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Mark S. Carey and Christopher Healy

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Short Selling and Bank Deposit Flows

Mark Carey

Christopher Healy[1]

Federal Reserve Bank of Cleveland

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Abstract

Some observers have argued that the short selling of bank stock contributes to bank runs and bank failures. Previously, no evidence has been available. We find no evidence that more short selling of bank stock is associated with materially larger outflows of bank deposits. We believe this means that proposals to restrict the short selling of bank stock should be supported by other arguments.

Keywords: Short-selling, bank runs, bank deposits
JEL codes: G21, G12, G01, G18

[1] Federal Reserve Bank of Cleveland, 1455 E 6th St., Cleveland, OH 44114. E-mail: mark@michelemark.com and christopher.healy@clev.frb.org. We thank colleagues at the Federal Reserve Bank of Cleveland for helpful conversations and comments and Scott Konzem and Stephanie Tulley for assistance with the data. The views expressed here are solely those of the authors and do not necessarily reflect the views of the Federal Reserve Bank of Cleveland or the Board of Governors of the Federal Reserve System.

1. Introduction

Following the failures of Silicon Valley Bank, First Republic Bank, and Signature Bank, some observers have suggested that the short selling of bank stock contributes to deposit outflows that eventually lead to bank failure, reprising similar suggestions made in 2008. For example, on May 11, 2023, JPMorgan Chase CEO Jamie Dimon argued that "…people are in collusion, people are going short and then making a tweet about a bank, they (the SEC) should go after them…"[2] Mandl et al. (2023) report on others' objections to the short selling of bank stock. Although the way in which short selling causes bank failure is rarely described in any detail in the popular press, Brunnermeier and Oehmke (2014) and Liu (2014) suggest mechanisms that can cause the failure of an otherwise sound bank. Their mechanisms are related to the bank run literature (e.g., Diamond and Dybvig 1983). Simplifying somewhat, holders of bank liabilities withdraw when the market value of bank equity falls a lot, forcing the sale of bank assets at a loss, which leads to insolvency and failure. A key presumption is that short selling depresses the bank's stock price. A related mechanism without such a presumption involves holders of liabilities withdrawing deposits that are low-cost for the bank when they observe a surge in short selling because they infer that short sellers have negative private information about the bank's solvency. The bank issues high-cost liabilities in response, which reduces profitability and may cause insolvency even if the bank was solvent before the short selling and withdrawals. Both mechanisms posit a causal relationship between short selling and deposit outflows.

The empirical literature on the short selling of bank stock since 2008 has largely focused on bans of, and limitations on, short selling that were implemented during and after the financial crisis of 2007-9 (GFC) and has found that such policies were costly. For example, liquidity was reduced and price discovery was slowed (Beber and Pagano 2013; Beber, et al. 2021; Bui, et al. 2023). Other papers focus on the role of short selling in the incorporation of information into share prices and the effects of such information on corporate decisions (Goldstein 2023; Purnanandam and Seyhun 2018; Chen, Liang, and Sun 2023; Asquith and Meulbroek 1995). We

[2] Matthew Fox, "JPMorgan CEO Jamie Dimon wants US regulators to consider a ban on the short selling of bank stocks," *Business Insider.* Other examples include Matthews (2023) and Saporito (2008).

are not aware of studies that look for evidence of a relationship between short selling and bank deposit outflows, which is the focus of this paper.[3]

Focusing on 2021Q1-2023Q3, which includes a period of public concern about bank solvency and liquidity, we find no evidence of an empirical relationship between short selling and deposit flows using confidential Federal Reserve data on deposit flows and publicly available data on short interest and short-sale volumes.[4] We find no statistically significant relationship between deposit flows and short interest, and simple plots show no evidence of a material increase in short interest preceding the three bank failures.

We do not claim very high confidence that there is no such relationship for two reasons: (1) The necessary data are observed with high quality only weekly and bimonthly, so it is conceivable that such a relationship exists only for a few days and then disappears. However, if that is the case and withdrawn deposits did not return to the bank in a very short time, the change in deposits would be observable in our data. And (2), identification that supports rejection of such a relationship is not achievable because we cannot rule out the possibility that other mechanisms approximately offset the effects of short selling on deposits. However, such mechanisms would have to offset the hypothesized relationship between short selling and deposit flows in all of the wide variety of specifications and subsamples that appear in this paper.

To date, those suggesting restrictions on the short selling of bank stock have been able to presume that more short selling is associated with larger deposit outflows because there was no empirical evidence for or against such a relationship. We believe that the evidence we present now places the burden of proof that short selling contributes to bank distress on proponents of restrictions on short selling. Our evidence suggests that such proof will be difficult to obtain.

Section 2 of this paper discusses mechanisms that might cause a sound bank to become distressed due to the short selling of its stock and describes our empirical strategy. Section 3 describes the data, Section 4 our results, and Section 5 provides concluding remarks.

2. Empirical Strategy

[3] A partial exception is Battalio (2023), who examine the behavior of measures of short-selling activity around the time of Silicon Valley Bank's failure.

[4] "Short interest" is the volume of outstanding short positions in a stock, measured in number of shares.

To set the stage, in Figure 1 we plot short interest for the three failed banks (Silicon Valley Bank (SIVB), First Republic Bank (FRC), and Signature Bank (SBNY)). Vertical lines denote their date of failure. Short interest spiked to extremely high levels only for First Republic, but the FDIC's report on its failure notes large deposit outflows immediately after Silicon Valley Bank's failure.[5] That is, the spike in First Republic's short interest followed deposit outflows rather than preceding them. At Silicon Valley Bank and Signature Bank, short interest was higher than at the average bank during the quarter before failure but not extraordinarily high. Overall, Figure 1 might be read as offering either some support or no support for the hypothesis that short selling contributes to bank failures.

We examine three main ways in which short sellers may cause changes in depositor behavior:

(1) Depositors observe outstanding short interest and interpret material increases in it as bad news about bank soundness. Depositors then withdraw;

(2) Individual short sellers may release information that they hope will cause a bank's share price to fall (after they have accumulated their short position). Such information might cause depositors to withdraw even if depositors pay no attention to short interest; or

(3) By increasing their short position, short sellers reduce bank stock prices, and depositors interpret negative returns on bank stock as bad news about bank soundness and choose to withdraw their deposits. That is, depositors do not make inferences from information about short interest but are attentive to bank stock returns, which might be influenced by short sales. This is a two-part mechanism involving an impact of short selling on stock returns and an impact of returns on deposit flows.

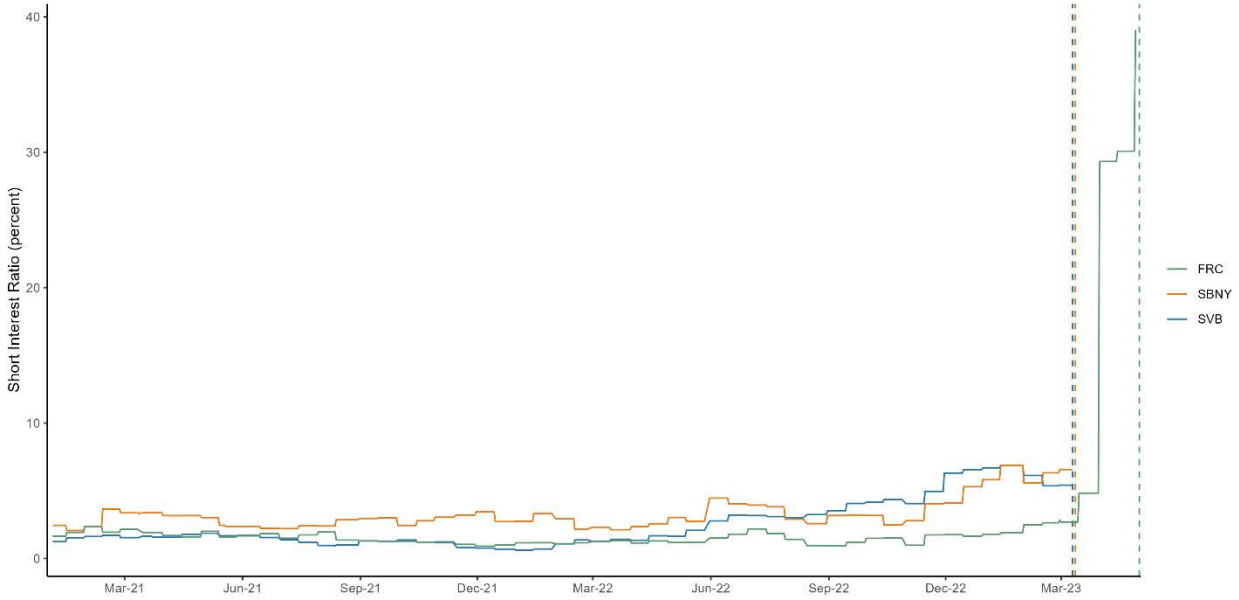
We offer evidence related to each of the three mechanisms.

If depositors interpret material increases in short interest as bad news and react by withdrawing their deposits, the level of short interest should predict deposit flows, perhaps with a lag. The relationship might be nonlinear in that deposits might flow out only when short interest

[5] "…an April 24, 2023 earnings call, which disclosed that First Republic lost over $100 billion in deposits during the first quarter of 2023, prompted a negative market response, a significant decline in the bank's stock price, and a resumption of significant deposit outflows." See https://www.fdic.gov/news/press-releases/2023/pr23073a.pdf.

is unusually high or at banks thought to be vulnerable for other reasons.[6] We use Granger causality methods to provide evidence.

Figure 1: Short interest for the three failed banks



We obtain evidence about the impact of short sellers' information releases by examining, for each sample bank, news stories that were published during the period January 2023 – September 2023 and that contain the words "bank" and "short." We read such stories one bank at a time, looking for those reporting on information about the bank that was released by entities with a short position. We found only two instances of a short seller releasing unflattering information about a bank.

To obtain information about the third mechanism, we relate bank stock returns to deposit flows, again using Granger causality methods. Because we find no economically material relationship, we do not examine the impact of short interest on bank stock returns. Extant evidence is mixed, with Barardehi, et al. (2023) finding that restrictions on short selling cause higher prices, implying that short selling does reduce returns. Reed's (2013) review mentions a

[6] We assume that deposit outflows cannot immediately be replaced by inflows of other deposits, that is, that bank marketing efforts to attract new depositors take time to have an effect. In the interim, the bank replaces withdrawn deposits with other liabilities, such as borrowings from the Federal Reserve or Federal Home Loan Banks or other sources of wholesale funding. However, if deposit outflows are large enough, wholesale funding may not be available and the bank will fail.

number of papers that find that short selling has an effect on returns. But Crane, et al. (2019) find no effect on stock prices. Beneish, Lee, and Nichols (2015) highlight the influence of the supply of loanable shares on short selling's consequences for returns.

2.1 Identification

As noted in the introduction, we find no evidence of a material relationship between short interest and deposit flows, but we cannot say with certainty that no such relationship exists. In addition to the aforementioned limitations of the data, it is possible that one or more of our three mechanisms is reflected in depositor behavior and the effects are economically material but such effects are offset by other influences. For example, some short selling is intended to establish hedges rather than being triggered by information about the prospects of a bank. Noise introduced by such activity into short interest measures might conceal the effects of speculative short selling.[7] More generally, we lack natural experiments or other sources of exogenous variation in speculative short interest, and thus, we cannot rule out that the effect of other variables correlated with short interest is masking the effect of short selling on deposit flows. However, we examine a large number of specifications and subsamples. It is unlikely that other mechanisms approximately offset an underlying true relationship between short selling and deposit flows across all such variations where we find no relationship, but do not offset such a relationship where we find that it is statistically significant but economically immaterial. We conduct a large number of robustness checks, described below. We believe our evidence places the burden of proof on those claiming that short selling causes deposit outflows.

3. Data

Data for deposits at individual banks are publicly available in SEC filings and reports to regulators only quarterly, which is too infrequent for the purposes of this paper. However, the Federal Reserve publishes weekly estimated aggregate commercial bank balance-sheet data (the H.8), which are based on bank-level data from FR 2644 filings. These data are less detailed than quarterly Call Reports but permit us to observe total deposits at individual banks at a weekly

[7] Of course, if short interest is not informative about bank prospects because of other influences, the foundation of the mechanisms is questionable.

frequency for an authorized stratified sample of about 850 domestically chartered banks and US branches and agencies of foreign banks at the beginning of 2021.

Filers of the 2644 are assured that their data will remain confidential and that no information will be revealed that could permit the public to identify either participants in the filing panel or data for an individual bank. Some results in this paper are presented in a way that preserves that confidentiality, and we also take steps to not identify which banks are in our sample. For example, when we plot bank deposits, we do so only for combinations of three banks at a time and only with normalizations such that dollar amounts are not revealed, and we add modest amounts of white noise to the data for each bank.

Our sample includes 134 banking organizations, a number far smaller than 850. Most banks do not have publicly traded equity, and thus, their stock cannot be sold short. Our requirement that banks be publicly traded cuts the sample to the approximately 230 banking organizations represented in the 2644 filings that have publicly traded equity.

We impose additional restrictions. First, we restrict the sample to banks that have data available for the entire sample period: January 1, 2021, through September 30, 2023. This restriction removes any bank that entered or left the panel during our sample period for any reason (participation is voluntary) or had missing data. Second, we exclude banks that change ownership. Third, any bank that reports two consecutive weeks of no change in deposits is excluded (we suspect reporting errors).[8] Fourth, we exclude a few banks that were so thinly traded that short transaction volume was zero more than once. Fifth, we eliminate any domestically chartered bank that is a subsidiary of a foreign banking organization.[9]

We use data from the Call Reports to construct some auxiliary variables.[10] Almost all equity return and shares outstanding data, which we obtain from Bloomberg, Compustat, and CRSP, are for the bank holding company because few chartered banks are publicly traded. In cases where a bank holding company owns multiple banks that file the 2644, we combine them

[8] The threshold for no change in deposits is an absolute value of 0.0001 percent

[9] Roughly equal numbers of banks are eliminated from the sample due to change in ownership, more than one trading day with zero short transaction volume, and missing 2644 data. The number eliminated for the other reasons is small.

[10] For some exercises, we label any bank that has an uninsured deposit ratio greater than the 80th percentile and a change in its combined HTM and AFS portfolio below the 20th percentile of our sample as "distressed." Measures are computed from Call Report data. Uninsured deposits are normalized by a bank's total deposits and the gain or loss on the combined HTM and AFS portfolio by a bank's total assets.

into a single virtual bank. Equity returns are weekly, ending at the close of trading on Wednesdays.

Short interest in a stock is the number of shares that have been sold short and not yet bought back to close short positions.[11,12] Short interest data for individual stocks is collected by FINRA and published twice a month with approximately a 10-day delay after the as-of date before data are published.[13]

FINRA also publishes daily information about short trading volume. However, these data do not include all short transactions. In principle, if FINRA data included all transactions and only those that influence short interest, one could cumulate transactions beginning after one bimonthly short interest value to obtain the next bimonthly short interest value. Unfortunately, daily short trading volume includes a wide variety of transactions not related to short interest and does not include long trades that are made to close out short positions. We use the FINRA daily data as predictors to obtain estimates of daily short interest, but such predictions are noisy.

Figure 2 displays the timeline for deposit, return, and short interest data used in this paper. Because returns are observed by the public for every trading day, no special treatment of returns is needed in regressions of changes in deposits on returns.

We observe deposits every week as of the end of each Wednesday. However, there is uncertainty about when the public learns about individual banks' deposit flows. The public might observe such flows only quarterly (and with a reporting lag after end-of-quarter), or the public might use other sources of information to construct noisy estimates of individual bank flows, including H.8 data, which are released with a seven-business-day lag after individual

[11] Short interest includes short positions established for a variety of purposes. For example, some writers of equity options may hedge with short positions in the underlying stock. Thus, short interest is a noisy indicator of the volume of short positions established as speculations on a decline in the share price.

[12] Some private firms collect daily data on short positions from a variety of brokerage firms and other relevant entities, but subscriptions to such data are costly and license agreements prevent subscribers from immediately publishing information about short interest in individual stocks. Because few depositors are professional financial market participants, we are skeptical that daily short interest information is available to a sufficient share of depositors to materially affect bank deposit flows.

[13] From the FINRA description of the data at https://www.finra.org/finra-data/browse-catalog/equity-short-interest : "The mid-month short interest report is based on short positions held by members on the settlement date of the 15th of each month. If the 15th falls on a weekend or another non-settlement date, the designated settlement date will be the previous business day on which transactions settled." "All short interest positions must be reported by 6 p.m. Eastern Time on the second business day after the reporting settlement date designated by FINRA." "Once the short position reports are received, the short interest data is compiled for each security and provided for publication on the 7th business day after the reporting settlement date."

banks' weekly data as-of date and which include aggregate deposits. Such uncertainty might influence the goodness-of-fit of our models of deposit flows.

Also uncertain is when the public learns about short interest and thus about the appropriate temporal alignment of changes in deposits and short interest in regressions. For our main analysis, we assume that the public knows about levels of short interest on the as-of date. However, it is possible the public does not know the values of short interest until the publication date. We perform robustness checks using the publication date.

Figure 2: Illustration of timing of key variables: January 2023

		Days Observed:		
DayOfMonth	DayName	Returns	Deposits	Short Interest
1	Sun			
2	Mon			
3	Tue	R		
4	Wed	R	D	
5	Thu	R		
6	Fri	R		
7	Sat			
8	Sun			
9	Mon	R		
10	Tue	R		
11	Wed	R	D	
12	Thu	R		
13	Fri	R		SI_asof_date
14	Sat			
15	Sun			
16	Mon			
17	Tue	R		SI_reported
18	Wed	R	D	
19	Thu	R		
20	Fri	R		
21	Sat			
22	Sun			
23	Mon	R		
24	Tue	R		
25	Wed	R	D	SI_publication
26	Thu	R		
27	Fri	R		
28	Sat			
29	Sun			
30	Mon	R		
31	Tue	R		SI_asof_date
1	Wed	R	D	

Table 1 provides summary statistics. Compared to all publicly traded US banks, our sample contains banks that have larger assets and deposits on average, mostly because very small banks are rarely publicly traded. Short interest is a small fraction of shares outstanding at the average bank, and total deposits grew slowly at the average bank during the sample period.

Table 1: Summary statistics

Variable	Sample				All Banks	
	Mean	50th-ish percentile	10th-ish percentile	90th-ish percentile	Mean	50th-ish percentile
Total Assets ($bil)	144.790	15.622	3.519	311.490	40.716	2.922
Total Deposits ($bil)	118.120	12.961	2.942	265.664	28.454	2.469
Short Interest (%)	1.87	1.54	0.72	3.15		
Short Transactions (daily%)	0.05	0.04	0.01	0.09		
ΔDeposits (weekly%)	0.14	0.01	-1.43	1.31		
Equity return (weekly%)	0.05	-0.20	-5.44	4.52		

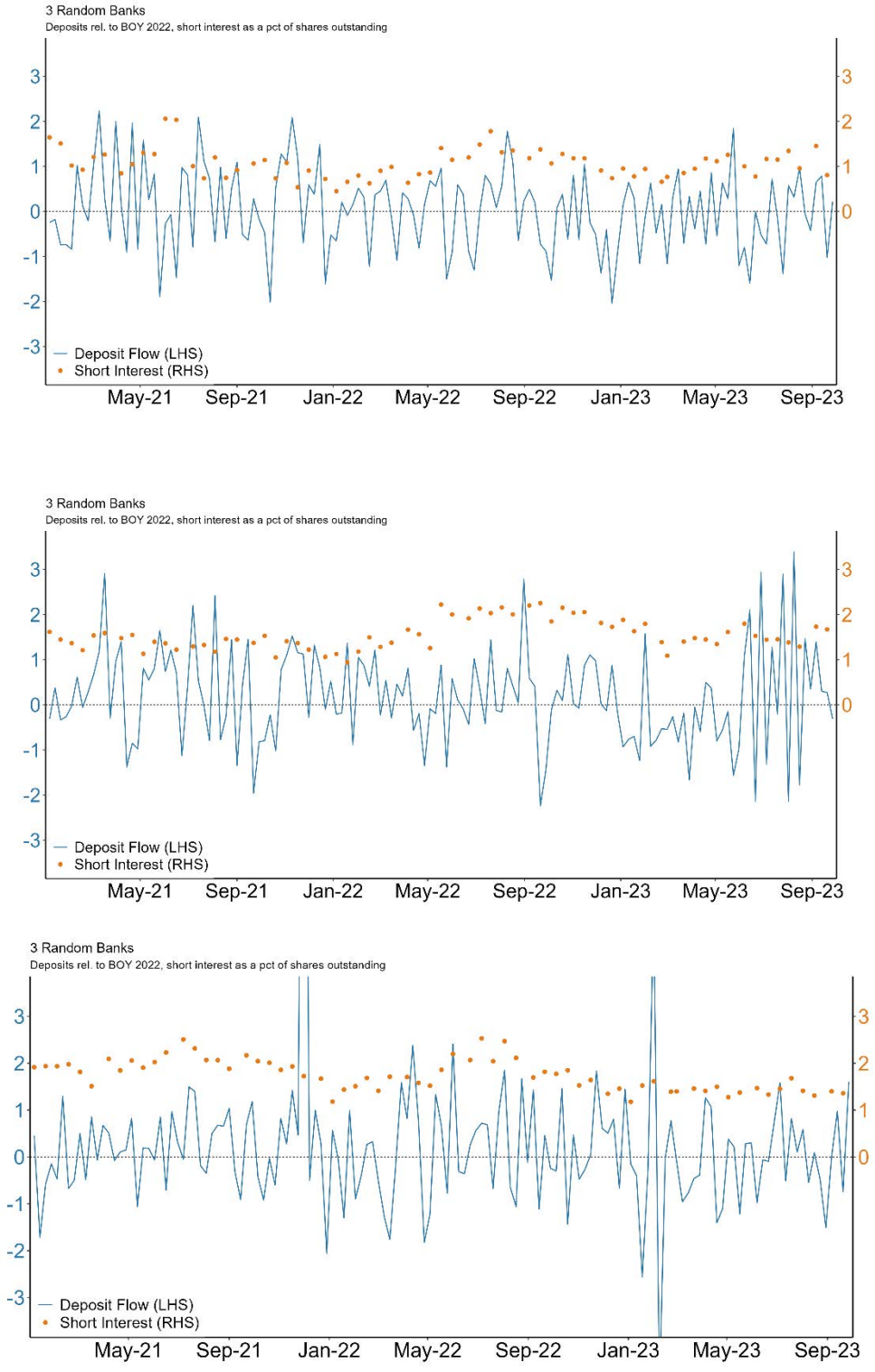
Note: "Short" variables are a fraction of shares outstanding at the start of 2021.
"P-ish" percentiles are the mean of the variable for banks between the P-2,P+2 percentiles.

4. Results

4.1 Bivariate relationships for subsets of banks of interest

We show bivariate relationships between deposit changes and short interest for a small subset of banks as another stage-setting exercise. These are banks with especially large deposit outflows in the first half of 2023. We compute weekly changes in deposits as a percentage of deposits on February 1, 2023, for each sample bank and identify the 20 banks with the most negative cumulative change from February 1, 2023, to May 31, 2023. Short interest is a percentage of the number of shares outstanding. We add white noise to each bank's ratios to protect individual banks' confidentiality and randomly select 9 of the 20 banks, which we combine into three simulated banks by equal-weighting individual bank percentages. Figure 3 plots short interest and changes in deposits for the three simulated banks. We do not see a pattern of short interest moving up before deposit outflows.

Figure 3: Short interest and deposit flows for three combinations of banks[14]



[14] Figures are cut off at 3.5 percent weekly deposit change.

4.2 Bimonthly short interest and deposit flows

We test hypotheses about the relationship between short interest measured bimonthly and deposit flows by estimating:

$$\Delta Deposits_t = \alpha_0 + \alpha_1 \Delta Deposits_{t-1} + \ldots + \alpha_1 \Delta Deposits_{t-4} + \beta ShortInterest_{t-1} + controls + \varepsilon_t \quad (1)$$

on a pooled sample that includes all banks in the data. Time is in weekly increments, and the ShortInterest value is for the as-of date before the Thursday that begins the seven-day period during which deposit change is measured. This means that two or even three weekly observations of ΔDeposits will be predicted by the same value of ShortInterest. We chose the number of lags of $\Delta Deposits_t$ using the Akaike criterion. We estimate (1) for two subsamples, 2021Q1-2023Q3 and 2023Q1-2023Q3, with the latter chosen to concentrate attention on the period of bank distress.

Other control variables include indicators for the weeks that include the 31st of the month and the 15th of the month to allow for payroll-related shocks to deposits; a systematic deposit-change factor measured by the aggregate change in banking system deposits from the Federal Reserve's H.8 weekly survey; and the effective federal funds rate, a proxy for the effect of interest rates on deposits. Results for short interest are not qualitatively different if these variables are omitted from the specification.

Columns (1) and (2) of Table 2 provide results for a base specification that includes the continuous measure of short interest and the aforementioned control variables. If increases in short interest were associated with decreases in deposits, the short interest coefficient should be negative, but it is positive for both the 2021Q1-2023Q3 and the 2023 samples. We show one-sided p-values for the short interest coefficient, and they are far from conventional thresholds of statistical significance for a null hypothesis that the coefficient is greater than or equal to zero (two-sided tests imply that the coefficient is statistically significantly larger than zero for the full sample, not negative). Other p-values in Table 2 are for two-sided tests.

Table 2: Prediction of weekly deposit flows using bimonthly short interest

	(1)		(2)		(3)		(4)		(5)		(6)	
	Base specification				Interact with distressed dummy				Week and bank fixed effects			
	2021-2023Q3		2023-2023Q3		2021-2023Q3		2023-2023Q3		2021-2023Q3		2023-2023Q3	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
		one-sided:		one-sided:		one-sided:		one-sided:		one-sided:		one-sided:
Short interest	0.040	0.999	0.015	0.809					0.102	1.000	0.165	1.000
Short interest x distressed					-0.003	0.417	-0.004	0.429				
Short interest x not distressed					0.069	1.000	0.040	0.956				
		two-sided:		two-sided:		two-sided:		two-sided:		two-sided:		two-sided:
Indicator week of 31st	0.145	0.004	0.242	0.061	0.145	0.004	0.244	0.060	0.081	0.756	0.291	0.701
Indicator week of 15th	0.097	0.032	-0.027	0.764	0.097	0.032	-0.027	0.767	-0.004	0.994	0.203	0.691
ΔDeposits---Aggregate	0.639	0.000	0.478	0.000	0.639	0.000	0.476	0.000	0.849	0.198	0.896	0.255
Fed funds rate (effective)	-0.008	0.378	0.097	0.431	-0.007	0.402	0.101	0.413	12.196	0.708	1.549	0.275
ΔDeposits---Lag1	-0.175	0.000	-0.191	0.000	-0.176	0.000	-0.191	0.000	-0.203	0.000	-0.288	0.000
ΔDeposits---Lag2	-0.142	0.000	-0.147	0.000	-0.143	0.000	-0.148	0.000	-0.165	0.000	-0.248	0.000
ΔDeposits---Lag3	-0.115	0.000	-0.134	0.000	-0.115	0.000	-0.134	0.000	-0.136	0.000	-0.230	0.000
ΔDeposits---Lag4	0.110	0.000	0.100	0.000	0.109	0.000	0.100	0.000	0.095	0.000	0.012	0.376
Intercept	0.043	0.254	-0.385	0.537	-0.004	0.913	-0.449	0.473	-1.170	0.671	-6.999	0.293
Week fixed effects	no		no		no		no		yes		yes	
Bank fixed effects	no		no		no		no		yes		yes	
Adjusted R^2	0.092		0.094		0.093		0.094		0.106		0.148	
Number of observations	19162		5226		19162		5226		19162		5226	

The signs of coefficients on control variables are as expected. Deposits increase during the weeks that include the 15th and 31st of the month and drop as the federal funds rate increases, though coefficients are not robustly statistically significantly different from zero. Individual banks' deposits tend to increase when banking system deposits increase (the coefficient on the aggregate change in deposits is near two-thirds and is statistically significant). Lagged changes in individual banks' deposits are also statistically significant predictors, with about one-third of a shock to deposits bleeding away over the following four weeks.

Results for pooled regressions might conceal a material negative relationship between short selling and deposit flows at a subset of individual banks. We ran regressions for each bank that are similar to those shown in columns (1) and (2). Figure 4 plots for the two samples the one-sided p-values for coefficients on short interest for the 134 banks included in the pooled regression sample. We expect about 5 percent of such regressions to yield p-values at or below 0.05 by chance alone and that is what the figures show.

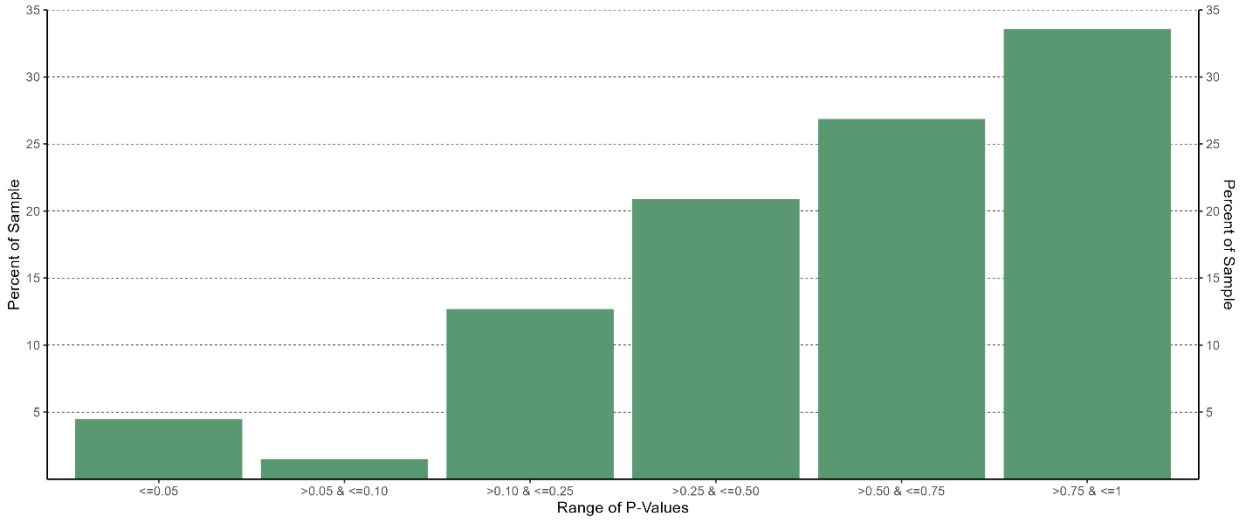
Results for the continuous short interest variable might conceal a different relationship between short interest and deposit flows for banks that are observably risky or distressed and those that are not. In the wake of the failure of Silicon Valley Bank, news reports implied that many observers' concerns about bank soundness were focused on banks with some combination of a large ratio of unrealized securities and loan losses to total assets (measured using market values reported in the Call Report) and a large share of uninsured deposits. We used the most recent Call Report data for each weekly observation to place banks into quintiles along each of these dimensions and categorize as "distressed" any bank that was in the top quintile of both uninsured deposit share and unrealized losses on securities as a fraction of total assets. Columns (3) and (4) of Table 2 report results when the distressed dummy is interacted with short interest. Results are qualitatively similar to those in columns (1) and (2): Higher short interest is not associated with larger outflows of deposits at conventional significance levels using one-sided tests. Results remain similar if we define distress using either high uninsured deposits or high unrealized losses on securities and loans.

A common empirical methodology is to include fixed-effect dummy variables in the specification to absorb influences on the independent variable that may be correlated with the variable of interest. This often forms part of an argument that a statistically significant coefficient on the variable of interest is not due to influences other than those being advanced as

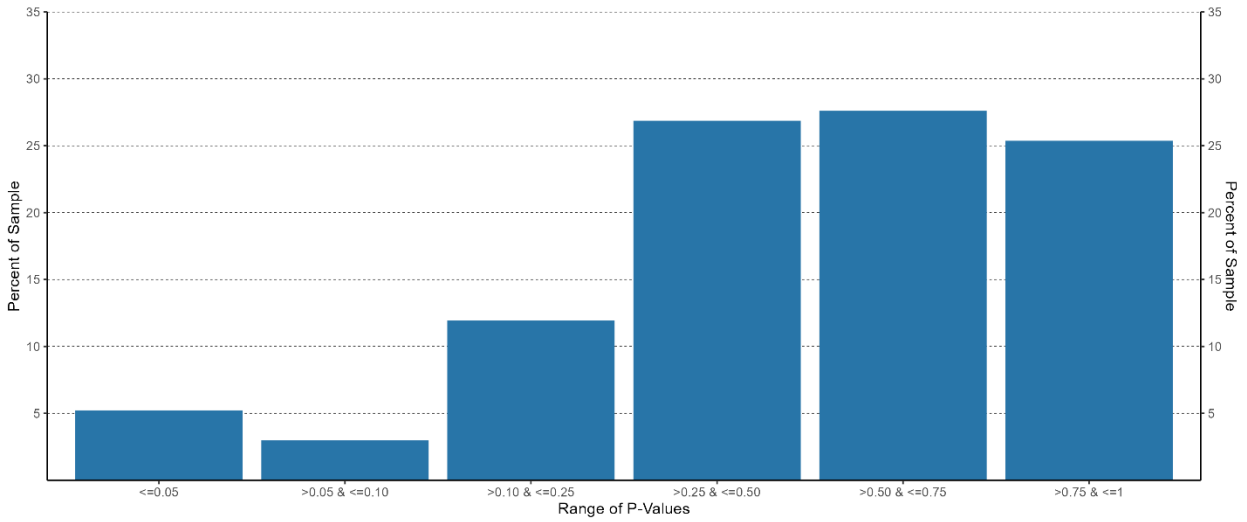
explanations for the relationship. In the specifications reported in Table 2, which provide no support for a negative relationship between short interest and deposit flows, such an argument has less force, but we include week and bank fixed effects in the regressions reported in columns (5) and (6). Results are qualitatively similar to those without fixed effects.

Figure 4: Distribution of p-values, short interest regressions using bimonthly short interest

Panel A: 2021Q1-2023Q3



Panel B: 2023Q1-2023Q3



Overall, the results in Table 2 and Figure 4 do not support claims that more short selling is associated with larger deposit outflows.

4.3 Results using imputed daily data to measure short interest

It is possible that any relationship between short selling and bank deposit flows occurs at a higher frequency than that captured in regressions using bimonthly short interest.[15] Information about short interest may reach depositors with a delay after the as-of date of the data. To address this concern, we impute short interest at a daily frequency using FINRA data on short trading volume for each trading day. We use these data to produce fitted values for daily short interest by estimating:

$$\text{ShortInterest}_{t} = \alpha_2 + \alpha_3 \text{ShortInterest}_{t-m} + \Sigma_{i=1}^{m-1} \eta_i \text{ShortVolume}_{t-i} + \zeta_t \qquad (2)$$

in which time is measured in trading days. We choose the number of lags, which varies across banks, to maximize the adjusted R^2 for each bank, with the number varying from 1 to 9 lags. We then use the fitted values to estimate variants of (1) in which 5 lags of fitted values of daily short interest are included as predictors of $\Delta\text{Deposits}_t$.

Table 3 reports the results. We focus on one-sided tests of the null hypothesis that the sum of the coefficients on lags of imputed daily short interest is greater than or equal to zero. In no case can the hypothesis be rejected, and the sum of the coefficients is usually not far from zero.

[15] We are not very concerned about having only weekly data for deposit flows because it would be necessary for deposits to flow out in response to the arrival of information about higher short interest and then to flow back in again very quickly if weekly data were to conceal a relationship. If the deposit flows persisted past the end of a weekly period they would be captured in the aforementioned regressions.

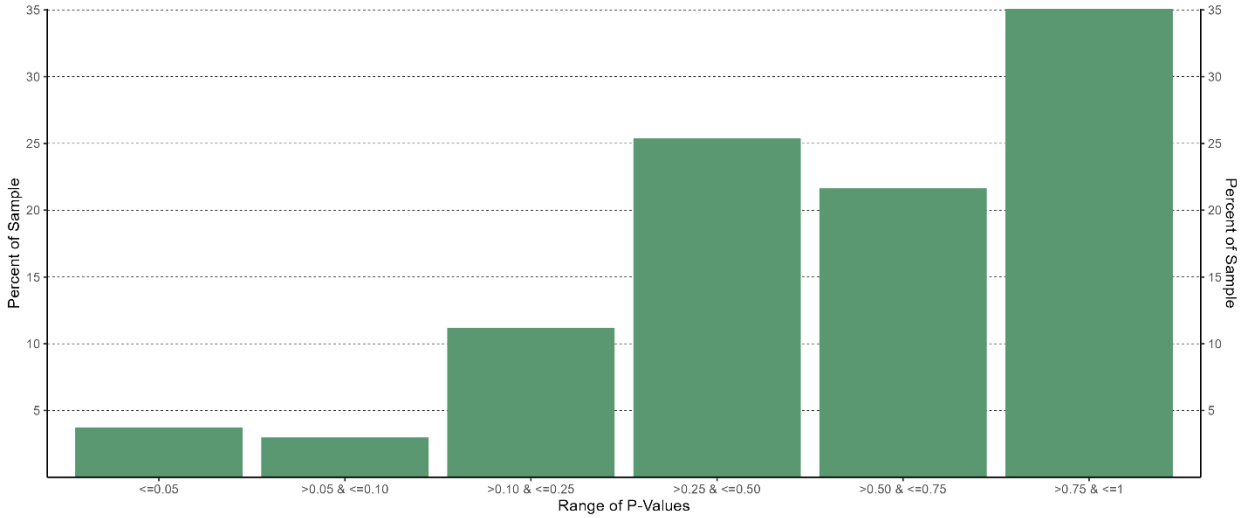
Table 3: Prediction of weekly deposit flows using imputed daily short interest

	(1) Base specification		(2)		(3) Interact with distressed dummy		(4)		(5) Week and bank fixed effects		(6)	
	2021-2023Q3		2023-2023Q3		2021-2023Q3		2023-2023Q3		2021-2023Q3		2023-2023Q3	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
		one-sided:		one-sided:		one-sided:		one-sided:		one-sided:		one-sided:
Daily short interest---Lag1	-0.220	0.000	-0.169	0.022					-0.206	0.000	-0.110	0.094
Daily short interest---Lag2	-0.128	0.019	-0.179	0.042					-0.117	0.029	-0.189	0.033
Daily short interest---Lag3	0.289	1.000	0.134	0.924					0.284	1.000	0.149	0.945
Daily short interest---Lag4	0.140	0.996	0.079	0.834					0.155	0.998	0.043	0.702
Daily short interest---Lag5	-0.056	0.142	0.132	0.958					-0.040	0.224	0.195	0.995
H0: Σlags ≥ 0		0.982		0.439						1.000		0.983
Short interest x distressed---Lag1					-0.134	0.162	-0.035	0.410				
Short interest x distressed---Lag2					-0.145	0.173	-0.310	0.050				
Short interest x distressed---Lag3					0.109	0.777	0.082	0.695				
Short interest x distressed---Lag4					-0.007	0.474	0.029	0.589				
Short interest x distressed---Lag5					0.166	0.903	0.220	0.930				
H0: Σlags ≥ 0						0.248		0.242				
Short interest x not distressed---Lag1					0.166	0.903	0.220	0.930				
Short interest x not distressed---Lag2					-0.231	0.000	-0.215	0.017				
Short interest x not distressed---Lag3					-0.145	0.016	-0.138	0.144				
Short interest x not distressed---Lag4					0.364	1.000	0.154	0.904				
Short interest x not distressed---Lag5					-0.111	0.027	0.111	0.885				
H0: Σlags ≥ 0						1.000		0.708				
		two-sided:		two-sided:		two-sided:		two-sided:		two-sided:		two-sided:
Indicator week of 31st	0.146	0.003	0.251	0.052	0.149	0.003	0.254	0.050	0.102	0.694	0.303	0.690
Indicator week of 15th	0.106	0.019	-0.007	0.940	0.107	0.017	-0.005	0.960	-0.029	0.955	0.208	0.683
ΔDeposits---Aggregate	0.638	0.000	0.472	0.000	0.639	0.000	0.473	0.000	0.797	0.227	0.898	0.254
Fed funds rate (effective)	-0.006	0.486	0.086	0.486	-0.006	0.521	0.087	0.479	10.987	0.736	1.500	0.291
Intercept	0.066	0.079	-0.292	0.640	0.022	0.584	-0.329	0.599	-1.011	0.713	-6.613	0.320
Week fixed effects	no		no		no		no		yes		yes	
Bank fixed effects	no		no		no		no		yes		yes	
Adjusted R^2	0.094		0.095		0.095		0.095		0.108		0.148	
Number of observations	19162		5226		19162		5226		19162		5226	

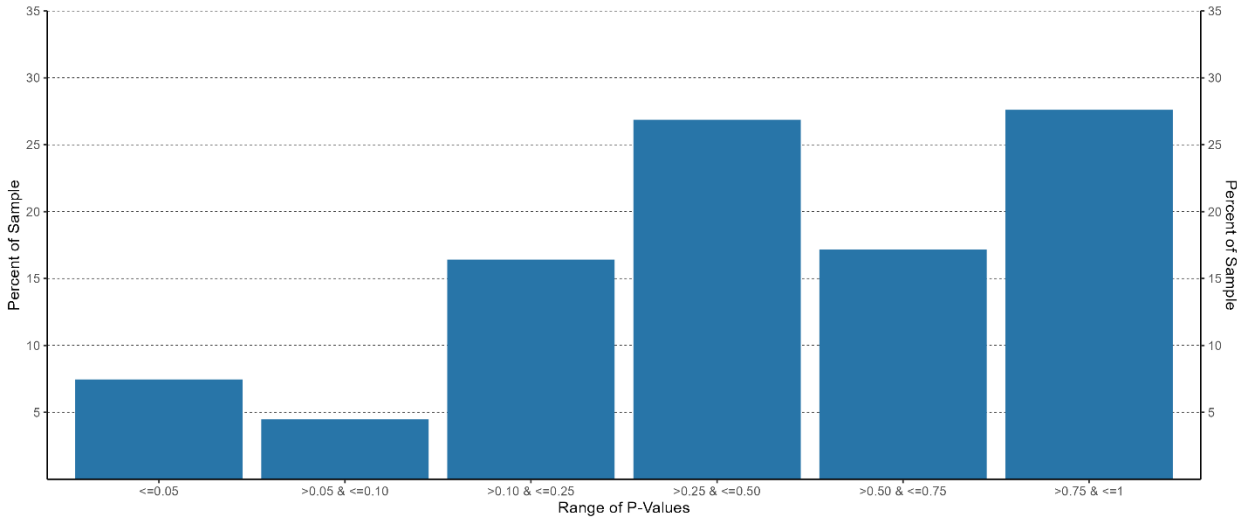
Note: Lags of ΔDeposits are included in specification but omitted from table to save space.

Figure 5: Distribution of p-values, short interest regressions using daily short interest

Panel A: 2021Q1-2023Q3



Panel B: 2023Q1-2023Q3



Analogous to Figure 4, in Figure 5, we report distributions of bank p-values for F tests of the null hypothesis that all coefficients on lagged daily values of ShortInterest are greater than or equal to zero. Again the number of banks for which the null can be rejected is similar to the number that would be expected by chance when the null is true.

4.4 Information releases by short sellers

For only two banks did we find news stories that included arguments that the bank was weak and that identified the source as having a short position: US Bancorp on April 17 and Western Alliance Bancorp on July 18.[16] The US Bancorp arguments focused on unrealized losses on loans and securities, while the Western Alliance arguments focused on what was described as misleading accounting. Using 10Q filings, total deposits at US Bancorp *increased* during the period March 31 – June 30, as did total deposits at Western Alliance between June 30 and September 30. We interpret the tiny number of stories and the lack of negative impact on quarterly deposits as providing no support for the hypothesis that short selling affects deposits because of associated information releases by short sellers.

4.5 Bank equity returns and deposit outflows

As noted previously, negative bank equity returns might trigger deposit outflows and short selling might reduce equity returns. We evaluate the first part of this two-part hypothesis by conducting Granger causality tests of the relationship between deposit flows and bank equity returns. We estimate a specification similar to (1) but we substitute for short interest the weekly equity return during the period ending on the as-of date (Wednesday) of weekly deposits. We include three lags of the weekly equity return to allow for the possibility that depositors act slowly upon information about returns. We focus on a null hypothesis that the sum of the coefficients on the return variables is less than or equal to zero (rejection would support an alternative that negative returns are associated with deposit outflows).

[16] We do not include stories that discuss only FINRA's short interest statistics because those are in our data. For 2023 through the third quarter, we searched for Bloomberg News stories about every bank in our data. We also searched noted "activist" investors' websites (e.g., Hindenberg Research) for short positions in any bank. We also searched a specialty newsletter, "The Bear Cave," on Substack for stories about any bank.

Table 4: Prediction of weekly deposit flows using weekly equity returns

	(1) Base specification		(2) Base specification		(3) Interact with distressed dummy		(4) Interact with distressed dummy		(5) Week and bank fixed effects		(6) Week and bank fixed effects	
	2021-2023Q3		2023-2023Q3		2021-2023Q3		2023-2023Q3		2021-2023Q3		2023-2023Q3	
	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value	Coeff.	p-value
		one-sided:		one-sided:		one-sided:		one-sided:		one-sided:		one-sided:
Bank's Stock Return	0.009	0.016	0.021	0.001					0.010	0.062	0.035	0.001
Bank's Stock Return - Lag1	0.008	0.020	0.017	0.007					-0.002	0.606	0.026	0.008
Bank's Stock Return - Lag2	-0.004	0.815	-0.007	0.825					-0.010	0.946	-0.003	0.605
Bank's Stock Return - Lag3	0.001	0.451	0.001	0.455					-0.002	0.597	0.015	0.080
H0: Σlags ≤ 0		0.046		0.006						0.616		0.000
Stock return x distressed					0.015	0.172	0.010	0.312				
Stock return x distressed---Lag1					0.009	0.299	0.027	0.103				
Stock return x distressed---Lag2					-0.004	0.590	-0.002	0.542				
Stock return x distressed---Lag3					0.025	0.064	0.022	0.149				
H0: Σlags ≤ 0						0.080		0.076				
Stock return x not distressed					0.008	0.025	0.022	0.001				
Stock return x not distressed---Lag1					0.008	0.023	0.016	0.015				
Stock return x not distressed---Lag2					-0.004	0.812	-0.007	0.827				
Stock return x not distressed---Lag3					-0.001	0.605	-0.002	0.590				
H0: Σlags ≤ 0						0.084		0.014				
		two-sided:		two-sided:		two-sided:		two-sided:		two-sided:		two-sided:
Indicator week of 31st	0.151	0.003	0.306	0.026	0.151	0.003	0.303	0.027	0.047	0.861	0.693	0.368
Indicator week of 15th	0.099	0.029	0.014	0.884	0.099	0.028	0.013	0.892	0.042	0.936	0.558	0.284
ΔDeposits---Aggregate	0.636	0.000	0.446	0.000	0.636	0.000	0.447	0.000	0.764	0.254	0.411	0.607
Fed funds rate (effective)	-0.001	0.930	0.102	0.411	-0.001	0.928	0.102	0.412	8.157	0.808	1.840	0.204
Intercept	0.109	0.000	-0.381	0.546	0.109	0.000	-0.379	0.548	-0.596	0.834	-8.325	0.220
Week fixed effects	no		no		no		no		yes		yes	
Bank fixed effects	no		no		no		no		yes		yes	
Adjusted R^2	0.092		0.096		0.092		0.096		0.105		0.148	
Number of observations	19162		5226		19162		5226		19162		5226	

Note: Lags of ΔDeposits are omitted to save space.

Results are in Table 4. Unlike in earlier exercises, we can reject the null hypothesis for almost all variants (the exception is column (5)), but the coefficients are small and the implied impact on deposit flows is not economically material. For example, the sum of coefficients in column (2) is 0.032. Multiplying the sum times an equity return of -20 percent would yield a predicted decline in deposits of only 0.6 percentage points, which Figure 3 implies is well within the normal range of weekly variations. Economic materiality is similar for all other columns in the table.

Moreover, distributions of p-values for the null hypothesis in individual-bank regressions, shown in Figure 6, are not very different from those in Figures 4 and 5, particularly for the 5 percent bin. As with other tests, the number of banks for which the null can be rejected is similar to the number that would be expected by chance if the null is true.

Given this evidence, it does not matter whether short selling affects bank equity returns because the economic effect of even quite large negative equity returns is so small that it is not economically material.

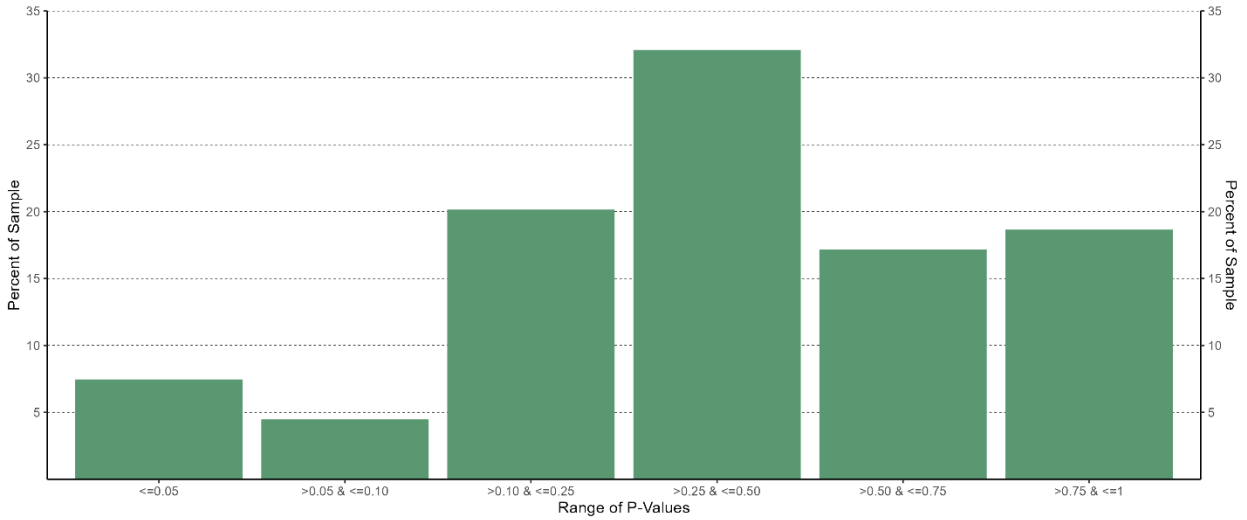
5. Concluding remarks

We find no evidence that short selling caused economically material deposit outflows at US commercial banks during the period 2021Q1-2023Q3. Although the short sample makes this paper a bit of a case study, a longer sample seems unlikely to increase the likelihood of finding a material relationship because of the lack of deposit outflows large enough to cause bank failures during years of financial normalcy.

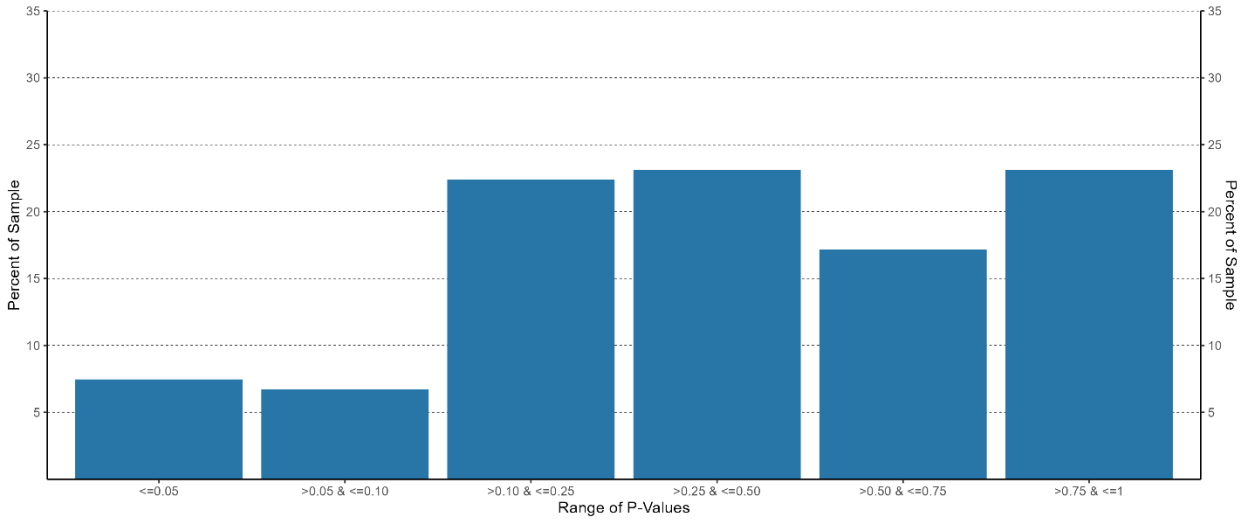
Although we cannot rule out the possibility that other influences on measures of short interest or on deposits are concealing a causal relationship between short selling and deposit outflows, we believe this paper's evidence places the burden of proof of such a relationship on those who argue in favor of it.

Figure 6: Distribution of p-values, regressions using weekly returns

Panel A: 2021Q1-2023Q3



Panel B: 2023Q1-2023Q3



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