Deposit Insurance & Bank Lending

Robert Rogers[1]
London School of Economics

Abstract. Over the past 30 years, bank funding has shifted from small FDIC–insured deposits to large, uninsured deposits. This paper shows that insured deposits fund more lending, particularly business lending, while uninsured deposits are used to purchase more liquid securities. A natural experiment from the 1980 expansion of FDIC insurance limits demonstrates this effect is causal — deposit insurance leads to more business lending and more local business formation. The coefficients are economically large: a 10 ppt increase in the share of assets that are insured leads to a 2-4 ppt increase in loans to businesses as a share of assets and a 4-8% increase in the local number of businesses and employees. The long-term growth of large, uninsured deposits can therefore help explain the secular decline in banks' business lending as a share of balance sheet.

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PhD Candidate, Finance. r.rogers@lse.ac.uk

The past 30 years have seen rapid growth of large, uninsured bank deposits. The FDIC insures all deposit balances up to a dollar threshold, currently $250K. As the level and inequality of financial wealth has grown, more deposits have exceeded these thresholds. 20% of total bank funding has moved from insured to uninsured deposits, as shown in figure 1.

Much has been written about the effect of the long secular decline in deposit *interest rates* on total lending, business lending, bank stability, and the rise of non-banks (e.g. Drechsler et al., 2021; Supera, 2021; Drechsler et al., 2023; Sarto and Wang, 2022). But what about the effect of this large decline in deposit *quality* on lending?

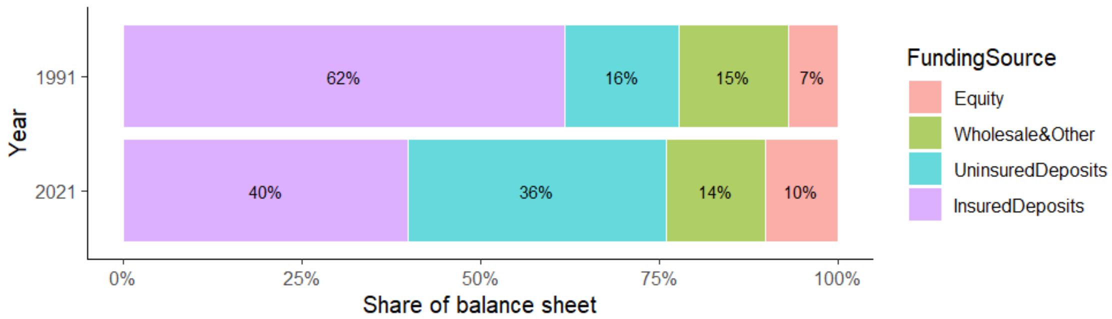

Fig. 1: Commercial bank funding sources, 1991 and 2021. Aggregate liabilities and equity of all commercial banks in the FFIEC call reports, divided by total assets, 1991 Q2 and 2021 Q2. "Wholesale and other" includes foreign deposits, repo funding, and other liabilities

I show that banks do tend to use small and large deposits differently. FDIC-insured deposits fund more lending, particularly business lending, while uninsured deposits are fund more liquid securities. Exogenous changes in insurance during the 1980 expansion of deposit insurance demonstrate that these effects are causal from deposit insurance to asset composition and that they have substantial knock-on effects on the local economy.

The scale of the identified effects is large. The natural experiment finds that each percentage point balance sheet that switches from uninsured to insured causes a 0.2 – 0.4 ppt increase in business lending as a share of assets. Taken at face value, this means the 20% shift in balance sheet from insured to uninsured deposits 1990–2020 could account for most or all of the long term decline in business lending as a share of bank activity (7 ppt over the same period).

The mechanism for this causal effect is intuitive. Large, uninsured deposits are less stable and more likely to run (Egan et al., 2017; Artavanis et al., 2022), as dramatically demonstrated by the failure of Silicon Valley Bank. Banks with more uninsured deposits therefore choose to hold more liquid assets that can be easily sold to fund deposit outflows. This mechanism was written into post-crisis regulation: the Liquidity Funding Ratio and Net Stable Funding Ratio require banks to hold more liquid assets against large, uninsured deposits.

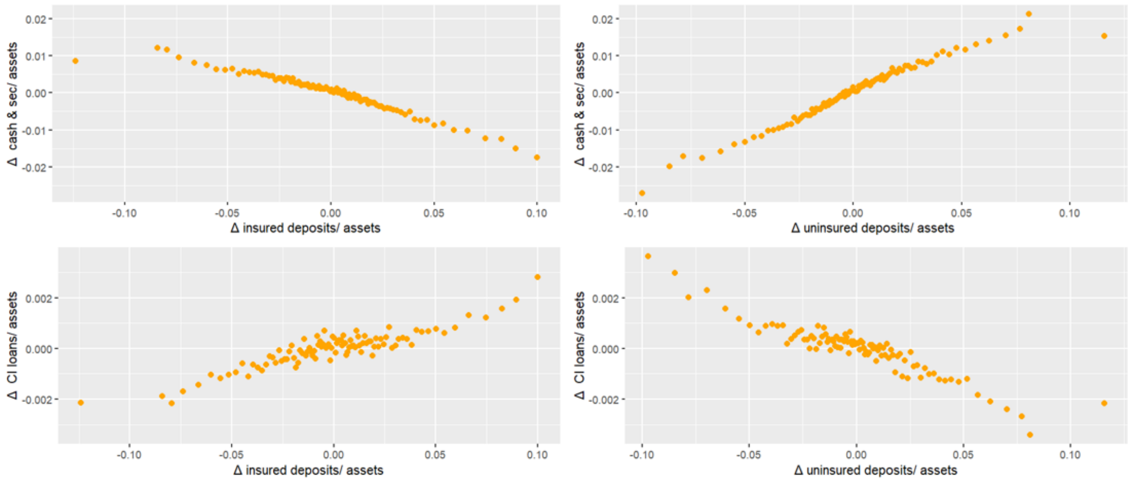

Fig. 2: Bin scatter plot of annual changes in insured deposits (left hand side) or uninsured deposits (right hand side) vs cash and securities (top) or commercial and industrial loans (bottom) as a share of balance sheet. All bank-quarter observations from 19787-2021 have been sorted into 100 equal-sized bins based on the x-axis. See section 1 for more detail on filters and data treatment.

The relationship between insured deposit share and asset liquidity is abundantly clear in the panel data of all banks. Banks whose funding moves from insured to uninsured deposits increase their holdings of cash and liquid securities and decrease their holdings of loans. Figure 2 plots the relationship between changes in insured or uninsured deposit funding and changes in holdings of liquid securities or business loans. The relationship is linear, symmetric, and holds controlling for bank and time fixed effects. Insured deposits fund more illiquid loans than uninsured deposits.

To test if this effect is causal from deposits to loans, I use the 1980 expansion of deposit insurance as a natural experiment. In March 1980, the The Depository Institutions Deregulation and Monetary Control Act (DIDMCA) was signed into law. As part of a broad suite of changes in banking regulation, this act more than doubled the FDIC insurance limit for deposits, raising it from \$40K to \$100K per customer. This change mechanically increased the share of each bank's deposits that were insured.

The effect of DIDMCA on insured deposit balances was heterogeneous depending on the number of accounts each bank had valued at over \$100K prior to March 1980. This heterogeneity allows a simple difference–in–difference event study comparing the evolution of lending behaviour by banks which gained more or less deposit insurance after 1980.

This approach shows large effects on business lending and on county-level business and employment. An extra 10 ppt of deposit insurance leads to a 2-4 ppt increase in loans to businesses as a share of assets. At a county level, this results in a 4-8% increase in employment and number of businesses.

If these effect sizes are correct and have continued to the current day, then changes in depositor size could explain most of the drop in bank business lending over the past 30 years. Commercial and industrial lending as a share of bank balance sheet fell by 7 ppt of

Fig. 3: Event study plots for the effect of deposit insurance on securities & cash holdings (left) and business lending (right). Callaway and Sant'Anna (2021) estimator of the effect of having above or below median estimated share of deposits newly-insured by DIDMCA in Q1 1980. Dependent variables are the ratio of securities and cash to assets (left) and of commercial and industrial loans to assets (right). The regression includes doubly robust controls for the ratio of securities and cash , RE loans, CI loans to assets as of end of 1979, as well as log assets, agricultural loans over assets, the deposit share of liabilities, and the share of time deposits. The share of deposits newly-insured is estimated based on the share of time deposits with value over USD 100K, as described in section 2. The corresponding diff-in-diff estimation is shown in table 2.

assets, from 19% at the start of 1990 to 12% at the end of 2019. The results of the natural experiment suggest the 20 ppt decline in insured deposits over the same period would lead to a 4–8 ppt drop in business lending, potentially explaining the entire change.

I take three approaches to address potential concerns about non-parallel trends between the high and low treatment groups. First, I employ the Callaway and Sant'Anna (2021) doubly–robust multiple time period estimator to weaken the parallel trend requirement to only hold conditional on a vector of observable controls. Second, I show event–study plots, as shown in figure 3, which do not show any pre–trend. Third, I conduct placebo tests using the exact same methodology for each quarter 1990-2000, to test if trends were parallel during other periods when the deposit insurance was not expanded.

The results for commercial & industrial loans and county employment hold up to these additional controls and tests. Results for real-estate lending show substantial non-parallel trends during the placebo period and so are more challenging to interpret causally. Section 2 also considers and rejects a few alternative explanations for the findings.

The rest of this paper is structured as follows. Section 1 shows the cross-sectional presents the cross-sectional evidence. Section 2 presents the results of the natural experiment and constitutes the majority of the paper. Section 3 gives a brief description of a model that rationalises the findings, although the bulk of the model is in appendix 3. The paper finishes with a brief conclusion.

1 Panel evidence on bank balance sheets

There is little literature explicitly measuring empirically how insured and uninsured deposits are lent out by banks in normal times.[2] I therefore begin by setting out the basic empirical relationship in the panel of all banks 1978–2021. Data treatment is described in section 1.

A simple examination of the cross section of bank balance sheets movements shows that large uninsured and small insured depositors fund different assets on average. Banks tend to match changes in illiquid and longer term assets more with changes in small insured deposits and changes in liquid and shorter term assets more with changes in large uninsured deposits.

The bin scatter plots in figure 2 show this relationship. In this chart I form equal-sized groups of annual observations of banks, sorted by insured or uninsured deposits, and plot their average changes in different asset ratios. I also winsorize growth rates at 2.5% and only include observations in which the relevant objects were at least 1% of balance sheet in both periods, and in which bank asset growth rates did not differ from market rates by more than 30 percentage points.

The chart shows that banks with larger increases in insured deposits increase their relative holdings of loans, particularly business loans, and decrease their relative holdings of cash, whereas banks with larger increase in uninsured deposits instead hold more cash. The observation on business loans is particularly striking considering that an overall increase in the number or size of business customers should both increase the large uninsured deposit ratio and business lending, pushing these results in the other direction.

The effects persist with bank and time fixed effects (i.e. allowing for bank-specific trends), controls for concurrent changes in other funding sources (e.g. equity and repo), and growth in assets — regression results are shown in table 1. The effect sizes are economically significant — a 10% increase in insured deposits/ assets is associated with a 1% increase in cash and securities/ assets, a 0.3% increase in mortgage loans/ assets, and a 0.1% increase in business loans/ assets.

To show that this result does not come from my particular choice of asset categories, the table includes the Berger and Bouwman (2009) measure of aggregate illiquidity of all assets in column 4. This metric — "asset side liquidity creation" provides an aggregate impact of the effects on the various asset categories. A 10% increase in insured deposits/ assets is associated with a 1% increase in the total illiquidity of assets.

[2] Calomiris and Jaremski (2019) look at the early history of deposit insurance at the start of the 20th century. And a few papers measure the impact of stresses on banks' deposit choices (Martin, Puri, and Ufier, 2018; Chen, Goldstein, Huang, and Vashishtha, 2020; Chavaz and Slutzky, 2021).

	$\Delta\frac{\text{Cash \& Sec}}{\text{Assets}}$	$\Delta\frac{\text{Mortgages}}{\text{Assets}}$	$\Delta\frac{\text{CI loans}}{\text{Assets}}$	$\Delta\frac{\text{Asset-side Liq. creation}}{\text{Assets}}$
Δ Insured deposit share	−0.103***	0.036***	0.014***	0.111***
	(0.009)	(0.005)	(0.002)	(0.011)
Δ Time deposit share	−0.089***	0.014**	0.011***	0.113***
	(0.010)	(0.004)	(0.002)	(0.012)
Δ Deposit share of liabs	0.056***	−0.038***	0.003	−0.071***
	(0.015)	(0.008)	(0.006)	(0.018)
Δ Repo share of liabs	0.094***	−0.039**	−0.013+	−0.111***
	(0.024)	(0.011)	(0.007)	(0.029)
Δ Equity/ assets	0.467***	−0.102***	−0.140***	−0.155
	(0.029)	(0.011)	(0.009)	(0.091)
Δ Log assets	0.036***	−0.006**	−0.005**	−0.048***
	(0.004)	(0.002)	(0.002)	(0.006)
Num.Obs.	328 371	213 083	327 921	243 979
R2	0.159	0.112	0.088	0.137
R2 Within	0.046	0.012	0.010	0.021
FE: rssdid	X	X	X	X
FE: dateq	X	X	X	X

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Table 1: Regression of asset class dynamics on insured and uninsured deposit dynamics, with fixed effects and controls. This regression presents the relationship between annual changes in different deposit types (insured and uninsured) and asset classes (cash & securities, residential mortgages, commercial & industrial loans, and asset-side liability creation from Berger & Bouwman (2009)) in all US bank panel data from 1982-2021, using annual observations and excluding 2020. I compute year-over-year changes in shares of a balance sheet item to bank total assets. I regress changes in shares of balance sheet items, and change in log assets, on changes in shares of insured and uninsured deposits allowing for bank and year fixed effects (i.e. bank-specific trends) and controlling for changes in equity capitalisation. Standard errors are clustered two ways.

One potential concern with the results is that large inflows could be held in securities and cash until lending opportunities are available. If uninsured deposits are more volatile, they could then appear more associated with cash and securities over one year periods even if there is no difference over the longer term.

This does not appear to be the case though. First, changes in uninsured deposits/ assets actually have a slightly lower standard deviation than those of insured deposits/ assets (4.7% vs 5.2%) because of the larger size of insured deposits at the average bank. Second, the bin scatter plots from figure 2 do not show any non-linearity where larger changes in deposits / assets are more associated with variations in cash. Third, the regressions in table 1 include a control for growth in total balance sheet (changes in log assets).

In appendix 2 I also consider whether the results could be driven by maturity and interest rate risk instead of liquidity and show this does not appear to be not the case. The same trends to not hold between liquid securities with different maturities.

2 Causal inference from the 1980 FDIC limit expansion

Section 1 demonstrates that there is a relationship between type of deposit funding and liquidity of loans, but it does not prove any causal impact of loan flows or types on lending activity. It could be that the causal relationship flows purely from assets to deposits (i.e. banks choose their depositor types based on the liquidity of their asset portfolio) or that both are simply related to other omitted variables. To demonstrate causality, we need to find a source of exogenous change in deposit insurance. I use the expansion of insurance caps in 1980 as this source of exogeneity.

2.1 Context

In March 1980, the Depository Institutions Deregulation and Monetary Control Act (DIDMCA) was signed into law. DIDMCA was a major regulatory reform package, which ended the "regulation Q" ceilings on the interest rates that banks could offer their depositors. The removal of these limits was phased in gradually over 6 years.

Importantly for this paper, DIDMCA also increased the maximum size of individual accounts that FDIC insurance covers from $40,000 to $100,000. This deposit insurance expansion was substantially larger than previous increases, and would last for 38 years.[3]

Two related motivations have been given for the increase in deposit insurance. The first is to encourage savings. President Carter, in his remarks on signing the bill said "Most significant of all, perhaps, [the bill] can help improve our Nation's very low savings rate" (Carter, 1980). Raising the insurance limit could make large deposits and savings more appealing to savers.

Second, the deposit insurance aimed to slow or stop outflows from the banking sector into money market funds or other instruments due to their higher interest rates. The FDIC later wrote that deposit insurance expansion was added "in recognition that many banks and savings-and-loan associations [were] facing disintermediation in a high interest-rate climate" (FDIC, 1996). From 1977 Q1 to 1981 Q1 total deposits in commercial banks shrank 10% in real terms (25% nominal increase vs 35% cumulative inflation).

The increase in insurance was not requested by the FDIC due to fears of bank failure — in fact it was opposed by the FDIC (FDIC, 1996). The increase was also applied to all banks as a mandatory measure, so there is no risk of selection effects from banks or the FDIC choosing to whom the treatment applies.

[3] The next increase was in 2008, to $250K. This paper does not focus on the 2008 increase because the timing of implementation was fuzzy — it was implemented as a temporary measure first and then made permanent in 2010 — and because of the general financial system turmoil in 2008.

2.2 Constructing the treatment variable

The ideal treatment variable would be the total value of newly insured by DIDMCA in March 1980 — i.e. the total balance between \$40K and \$100K of all accounts with over \$40K in value. In practice, the Call Reports only provide data on balances over \$100K, so I assume that the number of accounts valued between \$40K and \$100K is relatively small, and use a variable which I will call ΔI:

$$\Delta I = \$60K * \frac{\#\text{ accounts valued over \$100K}}{\text{assets}}$$

ΔI is correlated with deposit concentration, but not the same — the banks with the largest depositors will have a relatively small number of deposits relative to deposit size, so may score low on ΔI. In 1982 Q2, ΔI had a correlation of 43% with the ratio of uninsured deposits to assets. ΔI also appears to be related to how many business customers the bank has — correlation with CI loans/ assets is 47%.

In practice, however, data on the number of accounts with value over \$100 K is only available starting in 1982 Q2 — 2 years after the implementation of DIDMCA. So the regressions in this paper use a proxy for 1979 Q4 ΔI — the share of time deposit balances which are in accounts greater than \$100K. This metric closely correlates with ΔI, with a correlation coefficient of 75% as of 1982 Q2.

The estimated treatment is therefore the coefficients from a regression in 1982 Q2 of ΔI on the share of time deposit balances over \$100K, fitted onto the 1979 Q4 share of time deposit balances over \$100 K.

Local economic characteristics can also help predict ΔI (e.g. through the size distribution of local deposits) — home–state fixed effects can explain 26% of the variance, and home-county fixed effects 34%. As an alternate proxy and robustness in section 2.4, I also predict ΔI using only county-level variables. In particular I use a lasso regression one a long list of county business and employment variables and state dummies — the resulting coefficients are shown in in table 8.

2.3 Controlling for observables

The critical assumption for the validity of the difference-in-difference estimation is parallel trends — that high and low treatment banks and counties would have evolved the same way were it not for the DIDMCA changes to deposit insurance.

Table 7 compares the groups which are above and below the median estimated treatment (as described above). The two groups mostly look similar with two notable exceptions: median assets are 80% larger in the high-treatment group, and the asset mix is tilted more toward commercial and industrial loans (by 6 ppt of assets) and away from agricultural loans (by 8 ppt).

These observed differences can be controlled for. I use the Callaway and Sant'Anna (2021) estimator, which only requires that parallel trends hold conditional on observable controls. I.e. we must only assume that high and low treatment banks would have evolved the same, conditional on their pre-treatment asset size being the same and their pre-treatment ratio of commercial and industrial loans to assets being the same. I also control for pre-treatment levels of agricultural loans/ assets, cash and securities / assets, real estate loans/ assets, deposits/ assets, and time deposits/ deposits.

The estimator is so called "doubly robust" because it identifies a causal effect if either (but not necessarily both) a propensity score or outcome regression working models are correctly specified. I.e. if the chance of having a large or small number of large accounts follows a logistic propensity model in the controls, or the subsequent trend in assets is a linear function of the controls.

The Callaway and Sant'Anna (2021) estimator has the added benefit of also addressing the well-known issues with two way fixed effects estimators and heterogeneous treatment effects (e.g. de Chaisemartin and D'Haultfœuille, 2020). Even if the treatment effect sizes are heterogeneous and correlated with the treatment, the estimator provides an estimate of average treatment on the treated.

The estimator requires a discrete instead of continuous treatment effect. I therefore group all banks into the top half and bottom half in terms of their predicted 1979 Q4 ΔI measure. The top half are taken to be the treated and the bottom half the untreated.

2.4 Estimates

Bank-level estimates from the Callaway and Sant'Anna (2021) estimator with controls are shown in table 2. Effects on cash and securities / assets, RE loans/ assets, and CI loans/ assets are all significant. The ATT estimates give the causal impact of being above or below the median level of the 1979 Q4 total share of deposit balances over \$100K.

Category	ATT (ppt)	se	Implied effect of 1% Δ I (ppt)
Securities & cash/ assets	-2.37	0.20	-0.63
RE loans/ assets	0.69	0.12	0.18
CI loans/ assets	1.44	0.20	0.38
Log deposits	-0.27	0.78	

Table 2: Effect of having above or below median estimated share of deposits newly-insured by DIDMCA in Q1 1980. The Callaway Santanna ATT estimator includes doubly robust controls for the ratio of securities and cash, RE loans, and CI loans to assets as of end of 1979, as well as log assets, agricultural loans over assets, the deposit share of liabilities, and the share of time deposits. The share of deposits newly-insured is estimated based on the share of time deposits with value over \$100K. Data from 1977 Q1 to 1984 Q4 is used. Results are shown in percentage points

Event study plots for the same regressions are shown in figure 6. There is no apparent pre-trend for any metric before 1979, although there may be some anticipation visible in 1979 Q3 and Q4.

County level results are shown in 3, using the same approach. Effects on number of establishments, employment, and payroll are all large and significant. Event study plots for the same regressions are shown in figure 7.

Category	ATT (%)	se	Implied effect of 1% Δ I (%)
Log # establishments	2.19	0.35	0.76
Log employment	2.45	0.58	0.85
Log q1 payroll	5.21	0.91	1.81

Table 3: Effect on county-level business and employment measures of a county having above or below median estimated share of deposits newly-insured by DIDMCA in Q1 1980. The Callaway Santanna ATT estimator includes doubly robust controls for the log employment level, number of establishments, and quarterly payroll as of 1979 Q4, as well as log assets, the deposit share of liabilities, and the share of time deposits as of 1979 Q4. The share of deposits newly-insured is estimated based on the share of time deposits with value over $100K. Data from 1977 Q1 to 1984 Q4 is used. Results are shown in percentage points

To assist with interpretation of the ATT findings, the third column of tables 2 and 3 scales the results by the difference in newly–insured deposits as a share of balance sheet for these two groups. I estimate that the below–banks had approximately 2.1% of their balance sheet newly-insured (i.e. $\Delta I \approx 0.02$), whereas the above–median banks had approximately 5.9% of their balance sheets newly insured. The 3.7 percentage point gap in ΔI between the two halves thus implies that we can scale up the ATT estimate by approximately 26x to estimate the effect per unit of newly insured deposits. Adjusted standard errors are not provided for these rough scaling calculations.

To give comfort that the results are not all driven by the control methodology I also show the results from a simple "naive" two way fixed effects regression in table 5 and event study plots in figure 5. These show similar results to the estimate with controls.

Table 9 provides the same figures are calculated using the county–based lasso estimator of ΔI instead of the estimates based on each bank's share of large time deposits. Estimates are all almost identical for securities and commercial & industrial loans, but differ somewhat more for real-estate lending (0.7 vs 1.2).

2.5 Placebo tests

As a further test of the plausibility of parallel trends, I perform placebo tests of the exact same specifications repeated 1990-2000. The placebo tests start in 1990, 10 years after the main test, to ensure any remaining effect of DIDMCA has disappeared. They end in 2000 because data on the number of deposits over $100K is no longer available after the mid-2000s.

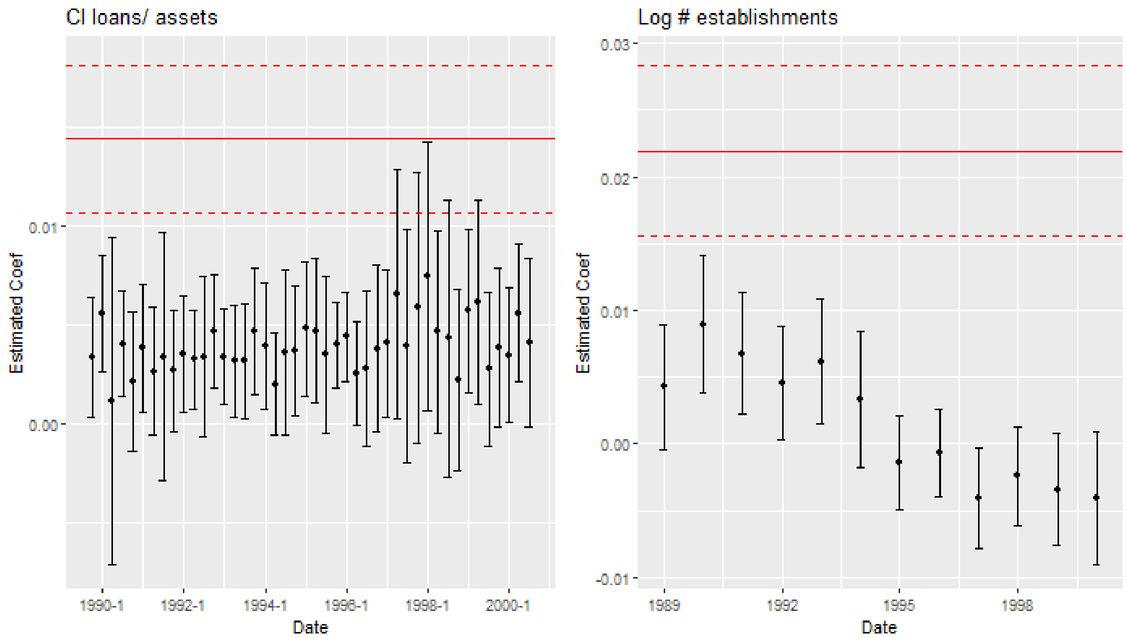

Fig. 4: Placebo test plots for business lending and number of establishments for the difference in difference estimation described in table 2. In each quarter from 1990 to 2000 (or each year for establishment data), the Callaway and Sant'Anna (2021) ATT estimator is calculated exactly as described for 1980 Q1 in section 2.4. The ATT estimate and its 95% confidence interval are plotted for each period. The 1980 Q1 estimator and its 95% confidence interval are shown in red. The left hand shows the bank-level results for the commercial and industrial loans to assets, while the right hand side shows the county-level results for the log of the number of business establishments.

If significant results are frequent, then the groups may be inherently different enough that there is no reason to believe parallel trends should hold. If results are always smaller or non-significant in other periods, than that shows that something unusual happened in 1980 to make the trends not parallel.

The other aspects of DIDMCA were not specifically focused on the $100K deposit size cutoff — so if something special happened to change the trends for banks with large deposits in 1980, it seems reasonable to assume it is the deposit insurance expansion.

The results of the placebo tests for business lending and for county-level number of establishments are shown in figure 4. In both cases, most periods give estimators whose confidence intervals either include 0. or come close to doing so. The largest measured effect sizes during the placebo regression are approximately one half as large as those measured in 1980.

A conservative adjustment of -50% to the estimates from tables 2 and 3 would therefore suggest that the effect of a 10 percentage point increase in deposit insurance is approximately 2–4 percentage points on CI loans/ assets and 4–8% on number of establishments, and number of employees. CI lending is only 14% of assets in 1979 for the treated banks, so the 2–4 percentage point effect on CI lending represents a much larger relative increase than the effects on number of establishments and employees.

Figures 8 and 9 show the placebo test plots for the other variables. The effects on employment and quarterly payroll show similarly small results relative to the measured 1980 coefficients.

However, real–estate lending shows large and significant estimates for many periods – negative in the early 1990s and positive in the late 1990s. In other words, the real-estate lending portfolios of above-and-below median banks by share of large time depositors evolves in very different directions at many points in time even without any changes in the deposit insurance limits. There may be other factors, regulations, or events in the 1990s which cause these changes. For conservatism however, this paper does not make any claims regarding causality of the relationship of insurance and real–estate lending.

Since securities and cash over assets is closely related to real–estate lending over assets (the banks predominantly hold either loans or cash and securities), the placebo tests for cash and securities also shows some substantial significant estimates. None of the estimates are as large in magnitude as the 1980 estimate, but nonetheless substantial caution should be taken if interpreting any of the 1980 evidence causally.

2.6 Reconciling estimates with the panel data

These estimates are substantially larger than the simple panel evidence from section 1. The univariate relationships plotted in figure 2 show that a 10 ppt increase in insured deposits / assets is associated with only a 1-2 ppt decrease in cash and securities/ assets and a a 0.2-0.3% increase in commercial and industrial lending.

There are at least three good reasons for this difference. First, the plots and regressions in section 1 only compare same-period 1-year differences, whereas the impacts of the deposit insurance expansion grow over the course of 2-3 years as banks adjust their lending portfolios. The event plots in figures 3 and 6 show that only approximately one quarter to one third of the impact is realised within the first year after deposit insurance expansion

Second, the increase in deposit insurance in 1980 was permanent and applied to all banks at once. Many deposit inflows to individual banks are temporary — the autocorrelation of changes in insured deposits over assets is -23%. As such, banks should be less willing to adjust their lending in response.

One reason for changes in deposit insurance levels to be temporary is that banks can choose to adjust to a surprise increase in insured deposits by lowering their deposit rates to bring their level of insured deposits over assets back to its earlier equilibrium (although at a lower interest expense) instead of adjusting their asset portfolio. In 1980, though, since the increase in insurance was applied to the whole system, on average banks needed to increase their insurance levels.

Finally, the relationship in the cross-section may be weakened by a positive correlation between corporate deposits and loans at an individual bank. If a bank attracts or loses corporate clients they are likely to bring or take both their loans and their (predominantly uninsured) deposits with them. Changes in the business model of bank in terms of their focus on retail vs corporate clients are therefore likely to weaken the cross-sectional relationship of deposit insurance with business lending.

2.7 Alternative explanations

One complicating factor affecting the interpretation of the results is the potential for deposit insurance limit changes to affect deposit inflows. An increase in insurance limits could cause larger inflows into banks with large depositors. E.g. there is some evidence depositors spread deposits across banks, holding amounts just under the FDIC coverage limits (e.g. Artavanis et al., 2022). Rapid inflows could lead to an increase in securities and cash holdings as a share of assets if banks take time to make loans.

However, we do not see evidence of large deposit inflows to banks with more large accounts in the data. Table 2 finds only an insignificant small negative number (-0.27%) for the ATT on deposit quantities.

Branch level deposit data from the 2008 increase in limits also does not pick up any obvious effect from the later deposit insurance increase either.[4] Year-to-year variance in branch-level deposits is no higher in 2008 than other years and there is no systematic gain or loss by banks that had a larger or smaller market share in each region.

A second potential complication comes from the lifting of interest rate ceilings for small time deposits in the late 1970s. Before the 1980s, banks generally faced caps on how much interest they could pay on small time deposits. In the late 1970s, however, two new products were introduced with higher caps — Money Market Certificate (MMC) in June 1st 1978 and Small Saver Certificate (SSC) accounts on July 1st 1979. MMCs had maturity of six months and denomination of $10,000 or more. SSCs had a maturity of at least 30 months and no minimum denomination. Supera (2021) argues that these two products resulted in an increase in small time deposits at banks and a resulting increase in business lending.

However, the timing of those effects do not exactly line up the relationship documented in this paper — the increase in time deposits and commercial and industrial loans documented documented by Supera (2021) appears to be mostly complete by 1980, whereas the relationship between number of large deposits and changes in commercial and industrial lending documented in this paper starts in 1980 and continues through 1981.

Additionally, the share of time deposits does not increase more rapidly for our above-median-treatment banks, as would be required for growth in time deposits caused the relative increase in business lending. Table 7 shows that the share of deposits that are time deposits actually grows two percentage points more for below–median vs above–median banks.

[4] Branch-level deposit data from 1980 is not available.

Finally, another complicating factor that occurred during the same time period was the Volcker disinflation and interest rate increases. From July 1979 to December 1980 the federal funds rate rose from 10% to 19%. It is not clear why this should lead to the effects observed in this section, but it is a major disruption that occurred in a similar time frame. The timing also does not line up precisely with the measured changes in business lending, however — CI loans appear to increase over 2-3 years and then stay elevated, whereas interest rates rose and then fell rapidly, returning to 10% by August 1982. Additionally, the placebo tests cover another period of rising interest rates, January 1994 to March 1995, which does not show any similar patterns.

3 Explaining the mechanism

The findings of this paper can be rationalised by a simple model in which:

- There are a range of investment projects with different levels of liquidity seeking bank funding.
- Competitive banks gather insured and uninsured deposits and lend to these projects.
- There is some small probability that uninsured deposits all decide to run (e.g. because a very rare disaster state becomes more likely)
- If a bank sells a loan early it pays some liquidation cost. The cost will be higher for less liquid projects. We might for example think that a loan to a risky, information-sensitive, non-public business will be illiquid, whereas a mortgage will be more liquid.

I show in appendix 3 that under these conditions a decrease in deposit insurance will raise the cost of funding for illiquid projects (e.g. businesses) and lower the risk cost of funding for liquid projects, securities, and the risk free rate. I show this in a simple three period model loosely based on Hanson et al. (2015) and Stein (2012)

The mechanism is that a competitive bank will incorporate the expected losses from firesales when it lend to illiquid projects. So if there are fewer insured deposits available, firesales are more likely, and the cost of borrowing for illiquid projects is greater. More uninsured funding is left chasing the liquid projects, driving down the returns on liquid securities.

An exogenous increase in deposit insurance will therefore increase business funding and local economic activity, as I show in section 2. On the other hand, a long term decline in the share of deposits insured, as experienced over the past 30 years, will tend to lead to declining bank lending. Small firms will have a harder time getting funding despite low yields on liquid securities, and more activity will be funded through securitisation and non-bank lending.

4 Conclusion

This paper tests the effects of deposit size and insurance on bank assets. Cross sectional evidence shows that increases in insured funding are associated with decreases in the share of assets in securities and cash, and increases in the share of assets in loans. Increases in uninsured funding are associated with the opposite.

Identification using the 1980 Depository Institutions Deregulation and Monetary Control Act finds large causal effects of deposit insurance on business lending and local employment and number of business establishments. A 10 percentage point increase in insurance as a share of balance sheet appears to lead to 2-4 percentage point increase in business loans as a share of assets and a 4-8% percentage point increase in the number of business establishments and employment.

These findings suggest that the large drop in the share of insured deposits over the past 30 years could account for some of the decline in bank balance sheet lending to businesses.

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Tables and Figures

	$\Delta log\frac{InsuredDep}{assets}$	$\Delta log\frac{UninsuredDep}{assets}$	$\Delta log\frac{RepoLiab}{assets}$
$\Delta log\frac{InsuredDep}{assets}$	1.00	-0.40	-0.19
$\Delta log\frac{UninsuredDep}{assets}$	-0.40	1.00	-0.13
$\Delta log\frac{RepoLiab}{assets}$	-0.19	-0.13	1.00

Table 4: Funding type correlation table. This table presents the correlation matrix of annual changes in insured and uninsured deposit and repo funding in all US bank panel data from 1978-2021, using annual observations. 2008-2009 is excluded and variables are winsorized at 2.5%.

	Cash & Sec / Assets	Mortgages / Assets	CI loans / Assets
Post 1979.75 * estimated exposure	−0.647***	0.587***	0.136***
	(0.083)	(0.060)	(0.026)
Num.Obs.	432 960	432 961	432 961
R2	0.750	0.868	0.792
R2 Within	0.015	0.033	0.002
FE: rssdid	X	X	X
FE: dateq	X	X	X

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Table 5: Naive two way fixed effects difference-in-difference regression for the effects of deposit insurance expansion. Dependent variables are the ratios of loan categories (cash & securities, real-estate loans, and commercial & industrial loans) to total assets. The dependent variable is a dummy for the quarter being 1980 Q1 or later multiplied by the estimated share of balance sheet newly insured. Share of deposits newly insured is estimated based on the total number of time deposits greater than $100K as of December 1979.

	Log employment	Log Q1 payrolls	Log # establishments
Post 1979.75 * estimated exposure	0.302	0.525	0.660
	(0.480)	(0.688)	(0.447)
Num.Obs.	24 192	24 192	24 231
R2	0.996	0.994	0.998
R2 Within	0.000	0.001	0.006
FE: cntynumb	X	X	X
FE: year	X	X	X

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Table 6: Naive county-level two way fixed effects difference-in-difference regression for the effects of deposit insurance expansion. Dependent variables are log of number of business establishments, total employment, and first quarter payroll from the County Business Paterns surve. The dependent variable is a dummy for the quarter being 1980 Q1 or later multiplied by the estimated share of balance sheet newly insured. Share of deposits newly insured is estimated based on the total number of time deposits greater than $100K as of December 1979.

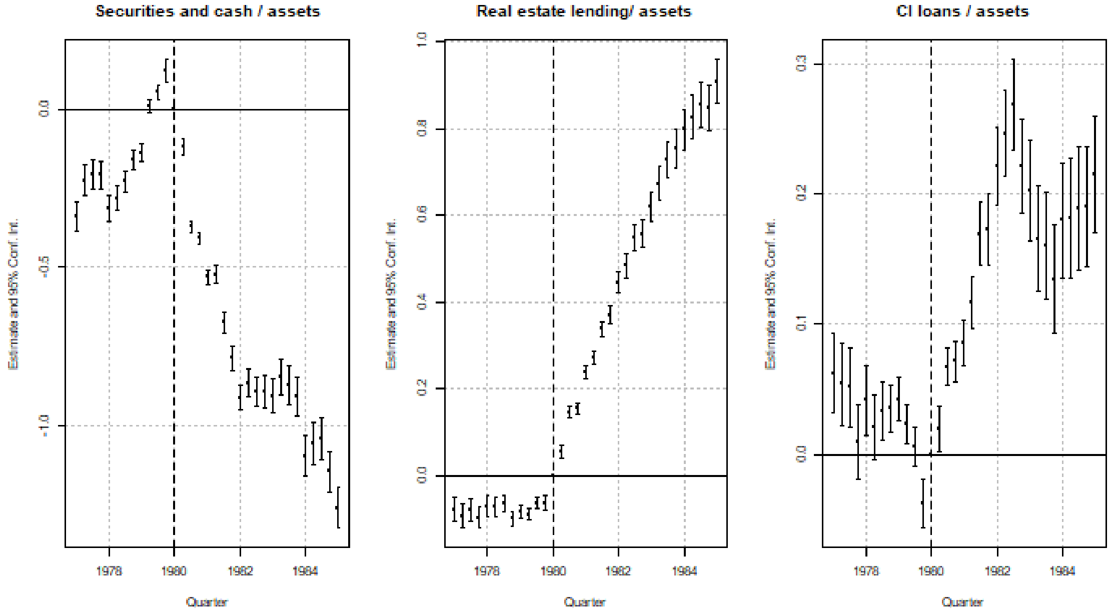

Fig. 5: Event study plot from the two way fixed effects regression described in table 5

	Bottom half	Top_half
1979 Q4 variables:		
Median assets	17590.00	32764.50
Mean assets	29109.98	196521.72
Share of time deposits > $100K	0.08	0.38
Deposit share	0.98	0.96
Share of time deposits	0.47	0.44
Securities & Cash/ assets	0.42	0.41
CI loans/ assets	0.08	0.14
RE loans/ assets	0.21	0.19
Equity/ assets	0.09	0.09
Agricultural loans/ assets	0.13	0.05
Count	6891.00	6890.00
1982 Q2 variables:		
Assets (82Q2)	36670.68	199571.00
Share of time deposits (82Q2)	0.61	0.56
Equity/ assets (82Q2)	0.09	0.08
Insured share of deposits	0.96	0.87
Δ I	0.02	0.05

Table 7: Characteristics of banks above and below median share of time deposits of value over $100K as of 1979 Q4. All figures represent means across all commercial banks (unless marked median).

	County lasso coefficients
# Establishments	0.0011
# 1-4 person establishments	0.0000
# 5-9 person establishments	0.0009
# 10-29 person establishments per capita	0.0020
# 20-49 person establishments per capita	0.0034
AZ	0.0149
AR	0.0020
CA	0.0284
CO	0.0130
CT	-0.0078
IL	-0.0001
IA	-0.0050
LA	0.0255
MI	0.0002
MN	-0.0049
MS	0.0044
NE	0.0000
NH	-0.0006
NM	0.0138
NY	-0.0070
ND	-0.0005
OH	-0.0055
OK	0.0200
PA	-0.0103
SC	0.0751
SD	0.0173
TX	0.0363
WV	-0.0036
WI	-0.0119
WY	0.0083

Table 8: Non-zero coefficients from the lasso regression of number of > $100K accounts on county characteristics. State codes represent state fixed effects. Characteristics other than state dummies are normalised to variance 1. County characteristics include state dummies, population, income, employment, poverty rates, and earnings (both in logs and levels), and number of business establishments for each size band of employees (both in total and per capita). Regression includes quarters from 1980 to 1985. Lambda is picked using k-fold cross-validation, using each quarter representing a fold.

Category	ATT (ppt)	se
Securities & cash/ assets	-2.65	0.23
RE loans/ assets	1.18	0.10
CI loans/ assets	1.53	0.13

Table 9: Results in percentage points of Callaway Santanna ATT estimator, using only county-level data to predict whether each bank is above or below the median share of deposits newly-insured by DIDMCA in Q1 1980. Shares of deposits insured are estimated using a lasso regression of bank-level large deposit shares on county characteristics 1980-1985.

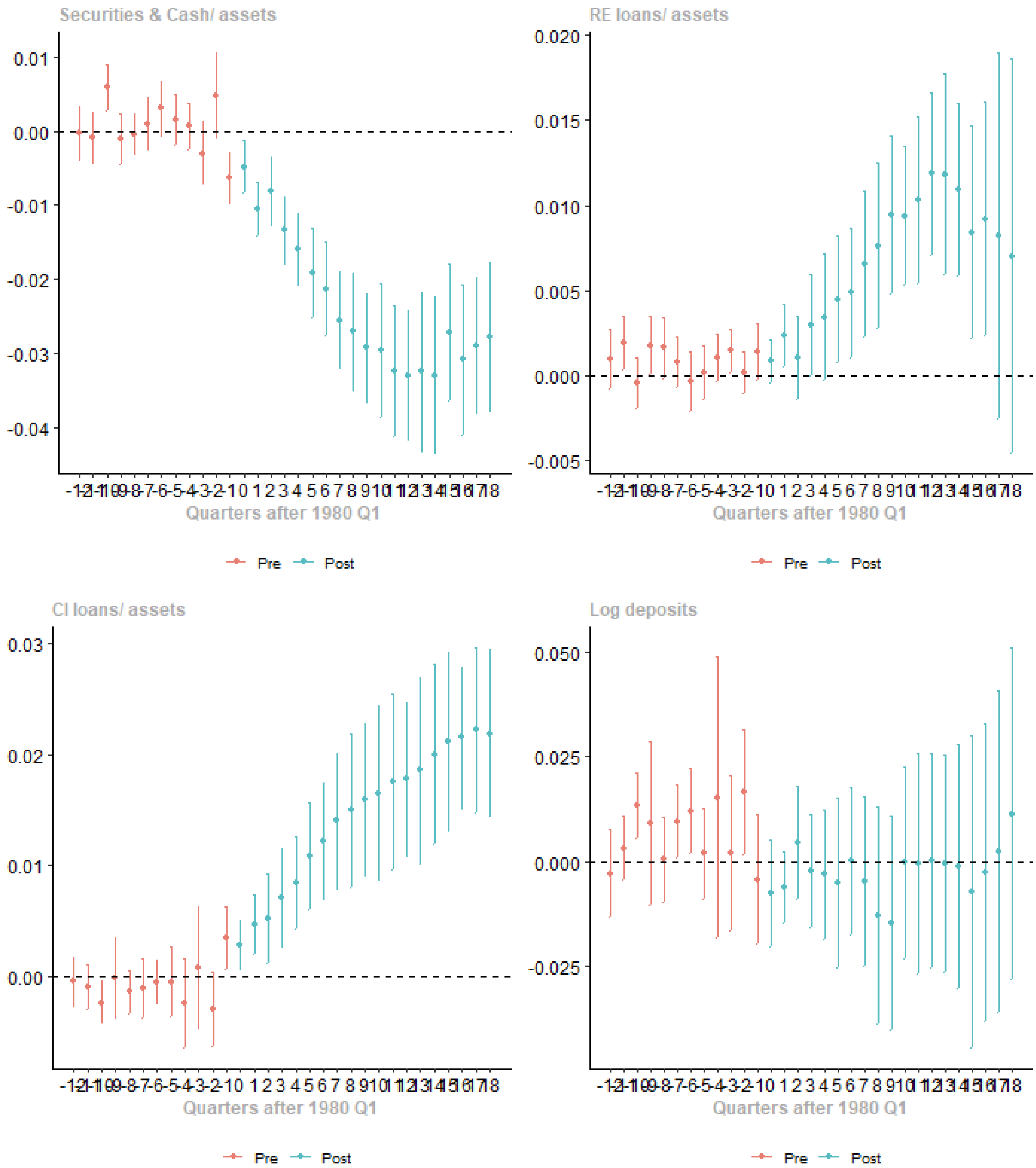

Fig. 6: Event study plots from the difference in difference estimation descried in table 2. Callaway and Sant'Anna (2021) estimator of the effect of having above or below median estimated share of deposits newly-insured by DIDMCA in Q1 1980. Dependent variables are the ratio of securities and cash to assets (top left), the ratio of real estate loans to assets (top right), the ratio of commercial and industrial loans to assets (bottom left), and log deposits (bottom right). The regression includes doubly robust controls for the ratio of securities and cash , RE loans, CI loans to assets as of end of 1979, as well as log assets, agricultural loans over assets, the deposit share of liabilities, and the share of time deposits. The share of deposits newly-insured is estimated based on the share of time deposits with value over USD 100K.

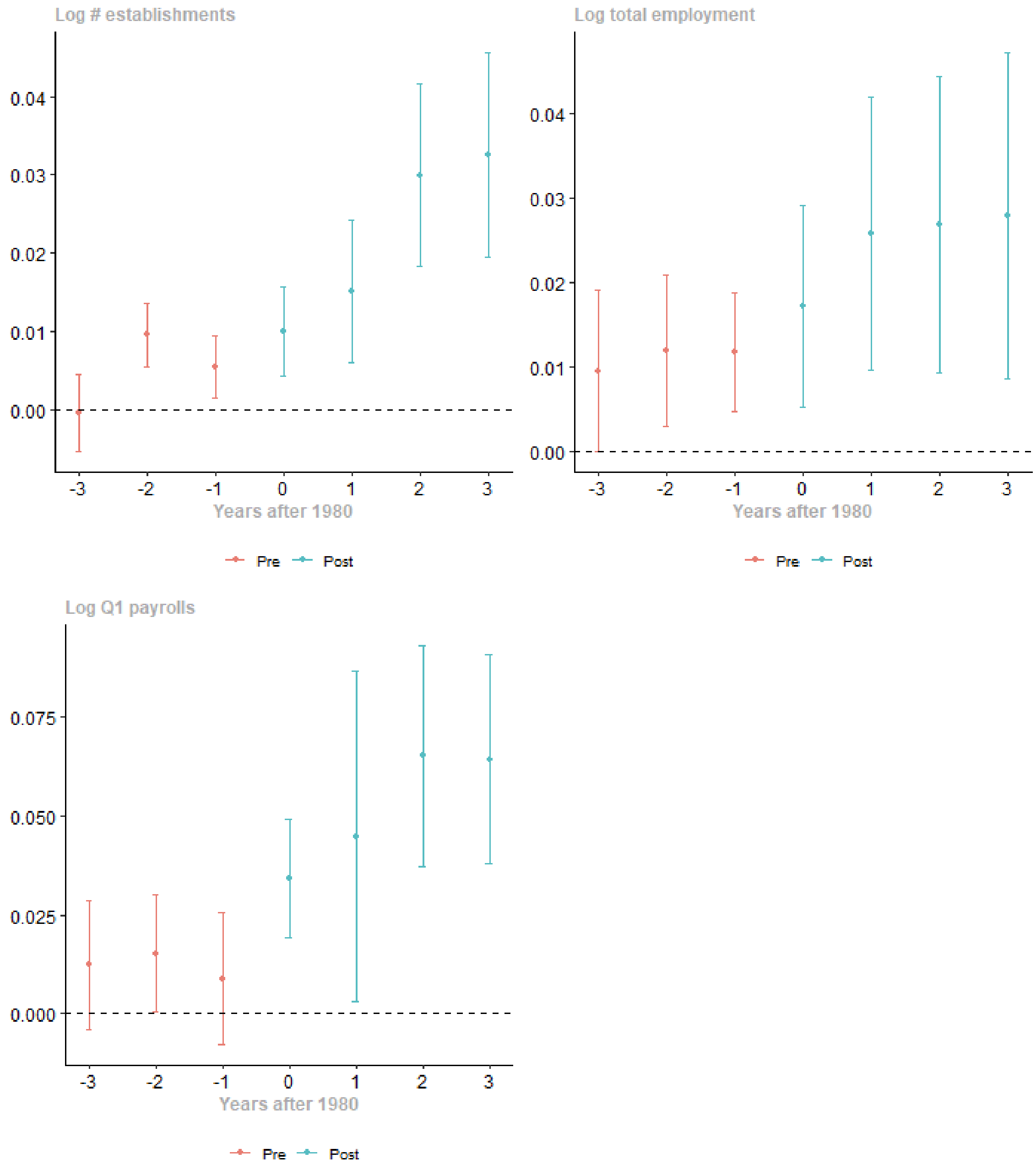

Fig. 7: Event study plots from the county-level difference in difference estimation descried in table 3. Callaway and Sant'Anna (2021) estimator of the effect of having above or below median estimated share of deposits newly-insured by DIDMCA in Q1 1980. Dependent variables are the log of the number of business establishments, the log total number of employees, and the log of first quarter payrolls. The regression includes doubly robust controls for the ratio of securities and cash, RE loans, and CI loans to assets as of end of 1979, as well as log assets, agricultural loans over assets, the deposit share of liabilities, and the share of time deposits. The share of deposits newly-insured is estimated based on the share of time deposits with value over $100K.

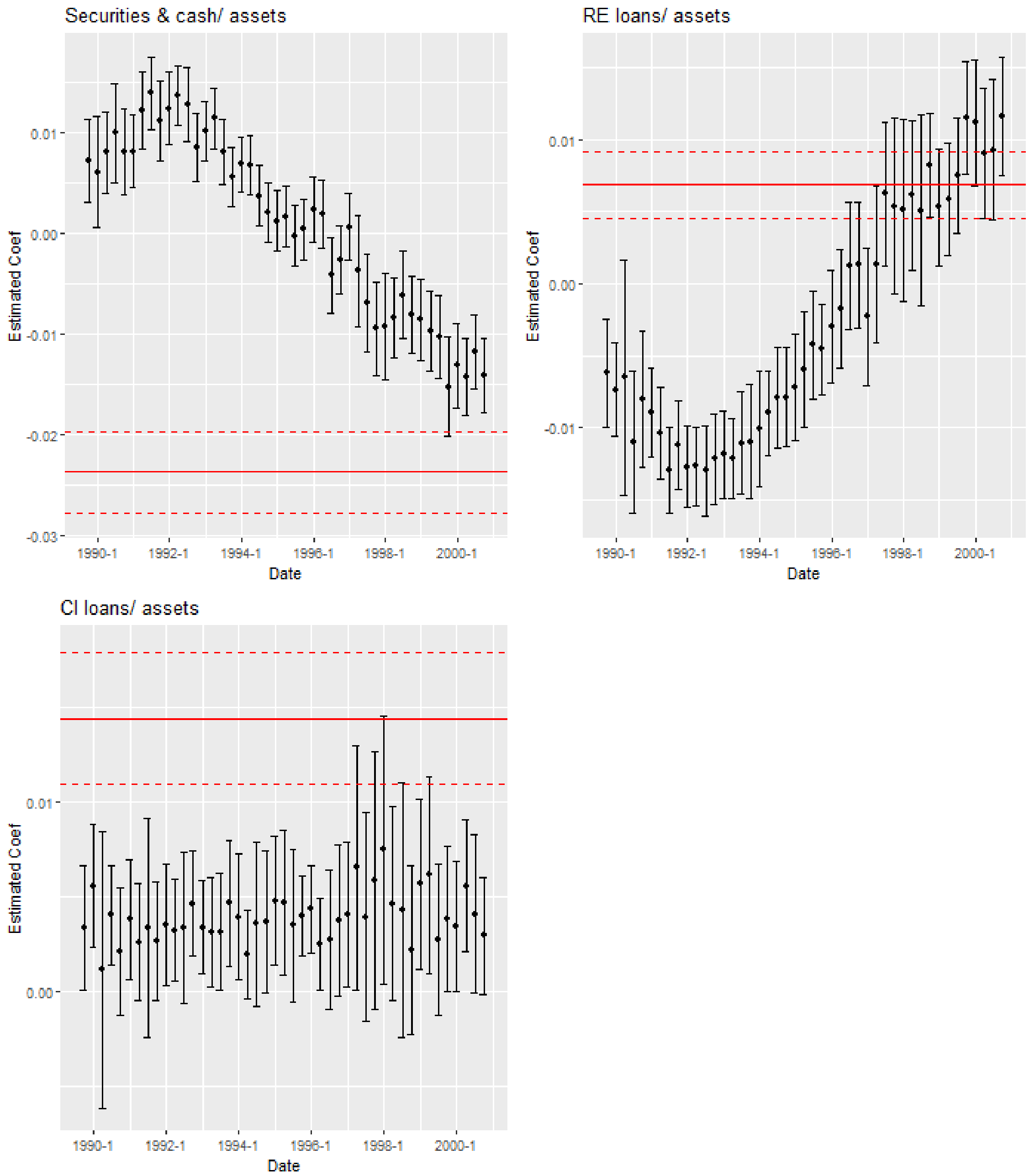

Fig. 8: Placebo test plots for the difference in difference estimation described in table 2. In each quarter from 1990 to 2000, the Callaway and Sant'Anna (2021) ATT estimator is calculated exactly as described for 1980 Q1 in section 2.4 and table 6. The ATT estimate and its 95% confidence interval are plotted for each period. The 1980 Q1 estimator and its 95% confidence interval are shown in red. Dependent variables are the ratio of securities and cash to assets (top left), the ratio of real estate loans to assets (top right), the ratio of commercial and industrial loans to assets (bottom left).

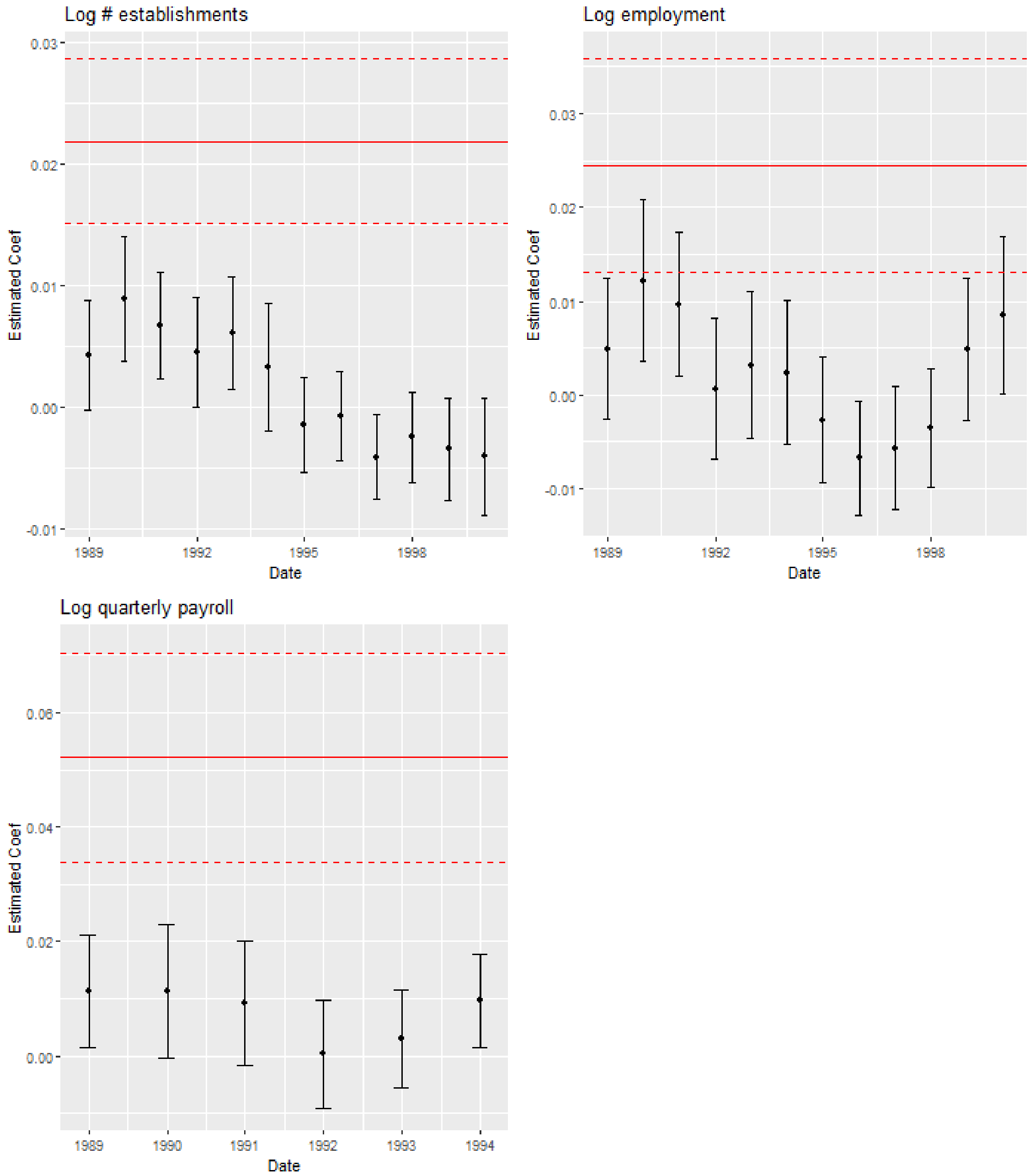

Fig. 9: Placebo test plots for the count-level difference in difference estimation descrbed in table 2. In each year from 1990 to 2000, the Callaway and Sant'Anna (2021) ATT estimator is calculated exactly as described for 1980 Q1 in section 2.4 and table 7. The ATT estimate and its 95% confidence interval are plotted for each period. The 1980 Q1 estimator and its 95% confidence interval are shown in red. Dependent variables are the log of the number of business establishments (top left), the log of the total employment (top right), and the log of 1st quarter payroll (bottom left). First quarter payroll data placebo tests cannot be performed after 1994 due to data availability.

1 Appendix: Data

This paper relies on bank balance sheet data from FFIEC call reports, linked with bank branch location data from the FDIC, and county employment and business data from the County Business Patterns survey.

Bank balance sheet data is sourced from the call the Call Report data gathered by the FFIEC and accessed through WRDS. I use data from 1976-2021. The data contain quarterly observations of the income statements and balance sheets of all U.S. commercial banks. I filter the data and define deposit data series as in Drechsler et al. (2021), and add additional quality filters to remove any banks whose non-missing asset and liability components do not add up to their total assets or liabilities, plus or minus 10%.

Starting from 1982 when the data is available, insured deposits are calculated as all deposits less than the deposit insurance threshold plus the number of deposits over the threshold multiplied by the threshold. E.g. in 2019 since the deposit insurance limit is $250,000, the insured deposits are the total value of all sub-$250,000 deposits plus the first $250,000 of all deposits of greater value. Data from Q2 2008 to Q4 2009 is excluded because the call report data only includes the $100,000 threshold whereas the true insurance threshold had been raised to $250,000.

On the asset side of the balance sheet I focus on cash and securities as liquid assets and two of the most common types of lending: commercial and industrial lending, and mortgage lending. For mortgage lending I focus specifically on owner-occupied first 1-4 household residential lending, to ensure the asset is as consistent as possible between banks. For regressions prior to 1990, I use real-estate lending instead, because the mortgage data was not yet available.

For the first difference plots in figure 2, changes and growth rates are calculated on an annual basis and winsorized at the 2.5% level as in Drechsler et al. (2021). Only banks with at least 1% of balance sheet in each category in both years are included, and observations with asset growth over 30% different than the market asset growth are discarded as being likely cases of inorganic growth.

For the first difference regressions in section 1, the series are not winsorized, to ensure that the standard errors are not artificially compressed by truncating outliers. Annual observations are also used instead of quarterly address any concerns about serial correlation from overlapping observations.

In section 2 I aggregate certain bank variables (e.g. commercial & industrial loans/ assets) to the county level. This aggregation uses the home-county of each bank reported in the call reports. Total assets of each category are summed and divided by the sum of total assets. I do not aggregate on the basis of each bank's branch locations or deposit locations because this data is not available from the FDIC until 1993.

2 Appendix: Liquidity vs maturity

One possible alternative explanation is that these results have more to do with maturity and interest rate risk than liquidity. The rates on stable insured deposits tend to have a lower sensitivity to interest rates, and hence it is possible that, even without a liquidity effect, banks would be more likely to invest them into longer-term assets whose interest income is not sensitive to interest rates, like mortgages.

To test if interest rate or liquidity effects are driving the results, we can compare securities of different maturities. These assets are all relatively liquid (compared to loans), but differ greatly in maturity — from under 1 year to over 15 years. Table 10 shows the results of the same regressions from table 1, but using different maturity buckets of securities as regressands.

	$\Delta \frac{<1\text{y secs}}{\text{assets}}$	$\Delta \frac{1\text{-}3\text{y secs}}{\text{assets}}$	$\Delta \frac{3\text{-}5\text{y secs}}{\text{assets}}$	$\Delta \frac{5\text{-}15\text{y secs}}{\text{assets}}$	$\Delta \frac{>15\text{y secs}}{\text{assets}}$
Δ Insured deposit share	−0.006	0.006+	0.001	−0.001	−0.003
	(0.004)	(0.003)	(0.002)	(0.003)	(0.003)
Δ Time deposit share	−0.009+	−0.017***	−0.006*	0.002	0.002
	(0.005)	(0.004)	(0.003)	(0.004)	(0.003)
Δ Deposit share of liabs	−0.010+	0.018**	0.013**	−0.030**	−0.027***
	(0.005)	(0.006)	(0.005)	(0.009)	(0.007)
Δ Repo share of liabs	0.020*	0.027**	0.023**	0.018+	0.002
	(0.007)	(0.008)	(0.006)	(0.010)	(0.008)
Δ Equity/ assets	0.052**	0.013	−0.028***	−0.041**	−0.014+
	(0.015)	(0.010)	(0.006)	(0.013)	(0.007)
Δ Log assets	0.002	−0.004**	0.002+	0.006**	0.002
	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
Num.Obs.	150 271	150 269	150 271	150 271	150 271
R2	0.074	0.083	0.062	0.095	0.088
R2 Within	0.002	0.002	0.001	0.003	0.003
FE: rssdid	X	X	X	X	X
FE: dateq	X	X	X	X	X

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 10: Regression of securities holdings dynamics by maturity category on insured and uninsured deposit dynamics, with fixed effects and controls. This regression presents the relationship between annual changes in holdings of securities by repricing maturity category in all US bank panel data from 1982-2021, using annual observations and excluding 2020. I compute year-over-year changes in shares of a balance sheet item to bank total assets. I regress changes in shares of balance sheet items, and change in log assets, on changes in shares of insured and uninsured deposits allowing for bank and year fixed effects (i.e. bank-specific trends) and controlling for changes in equity capitalisation. Standard errors are clustered two ways.

There does not appear to be a consistent pattern in which longer term securities are funded more by insured deposits. Both securities with under 1 year maturities and those with over 15 year maturities have weak negative associations with variation deposit insurance ratios. The data suggests that the association of deposit insurance variation with lending variation has more to do with the liquidity than interest rate risk.

3 Appendix: Model

This section provides a simple model of the bank and household investment problems, to explain the paper's empirical findings and understand how they would be affected by greater presence of non-bank funding.

Households invest their savings in bank deposits or equity investments for two periods. Each household differs in how "sticky" its deposits are are — i.e. how much of its deposit it will withdraw in a downturn in period 1. Banks compete for their deposits and invest them into a continuum of projects that differ by risk and liquidity. The model is loosely based on Hanson et al. (2015) and Stein (2012).

In equilibrium, the most illiquid projects are funded purely by the "sticky" portion of each household's deposits. The more liquid projects are funded by a mixture of market funding and the runnable portion of deposits. To draw a parallel to the real world, this would explain why e.g. small business loans are funded by insured deposits at banks whereas mortgages are often securitised and funded through a combination of non-bank investment and runnable non-insured bank deposits.

If the "stickiness" of deposits is decreased (e.g. through decreasing the insurance limit), then the net impact will be:

- An increase in the cost of funding for the most illiquid projects (e.g. small business loans)
- An increase in the share of projects funded with non-bank funding
- A small decrease in the cost of funding for the most liquid projects (e.g. government debt)
- A decrease in the real risk free rate (either through lower nominal rates or an increase in the price level)

3.1 Households and deposit demand

Households are risk neutral and get utility consumption today (c_0) and in period 2 (c_2) as well as liquidity utility from money-like deposits M. Each household chooses to buy risky assets A or deposits M and thus solves:

$$\max_{M_j,\ A_j} U_j = c_0 + U_j^M (M_j) + \beta E (c_2)$$

$$s.t.\ c_2 = R_M M_j + R A_j, \quad c_0 = e - M_j - A_j$$

From the first order condition for household investment, all non-money assets purchased by the household will have the expected return: $E(R_i) = 1/\beta$

Since deposits create value, Modigliani Miller does not hold. The expected return on deposits will be:

$$E(R_M) = \frac{1}{\beta} - U_j^{M\prime}(M_j)$$

We can define the customer cost of deposits (i.e. the extra return demanded for non–deposit investment) by $X_j = \frac{1}{\beta} - R_M$. With this notation, the customer deposit demand is given by $U_j^{M\prime^{-1}}(X_j)$

3.2 Assets

There is a continuum of different assets, distinguished by their illiquidity (L_i) and safety (z_i). All have perfectly correlated returns. Payoffs are provided in period 2 and depend on a signal in period 1.

In a bad state each asset has payoff z_i. There is also a small probability of a disaster state with 0 payoff.

At period 1 there is a signal about the state. If there is optimistic news, the good state is guaranteed. If there is pessimistic news, the disaster state occurs with probability ε and the bad state with probability $1 - q - \varepsilon$.

Assets can be liquidated in period 1 with liquidation cost k_i. k_i is a function of what share of assets are sold and their illiquidity. I.e. if a lot of banks are trying to sell asset i at once, then k_i will be higher.

3.3 Deposit types and stickiness

Each depositor has "stickiness" S_j, defined as the share of deposits they withdraw after bad news. I.e. after a pessimistic signal, each depositor withdraws $1 - S_j$ of their deposits to avoid losing money. This could be interpreted as deposit insurance (i.e. S_j is the insured share), or more broadly as a function of depositor attention or operational constraints.

Consider a "fully sticky" deposit and a "fully runnable" deposit. Each deposit type j can be completely replicated by S_j units of the fully sticky deposit and $(1 - S_j)$ units of the fully runnable deposit. Since the financial sector is competitive, the price of any deposit, X_j, must be:

$$S_j X_s + (1 - S_j) X_r$$

Where X_s is the "fully sticky" deposit price and X_r the "fully runnable".

The financial sector deposit choice problem can thus be rewritten as simply choosing among 2 deposits instead of K. There will therefore be an aggregate demand for sticky and runnable deposits:

$$M_s = D_s(X_s,\ X_r)\,; \quad M_r = D_r(X_s,\ X_r)$$

Later to work through the example of a change in deposit stickiness, I will assume sticky deposit demand is fixed: $D_s(X_s,\ X_r) = \overline{D}_s$

3.4 Financial sector choice of funding model

Because of the 100% correlation of assets, we can separate the financial sector problem into 3 separate decisions to invest in assets funded by runnable deposits, sticky deposits, and direct sales to customers.

In each case the household's FOC tells us \$1 in bank equity must have an expected return of $1/\beta$ if any assets are funded through this channel (or less if no assets are funded through this channel).

This condition on sticky deposit funding gives us:

$$\frac{E(R_i) - z_i E(R_{MS}) - C}{1 - z_i} \leq \frac{1}{\beta}$$

Or, rearranging slightly:

$$E(R_i) + z_i X_s - C \leq \frac{1}{\beta}$$

This condition must hold for all assets and must hold with equality for any assets that recieve any sticky deposit funding.

The same condition using runnable deposits gives:

$$E(R_i) + k_i F_i X_r - E(FS_i) - L_i - C \leq \frac{1}{\beta}$$

Where FS is the cost incurred from firesales:

$$E(FS_i) = (1 - p)(1 - k_i) F_i$$

The direct funding condition gives:

$$E(R_i) - L_i \leq \frac{1}{\beta}$$

We can immediately see that no assets will be financed by both sticky deposits and direct investment. Sticky deposits will be used if:

$$X_s \geq \frac{C - L_i}{z_i} \tag{A1}$$

and direct funding otherwise. To use both, we would need this inequality to hold exactly, by coincidence.

However, since k_i is an increasing function of the amount of assets sold (i.e. the amount funded by runnable deposits), assets can be financed with a combination of runnable deposits and another source.

Rearranging these conditions gives us the real cost of funding for each project:

- For assets financed by sticky deposits: $E(R_i) = \frac{1}{\beta} + C - z_i X_s$

- For assets financed with any level of direct funding: $E\left(R_i\right) = \frac{1}{\beta} + L_i$
- For assets financed purely with runnable deposits: $E\left(R_i\right) = \frac{1}{\beta} + C + E\left(FS_i\right) + L_i - k_i(1)F_iX_r$

These three conditions tell us two important facts about the comparative statics of the model.

First, increasing the "“customer cost” of sticky deposits X_s (i.e. decreasing the cost of sticky deposits for banks) will lower the cost of funding for illiquid deposit-financed projects, from the first item. We should therefore expect deposit insurance and retail deposit rates to be linked to business lending and business formation.

Second, if there is a risk free asset where $k = 1$, $z = 1$ and $L = 0$, this will be purely funded by runnables and will thus satisfy $E(R_i) = \frac{1}{\beta} + C - X_r$ from the the third bullet above. Increasing the "customer cost" of runnable deposits (X_r) will thus lower the real risk free rate. If the nominal rate is held constant, this would imply an increase in the time 0 price level. If instead the price level is held constant, this would imply lowering the nominal rate.

3.5 How much runnable deposit is used for each asset?

Let μ_i represent the share of asset I that is funded by runnable deposits. If $\mu_i \in (0, 1)$ and direct funding is also used, then the firesale discount must be such that the bank is indifferent between the two funding sources. I will call this required firesale discount Y_d:

$$k_i = \frac{1 - p + C/F_i}{X_r + 1 - p} \equiv Y_d$$

The same condition for an asset where sticky deposits are used instead of direct funding gives:

$$k_i = \frac{1 - p + \left(L_i + z_iX_s\right)/F_i}{X_r + 1 - p} \equiv Y_s$$

Since the condition for sticky deposits to be preferred over runnable funding is exactly $L_i + z_iX_s > C$, it must be the case that $Y_s > Y_d$ if and only if sticky deposits are preferred over direct funding.

Hence if k_i is an invertible function of μ_i, then μ_i will be given by:

$$\mu_i = \begin{cases} k_i^{-1}\left(Y\right) & \text{if } k_i^{-1}\left(Y\right) \in [0, 1] \\ 0 & \text{if } \ k_i^{-1}\left(Y\right) < 0 \\ 1 & \text{if } k_i^{-1}\left(Y\right) > 1 \end{cases}$$

$$\text{Where: } Y \equiv \max\left\{Y_d, Y_s\ \right\}$$

For simplicity, I will assume the parameters are such that $\mu_i = 0$ for all assets where $Y_s > Y_d$. This amounts to an assumption that firesale discounts are high for assets that are illiquid enough that they aren't suitable for market funding (i.e. $k_i(0) > Y_s$ if $L_i > C - z_i X_s$).

3.6 Equilibrium

Assume that sticky deposit demand is fixed at $\overline{D}_s$ (e.g. because everyone deposits up to the FDIC limit) and runnable deposit demand is a decreasing function of X_r and X_s, $D_r(X_r, X_s)$.

Assume further the density of asset type with safety and illiquidity given by z_i, L_i follows a pdf $f(z_i, L_i)$.

There are two equilibrium conditions. The first is that total invested sticky deposits equals the total sticky deposit household demand. In the case of a fixed demand, this can be written:

$$\overline{D}_s = \int_{\infty}^{\infty} \int_{\infty}^{\infty} \mathbf{1}\left(X_s \geq \frac{C - L_i}{z_i}\right) f(z_i, L_i)\, dz_i dL_i \tag{A2}$$

This equation pins down the sticky deposit price X_s.

The second equation requires that runnable deposits invested equals household runnable deposit demand:

$$D_r(X_r, X_s) = \int_{\infty}^{\infty} \int_{\infty}^{\infty} \mu_i f(z_i, L_i)\, dz_i dL_i \tag{A3}$$

This equation then pins down the price of runnable deposits, X_r, given the X_s defined in equation A2.

3.7 Comparative statics

Now that we have defined the equilibrium, we can examine the comparative statics of the model with regard to changes in deposit stickiness.

Consider an increase in $\overline{D}_s$, holding all else constant (e.g. due to an increase in deposit insurance thresholds). From A2, it is clear that X_s is an increasing function of $\overline{D}_s$. I.e. the more sticky deposits there are, the cheaper they are as a source of funding for banks. So X_s will increase.

Equation A3 shows that X_r is a decreasing function of X_s, since μ_i is increasing in X_r and unaffected by X_s under our assumptions. Hence X_r will decrease in order to balance the demand and supply of runnable deposits.

Given the changes in deposit costs, we can find the effects on cost of funding:

- The most illiquid projects, will see their cost of funding fall, proportional to their risk level:

$$\frac{\partial E(R_i)}{\partial X_s} = -z_i \tag{A4}$$

- Some projects will switch from being market-funded to sticky-deposit funded, if the condition $X_s \geq \frac{C-L_i}{z_i}$ holds under the new deposit demand but not the old.
- For assets funded with direct market funding, there will be no change the cost of funding, since $E(R_i) = \frac{1}{\beta}$.
- Assets funded solely by runnable deposits, will see an increase in their expected return (i.e. cost of funding):

$$\frac{\partial E(R_i)}{\partial X_r} = -k_i(1)F_i$$

These effects explain the patterns observed in section 2 — increased deposit insurance increases illiquid lending and funding of projects (i.e. number of new businesses and employment).

How might an increase in non-bank lending affect these results? If the cost of direct funding (L_i) is lower, e.g. due to fintech innovations or improvements in securitisation markets, then fewer assets will be deposit funded by the condition in equation A1. This will result in a higher customer price of sticky deposits — i.e. depositors will get worse rates — via the equilibrium condition in A2.

The cost of funding for assets funded by direct non-bank funding is unaffected by changes in deposit demand, from the funding cost equations in section 3.4.

Hence, if the technology to finance projects with non-bank direct-to-markets funding has improved in the last few decades, we should expect that changes in deposit insurance will have effect fewer assets and asset classes. However, any projects that are still receiving sticky-deposit funding will still find their cost of funding raised proportional to their risk level, as per the derivative in equation A4.