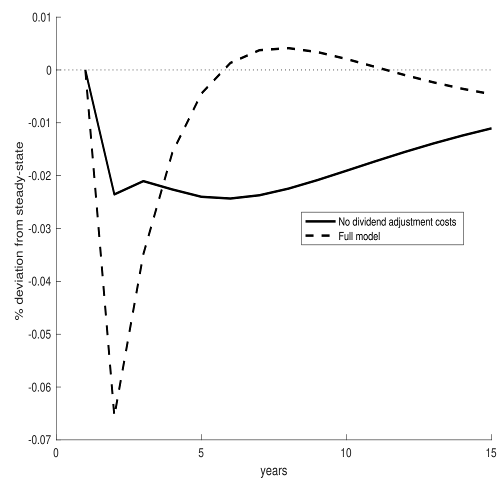
(a) Output



(b) Investment



(c) Employment



(d) Consumption

Figure 7. Response to the shocks with and without dividend adjustment costs
The figure plots the dynamics of output (top left panel), investment (top right panel), employment (bottom left panel), and consumption (bottom right panel) in percent deviations from steady state, in response to the shock that increases the banks' default probability and the simultaneous reduction in the bailout probability f. The dotted lines plot the dynamics for the full model with the dividend adjustment cost φ calibrated to match the volatility of firms' deposits (see Section 4)—the dotted lines here are identical to the dotted lines plotted in Figure 5—while the solid lines plot the dynamics for the case when $\varphi = 0$.

adjustment costs, while they slowly decline in the full model. As a result, in the full model, most resources are kept inside the firms, and because deposits become riskier, firms react by investing relatively more in physical capital, and with it, labor. Hence, the presence of the financial frictions that limit firms' ability to adjust quickly their balance sheets dampens the negative effects of the bank failures and of the reduced bailout probability.

6 Switching to full deposit insurance

As a final exercise, we use the model to estimate how the economy would change were the FDIC to move to full deposit insurance. We do so by raising the bailout probability from $f = 94\%$ to $f = 100\%$. Note that the same exercise could be implemented by raising the share of insured deposits of firms and households, ϕ and ϕ^h, to one—if either parameter is one, then the value of the other is irrelevant.

Recall that our model is calibrated to match the first fact that we document: that uninsured deposits face losses in only 6% of bank failures since 2008. In other words, the U.S. economy already has close to 100% deposit insurance, because even though the stock of uninsured deposits is quite large (see the right panel of Figure 3), those uninsured deposits are rarely marked down in the process of resolving a bank failure. In a sense, in 2023, 60% of deposits are fully insured and the remaining 40% are 94% insured.

We find nearly negligible effects of moving to full deposit insurance. This is not surprising, as the economy is calibrated to match the 94% bailout probability we observe in the data, and the exercise we run increases this probability by only 6 percentage point to 100%. The main effect we obtain is a transfer in the ownership of deposits: firms increase their deposit holdings by 0.28% while households decrease theirs by 0.15%. This is because firms have a higher share of uninsured deposits, so the shift to full deposit insurance is more beneficial for them.

7 Conclusion

We document three novel stylized facts about households' and firms' holdings of insured and uninsured deposits, the process used by the FDIC to resolve failed banks, and the bailout of uninsured deposits at failed banks. In particular, (i) nearly all uninsured deposits have been bailed out since the 2008 crisis; (ii) firms hold more uninsured deposits than households; and (iii) households effectively increase their deposit insurance coverage by holding multiple accounts, while the combined effect of all other FDIC rules by which households could increase their coverage is negligible.

We calibrate a quantitative general equilibrium model to analyze the effects of bank defaults and of the bailout of uninsured deposits on firms' investments, employment, and macroeconomic outcomes. The model incorporates the first two facts described above, though in future work we plan to model the third as well. The model focuses on the implications of deposits as "safe assets," and in particular on how changes in the safety value of deposits—for example by a reduction in the probability that uninsured deposits will be bailed out—affect firms' labor demand and investment.

Our main result is that a banking crisis, coupled with a sudden reduction in the probability that uninsured deposits are bailed out, has little to no effect on firms and macroeconomic outcomes. This result is the byproduct of two effects: on the one hand, the banking crisis and the lower bailout probability increase the riskiness of deposits, hindering firms' ability to engage in productive activities. On the other hand, frictions that prevent investors from quickly moving resources in and out of firms play an important role. That is, as deposits become riskier, firms redirect their internal funds to investments in physical capital, and with it, employment.

We also use the model to investigate what would happen if the U.S. moved from the current, partial deposit insurance regime to one of complete deposit insurance; that is, if depositors were guaranteed to never lose any money in the event of a bank failure, regardless of the amount of their holdings. We find no real effects of this policy change because, quantitatively, the U.S. already has near full deposit insurance, given the rarity that uninsured depositors ever face losses.

In work in progress, we are exploring the welfare effects of uninsured deposit bailouts and the implications for the optimal design of the deposit insurance scheme and of the resolution process of failed banks.

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Appendix

A Deposits and bank failures data analysis: details

A.1 Deposits

Our main analysis uses the Survey of Consumer Finances (SCF) to compute the amount of deposits held by households and to break this quantity down into insured and uninsured deposits. For other groups of depositors, we obtain aggregate data from the Flow of Funds (FF). When we work with both the SCF and FF at the same time, we use FF data from the third quarter of the respective year to facilitate the comparison. In the rest of this section, we provide details about our data analysis using the SCF. Starting with the 1992 survey, the SCF asks each respondent to provide detailed information about checking accounts, saving accounts, money market accounts, and certificate of deposits.

Regarding checking accounts, all years include information about amount, bank, and ownership of six checking accounts, as well as the amount held in any remaining checking account. We lack information about the bank and ownership of the remaining checking accounts, so we assume that the amount in these accounts is hold in one bank (that is different from all the other banks the household is engaged with) and is owned by the respondent.

Between 1992 and 2001, the SCF asks respondents about their money market deposit accounts, but this information is combined with savings account after 2001. Specifically, between 1992 and 2001 the survey asks about amount, bank, and ownership of up to three money market deposit accounts, as well as any amount held in additional money market deposit accounts. Similar to checking accounts, we assume that the amount held in additional accounts is in one bank (that is different from all the other banks the household is engaged with) and is owned by the respondent.

Regarding savings accounts, the SCF asks information about amount, bank, and ownership of up to five savings accounts between 1992 and 2001, and up to six savings/money market accounts after 2001. Similar to checking accounts, the SCF also asks about the amount held in any remaining checking account, and we assume such an amount is hold in one bank (that is different from all the other banks the household is engaged with) and is owned by the respondent.

Regarding certificate of deposits (CDs), the SCF provides the total amount of all CDs held by the family, up to five institutions where the CDs are held in the 1992 survey and up to seven in the following ones, and one response about the ownership of all the CDs. If the respondent lists multiple institutions where the CDs are held, we assume that the household owns the same amount of CDs at each of the institutions that are listed.

When information about the bank is provided, the public version of the SCF contains an identifier of the bank (rather than the name) for up to seven financial institutions the household is engaged with. For each additional institution, we have information about the broad category of the institution (e.g. "commercial bank," "brokerage," "person or other non-institution,"...). We remove accounts held at non-bank institutions such as stores, insurance companies, churches, unions, etc.

When information about ownership is provided, each account is assigned one of the following options: respondent, spouse, child or grandchild, other family member, unrelated person, respondent and spouse, respondent/spouse and child/grandchild, respondent/spouse and other relative, and respondent/spouse and unrelated person. We treat "child/grandchild" as one single owner. For the joint ownerships, we assume that the account is owned by three people; for instance, if the ownership is recorded as "respondent/spouse and child/grandchild," we assign equal ownership to the respondent, the spouse, and the child/grandchild. The SCF question about ownership includes, as possible responses, also "personal business account" and "trust account." We exclude personal business accounts, and we use the "trust account" to compute holdings in the trust ownership category (see Section 2.3 for a discussion of ownership categories). We assign the ownership of trust accounts entirely to the respondent.

We then calculate the amount held by each owner in any given bank, distinguishing between three ownership categories: single accounts, joint accounts, and (only for the respondent) trust accounts. Finally, we compute the amount of uninsured deposits, if any, as those that exceeds the FDIC insurance limit for each depositor, bank, and ownership category.

A.2 Bank failures

We use FDIC data to construct our sample of failed banks. We start our sample in 1986 so that we can link bank failures with aggregate data about the FDIC-insured banks from the FDIC Quarterly Banking Profile. Note that, for many failures before 1980, the data does not distinguish between those in which uninsured depositors were bailed out versus those in which they took a loss. We also exclude banks for which the FDIC bore no resolution cost, those for which the resolution cost is not available, or those that are recorded to have a negative resolution cost. Finally, we exclude banks for which data about assets or deposits as of the last filed Call Report before failure are not available.

For each failed bank, we then determine whether uninsured deposits experienced losses, based on the resolution method used by the FDIC. We drop 16 observations categorized as "MGR" (i.e., in which the resolution was handled by the Federal Savings and Loan Insurance Corporation by taking over management and generally providing financial assistance) because we cannot determine if uninsured deposits experienced losses. In our sample, uninsured depositors experienced no losses if the bank is resolved with a purchase and assumption transaction or if it is an assisted transaction, and experience losses in all other cases.