The Determinants of Uninsured Deposits

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The 2023 regional banking crisis in the United States was driven by losses on assets which caused uninsured depositors to rapidly withdraw their deposits. This did not strike all banks equally however. There was substantial variation in the amount of uninsured deposits between banks. In this analysis we determine factors, such as derivative use, which made banks more likely to fund themselves with uninsured and brokered deposits. We find evidence both uninsured and brokered deposits are increasing in bank equity, funding costs, and De Novo status. We also find that brokered deposits are increasing total loans and leases to assets, however uninsured deposits are correlated with lower level of total loans and lease. Results on derivative use and deposit usage are inconclusive however.

JEL Codes: E02; E60; F02; F35; G28

Keywords: Bank Deposits; Uninsured Deposits; Brokered Deposits; Interest Rate Derivatives

1 Introduction

The 2023 regional banking crisis highlighted the pitfalls of funding loans using uninsured and brokered deposits. When interest rates rise sharply, these large depositors pay close attention to the effect on the value of bank assets. If these asset values fall enough, uninsured depositors become concerned they will not be able to withdraw their funds, and so they withdraw them preemptively. It was this chain of events which caused the collapse of Silicon Valley Bank and Signature Bank, and caused a reduction in uninsured deposits across other regional banks such as Citizens Bank and PNC Financial

Services Group[1]. This preemptive withdrawl, often rapid, itself causes the bank's failure. This is a classic *bank run*.

Thus, a bank with substantial funding from uninsured deposits should seek to lessen interest rate risk via hedging with interest rate swaps and options on interest rates. The goal of this paper is thus to determine the factors which affect the use of uninsured and brokered deposits, including the use of derivatives such as interest rate swaps and swaptions. We also include brokered deposits in our analysis, however they face more stringent regulation than typical deposits. To do so we construct a panel from FDIC call report data ranging from 1992 to 2023.

Note, over long periods a bank can reduce interest rate risk using immunization. This is a long-term method because it requires the bank to reduce the duration of its assets through new origination or asset sales. In this analysis we are also concerned with how a bank manages the risk of uninsured deposits on a day-to-day basis. For example, if a bank increases its uninsured deposits over a given quarter, does it also increase its hedges in kind?

Prior to 2012 uninsured deposits were mainly large time deposits and typically had a 'deposit beta' close to 1 and have low operating costs. The 'deposit beta' measures the sensitivity of a bank's deposit rate to changes in interest rates. However, post-2012 uninsured deposits became dominated by low-beta savings and checking accounts. These accounts also have high-operating (and largely fixed) costs.

In the Diamond and Dybvig 1983 model, a forced sale of bank loans causes claims on the bank to exceed assets and prompts a bank run. In Drechsler, Savov, and Schnabl 2017 interest rate increases which are not equally matched by banks with deposit rate increases causes deposit outflows from banks. As interest rates increase, depositors will switch to liquid money market funds if bank deposit rates do not increase in kind (Xiao 2020). These deposit outflows may be manageable, however Hanson et al. 2015 find outflows of uninsured deposits may have a larger effect on the banks ability to fund long-term assets.

Jiang et al. 2023 investigate the use of interest rate hedges around the 2022 interest rate increases. They find about 25% of banks use interest rate swaps, however they only hedge 4% of assets on average. Interestingly they find less hedging for banks whose assets have the highest duration, and banks with more uninsured deposits tended to take profits on their hedges

[1]See, for example, https://www.wsj.com/livecoverage/stock-market-news-today-04-19-2023/card/uninsured-deposits-shrink-at-regional-banks-VfBjHzW0fpUYyIAlky

during the monetary tightening. Krainer and Paul 2023 find evidence that the reduction in lending due to losses on assets during the 2022 interest rate increases was greater for unhedged firms.

Drechsler, Savov, and Schnabl 2021 find evidence that bank profits are insensitive to changes in interest rates, and banks with stronger deposit franchises hold more long-term assets. This is due to bank deposit franchises, which allow banks to borrow at low rates which are insensitive to market rates. In fact, the operating costs of deposit franchises make deposits behave more like long-term fixed rate debt.

However, Drechsler et al. 2023 limit the above results to the case where the deposits remain at the bank. If interest rates rise, uninsured depositors have an incentive to remove their deposits from the bank. Accordingly, the bank can either manage interest rate risk, or liquidity risk, but not both. The authors conclude the only way so solve this dilemma is to not use uninsured deposits as a funding source. Early research (Choi, Goldsmith-Pinkham, and Yorulmazer 2023) on the failure of Silicon Valley Bank highlights the contribution of uninsured deposits. Chang, Cheng, and Hong 2023 find evidence that banks with higher levels of uninsured deposits were also riskier *prior* to the 2023 banking crisis.

However Goldberg and Hudgins 2002 find evidence that banks that failed had declining uninsured deposits (as a proportion of total deposits) prior to their failure, and that failing banks have fewer deposits from uninsured depositors prior to failure when compared to banks that do not fail. A similar result was found by Martin, Puri, and Ufier 2023. Maechler and McDill 2006 find evidence that solvent banks can increase uninsured deposits by raising the deposit rate if interest rates rise, whereas weak banks cannot. This result is consistent with insolvent banks losing uninsured deposits in the case that interest rates rise. Iyer, Puri, and Ryan 2016 find evidence that uninsured deposits are likely to run depending on the bank's solvency. Chen et al. 2022 find that for more transparent banks, changes in uninsured deposits are more sensitive to information about the performance of the bank.

Brokered deposits are an increasingly important source of bank funding (Barth and Sun 2018), however they face greater scrutiny from regulators due to a perceived risk of the brokered deposits being withdrawn quickly. Brokered deposits may be insured by the FDIC, however Howden 2014 finds bank stability would be increased, and costs reduced, if the FDIC removed insurance from brokered deposits. The status of brokered deposits is an active area of regulation[2] and research.

[2]See the 'Brokered Deposit Affiliate-Subsidiary Modernization Act of 2018': `https:`

1.1 Hypotheses

The results of the theoretical and empirical work in Drechsler, Savov, and Schnabl 2021 and Drechsler et al. 2023 find that the risk management dilemma faced by banks can be mitigated using interest rate options and by substantial capital cushions. A bank cannot, however, simultaneously hedge both interest rate and liquidity risk with interest rate swaps or though the deposit franchise. These results motivate the following hypotheses:

Hypothesis 1:

> The percent of uninsured deposits is increasing in bank capital levels. Since only options can simultaneously hedge interest rate and liquidity risk, and option markets are limited, banks that have greater levels of uninsured deposits should have greater equity cushions. The null hypothesis is no relationship.

Hypothesis 2:

> The percent of uninsured deposits is decreasing in total loans and leases. Consistent with hypothesis 1, uninsured deposits should support fewer loans and leases than insured deposits. The null hypothesis is no relationship.

Hypothesis 3:

> The percent of uninsured deposits is increasing in bank risk and wholesale funding costs. Markets should understand the difficulty in hedging uninsured deposits, and should therefore require higher wholesale funding costs. The null hypothesis is no relationship.

Hypothesis 4:

> The percent of uninsured deposits is increasing in interest rate option use. Employing derivatives with option-like payoffs may simultaneously hedge both liquidity and interest rate risk (ibid.). The null hypothesis is no relationship.

//www.congress.gov/bill/115th-congress/house-bill/6158

2 Data and Methods

In this section we first describe our data set and its method of construction. We then discuss the empirical methods we use to test our hypotheses.

Our panel was built from FDIC Call Report data from Q4 1992 through Q1 2023. The data are quarterly, and this provides us with 1,028,781 bank-quarter observations (though some measures will have fewer observations because banks may not report data for the measure). Summary statistics of our panel data set is in table 1 below.

Below is a list of the variables we use in the analysis and how they are calculated. The code in capital letters is the FDIC variable name in the call report dataset.

Table 1: Below is how each variable in our analysis was calculated. The codes are from the FDIC's Bankfind Application Programming Interface (`https://banks.data.fdic.gov/docs/summary_properties.yaml`)

Variable	Calculation
Uninsured Deposits	(DEP - DEPINS) / DEP
Brokered Deposits	BRO / DEP
Wholesale funding ratio	(FREPP + NTRTMLG) / ASSET
Equity ratio	EQ / ASSET2
Average assets	ASSET2
Loan Losses	LNATRES / ASSET2
Interest Rate Swaps	RTNVS / ASSET2
Interest Rate Options Bought	RTPOC / ASSET2
Interest Rate Options Sold	RTWOC / ASSET2
Exchange Rate Swaps	FXNVS / ASSET2
Other Swaps, Total Notional Value	OTHNVS / ASSET2
Interest Income to Assets	INTINCY / ASSET2
Commercial and Industrial Loans	LNCI / ASSET2
Total Loans to Individuals	LNCON / ASSET2
Credit Card Loans to Individuals	LNCRCD / ASSET2
Real Estate Loans	LNRE / ASSET2
Loans to States and Municipalities	LNMUNI / ASSET2
Net Loans and Leases to Assets	LNLSNET / ASSET2
De Novo	1 when the bank is less than 5 years old, 0 otherwise.
Fin. Crisis	1 from Q4 2008 to Q4 2011, 0 otherwise.
Post Crisis	1 from Q1 2012 to Q4 2015, 0 otherwise.
COVID Crisis	1 from Q1 2020 to Q4 2020, 0 otherwise.

For robustness we also calculated the Loan Losses ratio with Total Noncurrent Loans & Leases (NCLNLS) in the numerator instead of loan loss allowance. Results are similar and available on request.

2.1 Uninsured Deposits

There is substantial variation in the proportion of funding from uninsured deposits across banks. Below are histograms of the proportion of uninsured deposits at each bank in Q1 2003, 2013, and 2023. Each histogram is right-skewed. Most notably, the mean and median of the percent of uninsured deposits in 2023 is greater than in 2013 or 2003.

Figure 4 shows a time series of the mean percent uninsured deposits. Prior to the 2008 financial crisis mean uninsured deposits had risen to 25%, before falling to 12.5% in 2012. Since the mean percent of uninsured deposits has increased to over 27% in Q4 2023 before falling in Q1 2023.

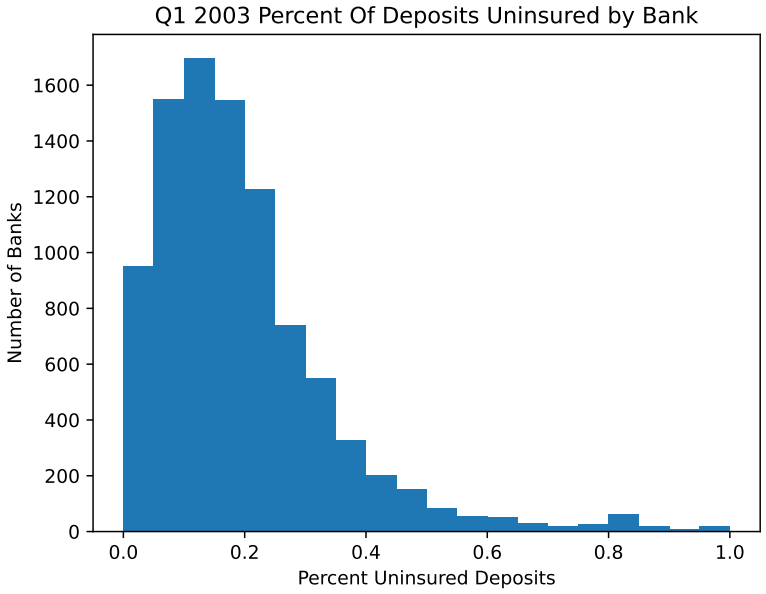

Figure 1: Q1 2003 Percent Uninsured Deposits

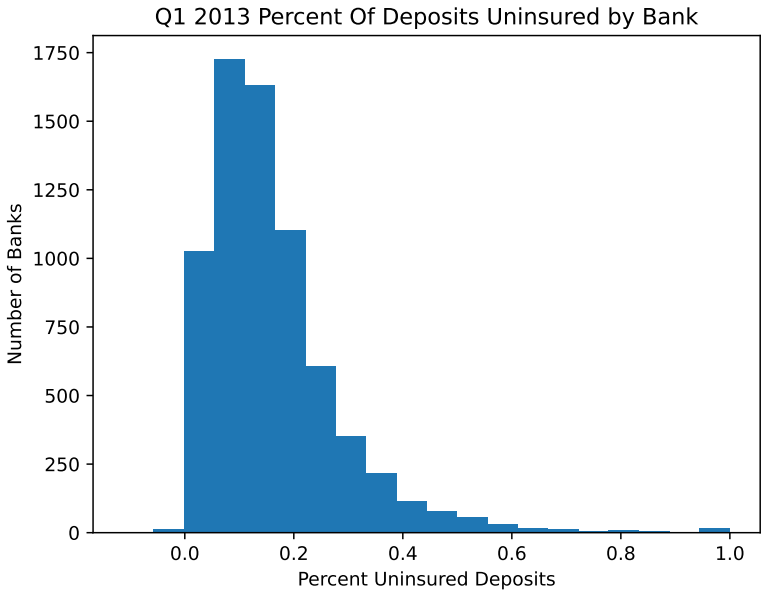

Figure 2: Q1 2013 Percent Uninsured Deposits

2.2 Panel Analysis

In this analysis we *within* estimators for our panel with bank fixed-effects. The fixed-effects *within* estimator tests whether the variation over time in the explanatory variable affects the over-time variation in the dependent variable.

Given the general panel data regression:

$$y_{it} = \beta_1 + \sum_{j=1}^{n} \beta_j x_{jit} + \alpha + \mu_{it}$$

where y_{it} is the dependent variable for bank i at quarter t, x_{jit} is explanatory variable j for bank i at quarter t, and β and μ_{it} are estimated parameters.

The *within* estimator is:

$$y_{i,t} - \bar{y}_i = \beta_1 + \sum_{j=1}^{n} \beta_j (x_{i,t} - \bar{x}_{ji}) + \mu_{i,t} - \bar{\mu}_i$$

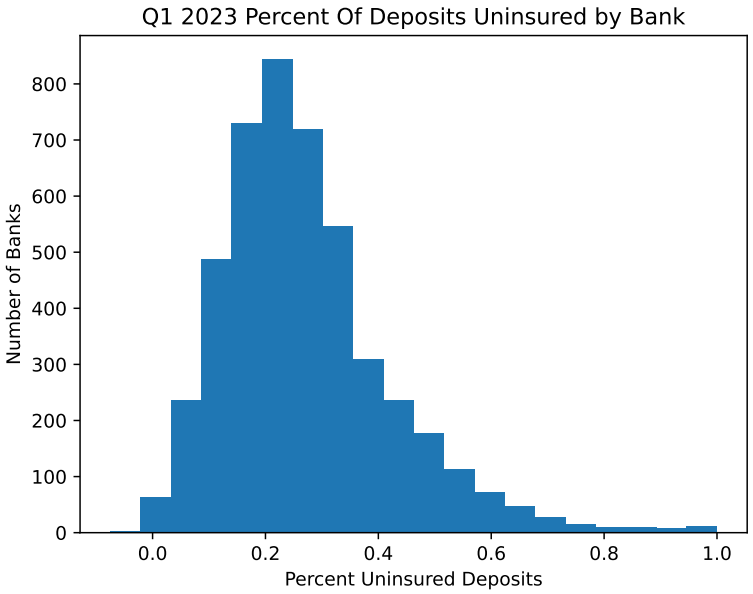

Figure 3: Q1 2023 Percent Uninsured Deposits

Detailed results of standard diagnostic tests for each model's residuals are available on request.

3 Results

Below are results for both uninsured and brokered deposit fixed-effects regressions. Each regression has bank fixed-effects. The *within* specification has 852402 observations because each observation is a bank-quarter.

3.1 Percent of Deposits that are Uninsured

Our model explains about 19% of the variation in uninsured deposits. The coefficient on bank equity is positive and significant at the 1% level, and the 0.3 coefficient value is economically significant. A one standard deviation increase in bank equity will, on average, increase uninsured deposits by 2.2 percentage points. We therefore reject the null hypothesis and find evidence supporting our first hypothesis. A positive relationship between equity and uninsured deposits increases bank safety, and is consistent with the intent of

Table 2: Descriptive Statistics: Panel built from FDIC Call Report data from Q4 1992 through Q1 2023. The data are quarterly.

Statistic	N	Mean	Median	St. Dev.	Min	Max
Fin. Crisis	1,028,781	0.09	0	0.29	0	1
Post Crisis	1,028,781	0.11	0	0.31	0	1
COVID Crisis	1,028,781	0.02	0	0.14	0	1
Uninsured Deposits	1,028,190	0.17	0.14	0.14	−6.69	1.34
Brokered Deposits	1,026,369	0.02	0.00	0.12	0.00	70.02
Int. Income	1,026,898	6.36	6.50	2.16	−35.71	587.07
C and I Loans	1,028,780	0.09	0.07	0.08	0.00	1.01
Non-current Loans/Leases	1,028,780	0.01	0.004	0.01	0.00	0.84
Equity	1,026,945	0.11	0.10	0.07	−5.19	1.00
Indiv. Loans	1,026,944	0.06	0.04	0.08	0.00	1.20
Credit Card Loans	1,026,945	0.01	0.00	0.05	0.00	1.20
Muni Loans	943,483	0.004	0.00	0.01	0.00	0.27
Real Estate Loans	1,028,780	0.42	0.42	0.19	0.00	1.46
Interest Rate Swaps	854,804	0.03	0.00	1.80	0.00	365.46
FX Swaps	854,419	0.002	0.00	0.13	0.00	23.98
Other Swaps	761,317	0.0002	0.00	0.01	0.00	0.89
Options Bought	852,968	0.01	0.00	0.29	0.00	59.24
Options Sold	854,419	0.01	0.00	0.28	0.00	62.13
Wholesale Funding Ratio	971,312	0.14	0.12	0.09	0.00	1.06
Loan Losses	1,026,944	0.01	0.01	0.01	−0.002	1.25
Net Loans/Leases	1,028,780	0.61	0.63	0.17	−0.02	1.00
De Novo	1,028,781	0.04	0	0.20	0	1
Log(Assets)	1,028,781	11.79	11.63	1.45	3.31	21.96

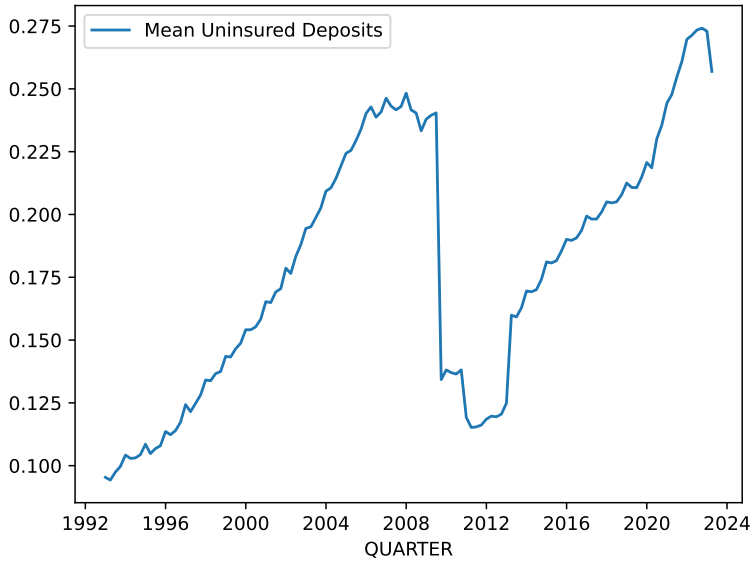

Figure 4: Mean Percent Uninsured Deposits by Quarter

regulators. The positive relationship between equity and uninsured deposits also supports Drechsler et al. 2023, which found the only methods to manage both the liquidity and interest rate risk from uninsured deposits was to increase equity or use derivatives with convex payoffs.

We also find evidence of a negative relationship between total loans and leases to assets and uninsured deposits, which rejects the null hypothesis and is evidence in support of hypothesis 2. This interesting result implies banks may not be using uninsured deposits to increase lending. Consistent with this result, we also find interest income is negatively and significant related to uninsured deposits. We also find that banks which use more uninsured deposits pay more for those deposits (measured by the wholesale funding ratio), possibly due to their increased risk for the depositor, and so we can reject the null in hypothesis 3.

Among loan types, uninsured deposits are increasing in commercial and industrial loans, and decreasing in real-estate loans and loans to individuals and states and municipalities. All coefficients on loan types are significant at the 1% level however they are only marginally economically meaningful. For example, a one standard deviation increase in C&I loans will only increase

uninsured deposits by 0.3 percentage points. These results are evidence that, even controlling for bank size, greater uninsured deposit use shifts loans from individuals and municipalities to commercial and industrial uses. Lastly, the coefficient on loan losses is negative and significant at the 1% level. So in addition to shifting loans to commercial and industrial uses, loans are being offered that result in less default risk. This latter point is sensible for bank risk management—uninsured deposit use should be used to fund safer loans.

Our results provide limited evidence that increased use of Interest Rate Swaps increases uninsured deposits. The coefficient on Interest Rate Swaps is positive and significant in two of our regressions, however the magnitude of the coefficient is not economically insignificant. The amount of options bought is significantly related to uninsured deposits, however the sign of the coefficient is negative in the regression with all independent variables, and positive in the restricted regressions.

However we find the amount of options sold is positively related to uninsured deposits, and is significant at the 1% level across all regressions. Moreover the coefficient of 0.049 is economically significant. A one standard deviation increase in options sold will, on average, increase uninsured deposits by 1.3 percentage points. This is interesting given by selling options the bank is selling another party insurance against movements in interest rate swaps. This insurance is a potential future obligation. While this result supports hypothesis 4, understanding why selling options is related to higher levels of uninsured deposits is an interesting topic for future theoretical or empirical research.

The use of uninsured deposits in increasing in the size of the bank and is higher for De Novo banks. De novo status on average increases a bank's uninsured deposits proportion by 7 percentage points. These results are sensible given large banks have access to more sources of funding, and new banks need to grow their deposit franchise. The crisis and post-crisis indicators all significantly reduce the use of uninsured deposits. This is consistent with deposit funding sources being affected by events which affect the macroeconomy.

3.2 Percent of Deposits that are Brokered

Our fixed effects model does not explain any of the variation in brokered deposits. This in itself is evidence that brokered deposits are used differently by banks than uninsured deposits. The coefficient on Interest Rate Swaps is positive and significant, though the size of the coefficient is not economically meaningful. Coefficients on interest income and wholesale funding are also

Table 3: The Determinants of Uninsured Deposits: Results are from 'within' estimators from fixed-effects models with bank fixed effects, for the years 1992 through 2023. Data are quarterly. The dependent variable is bank uninsured deposits as a percent of all deposits. Standard errors are clustered and heteroskedasticity consistent. P-values are below the cofficients in parentheses.

	Dependent variable:		
	Percent Uninsured Deposits		
	(1)	(2)	(3)
Equity	0.30***	0.32***	0.30***
	(0.008)	(0.002)	(0.002)
IRS	0.00*	0.0008*	0.0007
	(0.0004)	(0.0001)	(0.0001)
Options Bought	-0.051***	0.02***	0.02***
	(0.003)	(0.003)	(0.003)
Options Sold	0.049***	0.042***	0.037***
	(0.000)	(0.000)	(0.000)
Int Inc	−0.003***	−0.004**	−0.003**
	(0.001)	(0.000)	(0.001)
Wholesale Fund.	0.29***	0.29***	0.32***
	(0.000)	(0.000)	(0.000)
Total Loans/Leases	−0.13***		−0.11***
	(0.000)		(0.000)
CI Loans	0.34***	0.23***	
	(0.000)	(0.000)	
RE Loans	−0.032***	−0.127***	
	(0.000)	(0.000)	
Ind. Loans	−0.025 ***	−0.112***	
	(0.000)	(0.000)	
Loans States	−0.175***	−0.310***	
	(0.000)	(0.000)	
Loan Losses	−0.265***	−0.372***	−0.071***
	(0.000)	(0.000)	(0.000)
Fin Crisis	−0.07***	−0.07***	−0.07***
	(0.0003)	(0.0003)	(0.0003)
Post Crisis	−0.06***	−0.06***	−0.06***
	(0.0003)	(0.0003)	(0.0003)
Covid Crisis	−0.01***	−0.01***	−0.01***
	(0.001)	(0.001)	(0.001)
De Novo	0.067***	0.071***	0.081***
	(0.000)	(0.000)	(0.000)
ln(TA)	0.038***	0.039***	0.039***
	(0.000)	(0.000)	(0.000)
Observations	852,402	852,402	852,402
R^2	0.20	0.20	0.20
Adjusted R^2	0.19	0.19	0.19
Note:			*p<0.1; **p<0.05; ***p<0.01

positive and significant. In contrast to uninsured deposits, the coefficient on loan losses is positive and significant and economically meaningful. Also, unlike uninsured deposits, brokered deposit use increased during the financial crisis.

4 Conclusions

In this analysis we have investigated the determinants of bank levels of uninsured and brokered deposits. Understanding these determinants is important and timely given the role uninsured deposits played in the 2023 regional banking crisis, and recent theoretical research showing banks are unable to manage both the interest rate and liquidity risks of uninsured deposits without resorting to derivatives with convex (option-like) payoffs or increasing equity (Drechsler et al. 2023).

In this analysis we have found evidence that bank equity is increasing in brokered and uninsured deposits. This result is consistent with ibid. hypothesized methods of simultaneously controlling liquidity and interest rate risk, and with banks which use riskier forms of financing giving themselves a larger capital cushion. Also consistent with these hypotheses, we found evidence that total loans and leases and interest income are negatively related to uninsured deposit levels.

We also found evidence that banks which use greater proportions of brokered and uninsured deposit face higher funding costs. This is to be expected since these deposits themselves pay higher interest rates, however the result is also consistent with these funding sources increasing bank risk and possibly being used due to necessity rather than choice. This can also be seen in the positive relationship between uninsured and brokered deposit use and De Novo status. Newly created banks have yet to build a deposit franchise, and are forced to make use of higher cost deposits.

Regarding derivative use, options sold have a positive and significant effect on uninsured deposits and the results of options bought is inconclusive. These results lend some support to the hypothesis that option-like securities are a viable way to simultaneously hedge interest rate and liquidity risk in uninsured deposits. Option purchases or sales have no effect on brokered deposits. We have found evidence of a positive relationship between Interest Rate Swaps and brokered deposits, and some evidence which points to a similar relationship with uninsured deposits. Interest rate swaps, however, may hedge interest rate risk but not the liquidity risk of uninsured deposits. Our results would benefit from greater of granularity in the data recorded

Table 4: The Determinants of Brokered Deposits: Results are from 'within' estimators from fixed-effects models with bank fixed effects, for the years 1992 through 2023. Data are quarterly. The dependent variable is bank uninsured deposits as a percent of all deposits. Standard errors are clustered and heteroskedasticity consistent. P-values are below the cofficients in parentheses.

	Dependent variable:		
	Percent Brokered Deposits		
	(1)	(2)	(3)
Equity	0.001	0.002	0.003
	(0.850)	(0.871)	(0.776)
IRS	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)
Options Bought	−0.01	−0.01	−0.01
	(0.311)	(0.310)	(0.322)
Options Sold	0.01	0.01	0.01
	(0.231)	(0.242)	(0.230)
Int Inc	0.001**	0.001**	0.001**
	(0.021)	(0.012)	(0.040)
Wholesale Fund.	0.13***	0.13***	0.13***
	(0.000)	(0.000)	(0.000)
Total Loans/Leases	0.021		0.022***
	(0.467)		(0.000)
CI Loans	−0.004	0.016	
	(0.871)	(0.113)	
RE Loans	0.004	0.024***	
	(0.873)	(0.002)	
Ind. Loans	−0.013	0.006	
	(0.671)	(0.806)	
Loans States	−0.047	−0.027	
	(0.263)	(0.296)	
Loan Losses	0.298***	0.286**	0.287**
	(0.009)	(0.014)	(0.015)
Fin Crisis	0.003***	0.003***	0.003***
	(0.002)	(0.002)	(0.001)
Post Crisis	−0.007***	−0.007***	−0.007***
	(0.000)	(0.000)	(0.000)
Covid Crisis	−0.014***	−0.014***	−0.014***
	(0.000)	(0.000)	(0.000)
De Novo	0.007***	0.007***	0.007***
	(0.001)	(0.001)	(0.002)
ln(TA)	0.017***	0.017***	0.018***
	(0.000)	(0.000)	(0.000)
Observations	852,402	852,402	852,402
R^2	0.02	0.02	0.02
Adjusted R^2	−0.001	−0.001	−0.001
Note:			*p<0.1; **p<0.05; ***p<0.01

by the FDIC Call reports. Since call reports have data on the total notional value of swaps, and not whether the bank is primarily swapping fixed for floating of floating for fixed.

Perhaps the most interesting result not related to our hypotheses is the different in the relationship between total loans and leases and brokered and uninsured deposits. We have found evidence that brokered deposits are increasing total loans and leases to assets, however uninsured deposits are correlated with lower level of total loans and leases. This result suggests that these deposit types may be used by banks for different purposes. Or, possibly, the differing effect on uninsured and brokered deposits is due to the more stringent regulation facing brokered deposits. Determining why may be an interesting are for further research.

In sum, previous research has determined that to simultaneously lessen both the liquidity and interest rate risk of uninsured deposits, a bank should increase its equity and employ option-like securities. Based on this result, we have formed a set of hypotheses about the behavior of uninsured deposits relative to bank equity, loans, funding costs, and derivatives use. We have largely found evidence supporting earlier research, specifically uninsured deposits are increasing in bank equity, funding costs, and option sales, and decreasing in loans and leases.

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