Internet Appendix for “Deposit Franchise Runs”

Itamar Drechsler Alexi Savov Philipp Schnabl Olivier Wang*

This Internet Appendix serves as a companion to the paper "Deposit Franchise Runs." Its contents include supplementary material, tables, and figures that are not in the main text to conserve space. Section I provides proofs of the propositions. Section II outlines sources of our data. Section III describes additional information about our estimation. Sections IV to IX modify our baseline assumptions, such as sensitivity to exogenous outflow rate and retention of insured depositors, and explore alternative scenarios. Section X runs an event study of the 2023 regional bank crisis to test our predictions. Finally, section XI offers further extensions to our model.

I Proofs

A Proof of Proposition 1

Constant interest rate. We start with the baseline case of a constant interest rate. From (12) and using $D_{t-1} = (1-\delta)^{t-1} D$ we have

$$\begin{aligned} L &= \sum_{t=1}^{\infty} \frac{\delta D_{t-1}}{(1+r')^t} + \sum_{t=1}^{\infty} \frac{(\beta r' + c)\, D_{t-1}}{(1+r')^t} \\ &= D \left[\sum_{t=1}^{\infty} \frac{(1-\delta)^{t-1}}{(1+r')^t} \right] (\delta + \beta r' + c) \\ &= D \left[\frac{(\delta + \beta r' + c)}{r' + \delta} \right]. \end{aligned}$$

Therefore

$$DF \;=\; D - L \;=\; D \left[1 - \frac{(\delta + \beta r' + c)}{r' + \delta} \right] \;=\; D \left[\frac{(1-\beta) r' - c}{r' + \delta} \right]$$

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and

$$\frac{\partial DF\left(r\right)}{\partial r}=D\left[\frac{(1-\beta)\delta+c}{(r+\delta)^{2}}\right]$$

Thus, the dollar duration evaluated at r is

$$T_{DF}\ \equiv\ -\frac{\partial DF\left(r\right)}{\partial r}\ =\ -\frac{c+\left(1-\beta\right)\delta}{\left(r+\delta\right)^{2}}D\leq 0. \tag{IA.1}$$

General yield curve. We now extend the proof to the case of a general stochastic process for interest rates. Denote M_t the stochastic discount factor for date-t cashflows. The deposit franchise becomes

$$\begin{aligned} DF &= \mathbf{E}\sum_{t=1}^{\infty}M_{t}D(1-\delta)^{t-1}\left[(1-\beta)r_{t}-c\right] && \text{(IA.2)}\\ &= \mathbf{E}\sum_{t=1}^{\infty}M_{t}D(1-\delta)^{t-1}(1-\beta)(r_{t}+\delta)-\mathbf{E}\sum_{t=1}^{\infty}M_{t}D(1-\delta)^{t-1}\left[(1-\beta)\delta+c\right] && \text{(IA.3)}\end{aligned}$$

To compute the first term in (IA.3), note that for any short-term rate process $\{r_t\}$, no-arbitrage and the law of iterated expectations imply that for all t:

$$\mathbf{E}\left[M_{t-1}\right]=\mathbf{E}\left[(1+r_{t})M_{t}\right].$$

Therefore, multiplying both sides by $(1-\delta)^{t-1}$:

$$\begin{aligned}\mathbf{E}\left[(1-\delta)^{t-1}M_{t-1}\right] &= \mathbf{E}\left[\frac{1+r_{t}}{1-\delta}(1-\delta)^{t}M_{t}\right]\\ &= \mathbf{E}\left[\left(1+\frac{r_{t}+\delta}{1-\delta}\right)(1-\delta)^{t}M_{t}\right]\\ &= \mathbf{E}\left[(1-\delta)^{t}M_{t}\right]+\mathbf{E}\left[(r_{t}+\delta)(1-\delta)^{t-1}M_{t}\right].\end{aligned}$$

Summing over t yields a telescoping series:

$$\begin{aligned}\mathbf{E}\sum_{t=1}^{\infty}M_{t}(1-\delta)^{t-1}(r_{t}+\delta) &= \mathbf{E}\sum_{t=1}^{\infty}\left[(1-\delta)^{t-1}M_{t-1}\right]-\mathbf{E}\sum_{t=1}^{\infty}\left[(1-\delta)^{t}M_{t}\right]\\ &= \mathbf{E}[M_{0}]\\ &= 1.\end{aligned}$$

When $\delta = 0$, this is the familiar result that a floating rate bond paying the short rate r_t in each period trades at par. This implies that the first term in (IA.3) is simply

$$\mathbf{E} \sum_{t=1}^{\infty} M_t D (1-\delta)^{t-1} (1-\beta)(r_t + \delta) = D(1-\beta).$$

Turning to the second term in (IA.3), the yield y on a perpetuity amortizing at rate δ solves

$$\frac{1}{y+\delta} = \mathbf{E} \sum_{t=1}^{\infty} M_t (1-\delta)^{t-1},$$

that is, $y = \left(\sum_{t=1}^{\infty} q_t (1-\delta)^{t-1}\right)^{-1} - \delta$ where q_t is the price of a zero-coupon bond with maturity t.

Therefore, the deposit franchise simplifies to

$$DF = D(1-\beta) - D\,\frac{(1-\beta)\delta + c}{y+\delta} \quad \text{(IA.4)}$$

$$= D\,\frac{(1-\beta)y - c}{y+\delta}. \quad \text{(IA.5)}$$

B Proof of Proposition 2

Recall that an equilibrium requires the fixed-point condition (26)

$$\Lambda(v(\lambda(r'), r')) = \lambda(r'),$$

where Λ is given by the step function (11). Since r' is given we can simply denote $\lambda = \lambda(r')$, omitting the r' argument to ease notation.

- If $v(0, r') \geq \underline{v}$ then $\lambda = 1$ is an equilibrium since

  $$\Lambda(v(1, r')) = 1.$$

  Conversely, consider any $\lambda \in [0, 1)$. Since $\left(1 - \beta^U\right) r' > c^U$ we have $v(\lambda, r') > v(0, r')$ hence

  $$\Lambda(v(\lambda, r')) \geq \Lambda(v(0, r')) = 1 > \lambda,$$

  hence λ cannot be an equilibrium.

- If $v(1, r') < \underline{v}$ then $\lambda = 0$ is an equilibrium. Since $\left(1 - \beta^U\right) r' > c^U$ we have $v(0, r') <$

$v(1,r')$ hence $\Lambda(v(0,r')) \leq \Lambda(v(1,r')) = 0$, therefore

$$\Lambda(v(0,r')) = 0.$$

Conversely, consider any $\lambda \in (0,1]$. Then $v(\lambda,r') < v(1,r')$ hence $\Lambda(v(\lambda,r')) \leq \Lambda(v(1,r')) = 0$, therefore $\Lambda(v(\lambda,r')) = 0 < \lambda$ and λ cannot be an equilibrium.

- If $v(0,r') < \underline{v} \leq v(1,r')$ then:
  - $\lambda = 0$ is an equilibrium since $\Lambda(v(0,r')) = 0$;
  - $\lambda = 1$ is an equilibrium since $\Lambda(v(1,r')) = 1$.

Given a no-run bank value $v(1,r')$, the solvency ratio under a run is

$$v(0,r') = v(1,r') - u \times \frac{\left(1-\beta^U\right)r' - c^U}{r'+\delta}.$$

Therefore the condition $v(0,r') < \underline{v}$ is more likely to be satisfied if u is higher, if β^U or c^U is lower, and when r' is higher.

C Proof of Proposition 3

An equilibrium with $\lambda = 0$ exists when $v\left(0,r'\right) < \underline{v}$. From (8), we have

$$\frac{T_A}{D} = \frac{l\left(1+e\right)}{\left(r+\delta\right)}. \tag{IA.6}$$

We also have

$$v\left(0,r'\right) = \frac{A\left(r'\right)}{D} - 1 + \frac{DF_I\left(r'\right)}{D}. \tag{IA.7}$$

The value of the assets is equal to the sum of short term assets, $\left(1-l\right)A$, whose value is independent of the interest rate, and long-term assets. Long-term assets represent a fraction l of the value A of assets at r. If their initial cash flow is C, we have $lA = C/\left(r+\delta\right)$, which gives $C = \left(r+\delta\right)lA$. Therefore, at r', the value of the long-term assets is $\frac{r+\delta}{r'+\delta}lA$. Thus,

$$A(r') = \left(1-l\right)A + \frac{r+\delta}{r'+\delta}lA. \tag{IA.8}$$

Therefore

$$v(0,r') = (1-l)\,\frac{A}{D} + \frac{r+\delta}{r'+\delta} l \frac{A}{D} - 1 + \frac{(1-\beta^I)r' - c^I}{r'+\delta}\frac{D_I}{D}$$
$$= (1-l)\,(1+e) - 1 + (1-u)(1-\beta^I) + \frac{l(1+e)(r+\delta) - (1-u)\left[(1-\beta^I)\delta + c^I\right]}{r'+\delta}.$$

This shows that $v(0,r')$ is monotone in r'. The existence of a threshold r^{Run} therefore depends on whether $\lim_{r'\to\infty} v(0,r') < \underline{v}$. This limit is

$$\lim_{r'\to\infty} v\left(0,r'\right) \quad = \quad (1+e)\,(1-l) - 1 + \left(1-\beta^I\right)(1-u)\,. \tag{IA.9}$$

Note that this limit is decreasing in l. Thus, the threshold T_A^{Run} is where l is high enough that

$$(1+e)\,(1-l) - 1 + \left(1-\beta^I\right)(1-u) = \underline{v}. \tag{IA.10}$$

Re-arranging to match the expression in (IA.6),

$$T_A^{Run} \quad = D \quad \frac{e - \underline{v} + \left(1-\beta^I\right)(1-u)}{r+\delta}. \tag{IA.11}$$

Therefore when l is high enough so that $T_A > T_A^{Run}$ or

$$l > \frac{e - \underline{v} + \left(1-\beta^I\right)(1-u)}{1+e},$$

then $\lim_{r'\to\infty} v(0,r') < \underline{v}$, and since $v(0,r')$ is monotone in r', it must be weakly below $\underline{v}$ at some $r' = r^{Run}$ and remain below after, hence $\lambda = 0$ is an equilibrium for all $r' > r^{Run}$, where

$$r^{Run} = \frac{l(1+e)r - (1-u)c^I + \delta(e-\underline{v})}{l\,(1+e) - (e-\underline{v}) - (1-u)\,(1-\beta^I)}.$$

An equilibrium with $\lambda = 1$ fails to exist when $v(1,r') < \underline{v}$. We have

$$v\left(1,r'\right) \quad = \quad \frac{A\left(r'\right)}{D} - 1 + \frac{DF\left(r'\right)}{D}. \tag{IA.12}$$

Plugging in,

$$v\left(1,r'\right) \quad = \quad (1-l)\,(1+e) - \beta + \frac{l(1+e)(r+\delta) - \left[(1-\beta)\delta + c\right]}{r'+\delta} \tag{IA.13}$$

Like $v(0, r')$, $v(1, r')$ is also monotone in r'. Note that $\lim_{r' \to -\delta} v(1, r') = \pm\infty$, hence the $\lambda = 1$ equilibrium disappears for low enough r' when $\lim_{r' \to -\delta} v(1, r') = -\infty$. This requires $v(1, r')$ to be increasing in r', that is

$$l < \frac{(1-\beta)\,\delta + c}{(1+e)(r+\delta)}. \tag{IA.14}$$

Therefore, the threshold asset duration below which $\lambda = 1$ is not an equilibrium for sufficiently low r' is

$$T_A^{Insolv} = D \frac{(1-\beta)\,\delta + c}{(r+\delta)^2} = -T_{DF}(r). \tag{IA.15}$$

When T_A is below T_A^{Insolv}, the value of the bank falls toward $-\infty$ as $r' \to -\delta$. Since it is monotone in r', it must fall below the threshold $\underline{v}$ for sufficiently low $r' \leq r^{Insolv}$, where

$$r^{Insolv} = \frac{l(1+e)r - c + \delta(e - \underline{v})}{l\,(1+e) - (e - \underline{v}) - (1-\beta)}.$$

D Proof of Proposition 4 and 5

We wish to know when $T_A^{Insolv} \leq T_A^{Run}$ so that the bank can rule out both runs at high interest rates and insolvency at low interest rates. Plugging in, this requires

$$T_A^{Insolv} \leq T_A^{Run} \tag{IA.16}$$

$$\frac{(1-\beta)\,\delta + c}{(r+\delta)^2} \leq \frac{e - \underline{v} + \left(1-\beta^I\right)(1-u)}{r+\delta} \tag{IA.17}$$

$$(1-\beta) - \frac{(1-\beta)\,r - c}{r+\delta} \leq e - \underline{v} + \left(1-\beta^I\right)(1-u). \tag{IA.18}$$

Re-arranging and using $v(r) = \frac{A(r)}{D} - 1 + DF(r) = e + \frac{(1-\beta)r - c}{r+\delta}$ and $1 - \beta = u\left(1-\beta^U\right) + (1-u)\left(1-\beta^I\right)$, the condition becomes

$$v(r) \geq \underline{v} + \left(1-\beta^U\right) u. \tag{IA.19}$$

More generally, suppose that r' is bounded above by $\bar{r}$. Then T_A^{Insolv} is unchanged but T_A^{Run} is higher, such that

$$\underline{v} = (1-l)(1+e) - 1 + (1-u)(1-\beta^I) + \frac{l(1+e)(r+\delta) - (1-u)\left[(1-\beta^I)\delta + c^I\right]}{\bar{r}+\delta} \tag{IA.20}$$

$$l(1+e) = \frac{\bar{r}+\delta}{\bar{r}-r}\left\{e - \underline{v} + (1-u)\left[\frac{(1-\beta^I)\bar{r} - c^I}{\bar{r}+\delta}\right]\right\} \tag{IA.21}$$

hence

$$T_A^{Run} = D\,\frac{e - \underline{v} + \left(1-\beta^I\right)(1-u)}{r+\delta} \times \frac{\bar{r}+\delta}{\bar{r}-r}.$$

Relative to the case with $\bar{r} \to \infty$, T_A^{Run} is simply multiplied by a factor $\frac{\bar{r}+\delta}{\bar{r}-r} > 1$. As a result the condition $T_A^{Insolv} \leq T_A^{Run}$ becomes

$$v(r) \geq \underline{v} + u\frac{\left(1-\beta^U\right)\bar{r} - c^U}{\bar{r}+\delta}.$$

E Proof of Proposition 6

The proof of (35) follows the proof of Proposition 1 with the new deposit base $D\left[1 - w\left(r'\right)\right]$ replacing D.

The proof of (36) follows by differentiating (35) with respect to r' and substituting $r' = r$ and the expressions for T_{DF} and $DF(r)$ from Proposition 1.

F Proof of Proposition 7

Substituting the expressions for $T_{DF}(r)$ and $DF(r)$ from Proposition 1 back into (36),

$$T_{DF} = -\frac{(1-\beta)\,\delta + c}{(r+\delta)^2} + w'(r)\left[\frac{(1-\beta)\,r - c}{r+\delta}\right] \tag{IA.22}$$

$$= -\frac{\left[1 - \left(\beta + w'(r)\left[(1-\beta)\,r - c\right](1 + r/\delta)\right]\right)\delta + c}{(r+\delta)^2} \tag{IA.23}$$

$$= -\frac{\left(1-\tilde{\beta}\right)\delta + c}{(r+\delta)^2}. \tag{IA.24}$$

This expression is the same as (17) but with $\tilde{\beta}$ replacing β.

II Data appendix

Call reports. The call reports are accessible through the Federal Financial Institutions Examination Council and Wharton Research Data Services. The data contain quarterly income statements and balance sheets. We use the CRSP-FRB crosswalk provided by the New York Federal Reserve to merge in the stock returns of publicly traded bank holding companies from CRSP.

Macro data. We collect interest rate data from FRED. We use the quarterly average effective Fed funds rate (FEDFUNDS) for the estimation of deposit betas. We use the daily 10-year Treasury yield (DGS10) for the estimation of deposit franchise values as of December 31, 2021 (1.52%), February 28, 2023 (3.92%), and February 29, 2024 (4.25%).

Bloomberg indices. We collect data on the prices (with reinvested coupons) of Treasury and mortgage-backed security (MBS) indices by maturity from Bloomberg on the same dates as the Treasury yields. The specific indices and how we map them to banks' balance sheets from the call reports are listed in Table IA.V. The mapping uses the same asset class whenever possible, and closest available remaining maturity. In some cases we use more than one index to match the average remaining maturity of a call report item. Since call report items give a range of remaining maturities, we approximate the average remaining maturity of an item under the assumption that remaining maturities are uniformly distributed (i.e., staggered).

Expected betas. The Fed began surveying banks about their expected deposit betas starting with the November 2022 Senior Financial Officer Survey (SFOS, available through the Board of Governors website). This was done separately for retail and wholesale betas; we use the retail betas as they are closest to the call reports.

Banks were asked to report their current realized beta and their expected beta in six months. We use the ratio of these two values (expected over current) as the scaling factor for each partial-cycle beta (February 2023 and 2024). For the February 2023 date, we use the November 2022 survey (the most recent at the time), which gives us a scaling factor of $0.31/0.23 = 1.35$. For the February 2024 date, we use the September 2023 survey, which gives a scaling factor of $0.41/0.35 = 1.17$. It remains possible that even these betas are incomplete; they are also uncertain. This is an intrinsic problem in valuing an intangible asset such as the deposit franchise.

Figure IA.3 plots our call report betas against the current and expected betas from the SFOS at each point in time. There are some differences but the overall pattern is that the betas evolve consistently across the two datasets.

III Estimation Appendix

A Data and sample

Our main data source are the US call reports from June 2015 to March 2024. We restrict the sample to commercial banks with at least $1 billion of assets as of December 2021. We exclude banks without a significant domestic deposit base, specifically broker-dealers, credit cards banks, custodians, foreign-owned banks, and banks with a deposits to assets ratio of less than 65%. We drop 7 bank-quarter observations because quarterly average assets deviates by more than 50% from end of quarter assets or the absolute value of quarterly asset growth exceeds 50%. This leaves 714 banks.

Column (1) of Table IA.I provides summary statistics as of December 2021, on the eve of the hiking cycle. The average bank in our sample has $23 billion in assets, consisting of loans (62%), securities (22%), and cash (12%). Its main source of funding are domestic deposits (86%), 38% of which are uninsured. Its book equity ratio is 10%.

Column (2) breaks out large banks, which we define as those with at least $100 billion in assets. There are 17 large banks in our sample. Their average assets are $741 billion, 53% of which are loans, 25% securities, and 13% cash. Large banks also finance themselves primarily with domestic deposits (81%), but with a higher uninsured share (60%). Their equity ratio is also 10%.

The last row of Table IA.I reports the average net non-interest expense rate for all banks (1.49%) and large banks (1.03%). We use it to estimate the cost of running a deposit franchise.

We supplement the call reports with data on the stock prices of public banks from CRSP, interest rate data from FRED, and Treasury and MBS index prices from Bloomberg. Additional details are provided in Section II above.

B Estimation

We implement our framework by estimating bank values on three distinct dates: December 2021, February 2023, and February 2024. December 2021 is the end of the last quarter before the Fed began raising rates. We think of it as the initial date in the model. At the time, the 10-year Treasury yield was $r = 1.52\%$.[1] It rose sharply from there, reaching

[1]Note that valuations depend on long-term rates like the 10-year rate, not short-term rates like the Fed funds rate.

$r' = 3.92\%$ in February 2023. This is a natural choice for our second date because it immediately precedes the failure of SVB in early March 2023. The third date, February 2024, is one year later and corresponds to $r' = 4.25\%$.

While we have interest rates and asset prices on a daily basis, we only have call reports at quarter ends. We therefore use the December 2022 and 2023 call reports for our February 2023 and 2024 valuations, respectively.

Estimating bank values in our framework requires three separate components: the market value of the bank's assets, the value of its insured deposit franchise, and the value of its uninsured deposit franchise. We need to separate the insured and uninsured franchise values because they behave differently in a run. For this we need to estimate their respective deposit betas and costs. We explain how we do this next.

Deposit betas. The literature (Drechsler, Savov, and Schnabl, 2017, 2021) typically estimates deposit betas from banks' interest expense on deposits. A key challenge we face is that banks do not break out interest expense on insured and uninsured deposits. We develop a two-step estimation procedure to overcome this challenge.

The first step is to estimate each bank's overall deposit beta, as in (4). We do this by simply dividing the change in the bank's deposit rate (deposit interest expense over deposits) by the change in the Fed funds rate over a given period 0 to t:

$$\beta_{i,t} = \frac{DepositRate_{i,t} - DepositRate_{i,0}}{FedFundsRate_t - FedFundsRate_0}. \tag{IA.25}$$

For the initial date, December 2021, we take these betas from the previous cycle (December 2015 to June 2019).[2] For the second and third dates (February 2023 and 2024), we take them from December 2021 up to that point in the current cycle.

Since the current cycle is ongoing and deposit rates tend to lag policy rates, the estimated betas for February 2023 and 2024 are likely below the true, forward-looking betas that enter banks' valuations. We address this by scaling them up using survey data on banks' current and expected future deposit betas from the Fed's Senior Financial Officer Survey (see details in Section II above).

Panel A of Table IA.II presents our estimated betas. The average beta in December 2021, which is calculated from the previous hiking cycle, is 0.25 (standard deviation 0.14). The scaled betas for February 2023 are similar with a mean of 0.21 (standard deviation 0.16). Thus, early in the current cycle betas behaved similarly to the previous cycle. The average beta for February 2024, on the other hand, is 0.42 (standard deviation of 0.16). Be-

[2] Our sample includes one bank that was not operating during the 2015-2019 cycle. We assume this bank had the average insured and uninsured betas, respectively, of all other banks as of December 2021.

tas thus increased significantly later in the cycle. A likely explanation is that the previous cycle was slower and shallower than the current one, which allowed banks to keep betas low. By February 2024, the current cycle had turned out to be much steeper and faster, forcing banks to raise their betas.

The second step is to separate the insured and uninsured betas. We do so by assuming that the difference between the insured and uninsured beta is constant across banks. This allows us to identify it from a cross-sectional regression of overall betas on the uninsured deposit share:

$$\beta_i = \alpha + \gamma \times UninsuredDepositShare_i + \epsilon_i, \qquad \text{(IA.26)}$$

where $UninsuredDepositShare_i$ is bank i's ratio of uninsured deposits to domestic deposits, averaged over the period during which β_i is estimated. We run this regression separately for each of our three dates.

Figure 6 provides a binscatter plot of the deposit beta against the uninsured deposit share for February 2023 (plots for the other dates look similar). The figure shows a robust positive relationship, indicating that uninsured deposits have significantly higher betas. Panel B of Table IA.II reports the regression results. The coefficients are 0.12 in December 2021, 0.27 in February 2023, and 0.24 in February 2024, all highly significant. The increase over time is consistent with the fact that betas were compressed during the previous cycle, which is used to compute the December 2021 betas. The magnitudes imply that on average uninsured deposits have betas that are between 0.12 (December 2021) and 0.24 to 0.27 (February 2023 and 2024) higher than insured deposits.

We use these estimates to back out an insured and uninsured deposit beta for each bank as follows:

$$\beta_i^I = \beta_i - \widehat{\gamma} \times UninsuredDepositShare_i \qquad \text{(IA.27)}$$

$$\beta_i^U = \beta_i^I + \widehat{\gamma}. \qquad \text{(IA.28)}$$

The implicit assumption is that insured and uninsured betas differ by the same amount, estimated as $\widehat{\gamma}$ in Table IA.II, Panel B separately for each date. In a final step, we winsorize the betas at the 5% level to reduce the impact of outliers.

Panel B of Table I reports the results. In December 2021, the average insured and uninsured deposit betas are 0.22 and 0.33, respectively. In February 2023, they are similar: 0.11 and 0.37. Then in February 2024 they are higher: 0.33 and 0.57. Thus, early on in the cycle betas behaved as in the previous, shallow cycle. They increased later as the cycle became much steeper. The increase was similar for insured and uninsured betas. It is plausible that part of the increase in betas is due to the regional bank crisis, which may have "awakened" some depositors. However, from Figure IA.3, there is no clear discontinuity or inflection point in betas following that episode. Rather, betas have been rising steadily as rates have risen sharply.

Deposit costs. The next task is to estimate the cost of deposit provision. We cannot measure it directly because the call reports do not break out deposit costs from other expenses. We therefore use a hedonic approach similar to Hanson et al. (2015). We regress banks' net non-interest expense (non-interest expense minus income over assets) on deposits while controlling for other balance sheet items. The coefficient on deposits identifies deposit costs under the identifying assumption that deposits are not correlated with unobserved variables that drive costs independently of deposits.

We focus on core deposit costs, taking out large time deposits, which are a form of wholesale funding. We break up core deposits into three types to capture their cost differences: insured zero-maturity (i.e., checking and savings) deposits, uninsured zero-maturity deposits, and small time deposits. This gives us separate insured and uninsured deposit cost estimates. We also interact deposits with size controls to capture differences in costs by bank size. Our regressions thus have the form:

$$NetNoninterestExpense_{i,t} = \alpha_t + \gamma^j + \sum_{j,k} \beta^{j,k}\, Size^j_{i,t} \times Deposits^k_{i,t} + X_{i,t} + \epsilon_{i,t}, \quad \text{(IA.29)}$$

where $NetNoninterestExpense_i$ is bank i's annualized net non-interest expense over assets, α_t are time fixed effects, γ^j are size quartile fixed effects for $j = 1, \ldots, 4$, $Size^j$ are size quartile indicators, $Deposits^k$ are deposits of type k (uninsured zero-maturity deposits, insured zero-maturity deposits, and small time deposits), and X are balance sheet controls. We cluster standard errors at the bank level. We estimate the regression over the previous hiking cycle, from December 2015 to December 2019.

Like Hanson et al. (2015), the balance sheet controls we include are such that the omitted category is a bank that funds itself with wholesale funding (large time deposits and repo) and invests in cash and securities. We control for loans, foreign deposits, other borrowed money, equity, trading assets and liabilities, and other assets and liabilities. Other assets and liabilities are those that exclude deposits, the controls, and the omitted categories of cash, securities, large-time deposits and repo (these are absorbed in the size fixed effects). All these items are scaled by assets. The cost of running such a bank is absorbed in the size fixed effects γ^j. We expect this cost to be close to zero, which gives us a simple diagnostic for potential misspecification.

Panel A in Table IA.III presents the results. Column (1) gives the average cost of core deposits without breaking them up by type or differentiating by bank size. This cost is

1.322% per dollar of deposits. This number is very similar to Hanson et al. (2015), who estimate a cost of 1.3% for checking and savings deposits.

Column (2) splits core deposits into the three types. It finds a cost of 1.149% for uninsured zero-maturity deposits, 1.552% for insured, and 1.521% for small time deposits. Uninsured deposits thus have lower per-dollar costs than insured deposits, which is expected given their larger account sizes.

Column (3) presents the full specification with size interactions. We do not interact uninsured deposits with size because they are concentrated among the largest banks. The cost of uninsured deposits dips slightly to 1.084%. The costs of insured deposits are decreasing in size. Banks in the bottom quartile of our sample have insured zero-maturity deposit costs of 1.563% versus 1.293% for banks in the top quartile. For small time deposits, costs are 1.766% in the bottom quartile and 0.884% in the top quartile. This pattern is consistent with economies of scale in the deposit business.

The last four rows in column (3) show the size fixed effects. They are all close to zero and statistically insignificant. This is consistent with the prediction that wholesale-funded banks that invest in cash and securities have near-zero costs, and suggests that the regression is reasonably well specified.

We also consider the possibility of an omitted variable bias where productive banks which are efficient at servicing deposits might also be good at amassing high levels of deposits. In this case, we should expect some concavity whereby the increase in net non-interest expenses begin to plateau at higher level of deposits. We do not find clear evidence of this in the data (Figure IA.4).

We use the estimates in Table IA.III to compute bank-level insured and uninsured deposit costs. For each bank, the insured deposit cost is the weighted average of the coefficients in column (3) on zero-maturity insured deposits and small time deposits for the bank's size quartile, where the weights are the deposit shares. The uninsured deposit cost is a weighted average of the coefficient on uninsured zero-maturity deposits and the cost of large (uninsured) time deposits, which is zero. We also calculate an overall deposit cost as the weighted average of the insured and uninsured costs.

Panel C of Table I summarizes the deposit cost estimates. The average cost of insured deposits across all banks is 1.494% with a standard deviation across banks of 0.163%. Insured costs are higher for the smallest quartile (1.602%) than the largest (1.246%). Uninsured deposit costs are 0.954% on average and similar across the size distribution. The average overall cost is 1.303% (again very similar to the Hanson et al., 2015, estimate) and falls to 1.145% for the largest size quartile.

Bank of America is unusual in that it breaks out its non-interest expense and income related to deposits. For 2023, they report $10.477 billion in net non-interest expense on

$987.675 billion of deposits (Bank of America, 2023). This gives a per-dollar deposit cost of 1.061%, which is very close to our estimate of 1.109% for large banks in Panel B of Table IA.III. It is even closer to our point estimate for Bank of America, which is 1.106% at the end of 2023. This helps to validate our deposit cost methodology.

Exogenous outflows. The deposit franchise value depends on the exogenous outflow rate δ, which captures the natural rate of decay of a bank's deposit base. Banks do not disclose their deposit decay rates, hence we rely on estimates from the literature. These estimates differ substantially for both conceptual and measurement reasons. The main conceptual reason is that as existing deposits decay, banks incur deposit acquisition costs to replace them (for marketing, promotional pricing, etc.). These costs reduce the profitability of the marginal deposit dollar below that of the average. If they are high enough to make marginal deposits zero-NPV, then the bank can be valued based solely on existing deposits, whose decay rate tends to be high, and ignoring acquisition costs. The alternative is to use all deposits (existing and future), which implies a low decay rate, and include acquisition costs. Acquisition costs are difficult to capture because they change with the profitability of the marginal deposit dollar. This makes valuation based on existing deposits relatively common. Ellis and Jordan (2001) discuss this issue in detail.

An obvious source of decay rate estimates comes from the OCC's "Interest Rate Risk Statistics Report." The most recent report (Office of the Comptroller of the Currency, 2024) shows an average life of between five and six years for zero-maturity deposits at banks with over $10 billion in assets (similar to our sample). However, Sheehan (2013) argues that the OCC's estimates are too low and finds an average life of about ten years for most types of deposits (Sheehan, 2013, Table 4), which implies an annual decay rate of 10%. Artavanis et al. (2022) also find a 10% decay rate using Greek data. Wilary Winn (2016) and Stanton (2023) are studies by consulting firms that provide advisory services to banks. They also find decay rates of about 10%. Based on this reading of the academic literature and industry practice, we use $\delta = 10\%$ as our baseline rate of exogenous outflows.[3]

Marking assets to market. Banks report the book value of their assets but we need market values for valuation. We estimate them as follows. We first assume that book and market values are the same in December 2021, before the interest rate shock. To validate this assumption, we take advantage of the fact that banks report market (or "fair") values for their securities portfolios. We find that book and fair values are nearly identical in December 2021. We then estimate the mark-to-market losses on the assets as interest

[3] In Internet Appendix IV we provide robustness using an average deposit life of six years ($\delta = 1/6$), in line with the OCC's "Interest Rate Risk Statistics Report," and, at the other extreme, 20 years.

rates went up.

Banks report the distribution of their assets by repricing maturity bins. The repricing maturity of an asset is the time until its interest rate resets. We match each bin to a Bloomberg total return index with the nearest maturity. We use Treasury indices for non-real estate assets and MBS indices for real estate assets. This is important because the duration of mortgages is greatly affected by their amortization and prepayment schedules. Using MBS indices for real estate assets accounts for this. The exact indices and how we match them to repricing maturity bins are listed in Section II above.

We calculate the mark-to-market losses of each bank by multiplying its holdings in a given asset bin as of December 2021 by the percentage change in the matched Bloomberg index from December 2021 to February 2023 and February 2024 (the dates we focus on). We then sum up the losses across bins to get the loss for the whole bank (we assume zero loss on cash). We divide it by the sum of securities, loans, and cash as of December 2021 to convert it to a percentage asset loss. The implicit assumption is that banks have the same percentage loss on assets whose repricing maturity they do not report. These assets are small, representing only 6.2% of the balance sheet, hence their impact is likely small.

Panel A of Table I reports summary statistics for the mark-to-market asset losses. The average bank lost 8.22% of assets from December 2021 to February 2023. There is substantial variation in this number, with a standard deviation of 2.41%. Asset losses recover slightly to 7.37% as of February 2024. Large banks incur slightly smaller losses of 6.75% as of February 2023 and 5.98% as of February 2024. Our losses are similar but slightly smaller than Drechsler, Savov, and Schnabl (2023) who estimate an aggregate loss of 10% and Jiang et al. (2024) who estimate a loss of 9.2% for all banks and 10% for large banks. These losses are large compared to banks' average equity ratio of 10%.

Table IA.I: Summary statistics

This table provides summary statistics for all banks in the sample as of December 2021. The sample is restricted to commercial banks that are operating at the start of the hiking cycle (Dec 2021) and in the quarter prior to the regional bank crisis (Dec 2022) with over $1 billion in assets as of Dec 2021. We exclude banks without a significant domestic deposit base, specifically broker-dealers, credit card banks, custodians, foreign-owned banks, and banks with a deposits to assets ratio of less than 65%. The data are from the US call reports. Large banks have at least $100 billion in assets. All shares are scaled by assets except the uninsured deposit share, which is scaled by domestic deposits. Standard deviations in parentheses.

	All banks (1)	Large banks (2)
Assets ($ bill)	23.31	741.45
	(184.04)	(971.09)
Loans %	0.62	0.53
	(0.13)	(0.12)
Securities %	0.22	0.25
	(0.14)	(0.12)
Cash %	0.12	0.13
	(0.09)	(0.08)
Equity %	0.10	0.10
	(0.02)	(0.02)
Domestic deposits %	0.86	0.81
	(0.04)	(0.11)
Uninsured %	0.38	0.60
	(0.16)	(0.16)
Net noninterest expenses %	1.49	1.03
	(0.63)	(0.35)
Observations	714	17

Table IA.II: Deposit betas

The table presents estimates of deposit betas. Panel A shows average deposit betas in December 2021, February 2023, and February 2024. The December 2021 betas are calculated based on the previous cycle from December 2015 to June 2019. The betas in February 2023 and 2024 are calculated as of that date in the current cycle and scaled up using survey data on expected betas from the Fed's Senior Financial Officer Survey. Panel B shows regressions of the deposit beta on the uninsured share of deposits. Panel A show standard deviations in parentheses.

Panel A: Deposit betas

	Dec 2021	Feb 2023	Feb 2024
	(1)	(2)	(3)
Deposit beta	0.254	0.213	0.419
	(0.137)	(0.162)	(0.161)
Obs.	714	714	685

Panel B: Regressing beta on the uninsured deposit share

	Deposit beta		
	Dec 2021	Feb 2023	Feb 2024
	(1)	(2)	(3)
Uninsured Share	0.116***	0.265***	0.239***
	(0.036)	(0.036)	(0.043)
Constant	0.219***	0.114***	0.334***
	(0.012)	(0.015)	(0.017)
Obs.	713	714	685
R^2	0.014	0.069	0.043

Table IA.III: Deposit costs

The table presents regressions of net non-interest expense on bank characteristics, which we use to estimate deposit costs. Net non-interest expense is non-interest expense minus non-interest income divided by assets. Core deposits are checking, savings, and small time deposits over assets. Uninsured zero-maturity (ZM) deposits are uninsured checking and savings deposits. Insured zero-maturity (ZM) deposits are insured checking and savings deposits. Size controls and interactions use quartile splits. All columns control for time fixed effects and the asset shares of loans, foreign deposits, other borrowed money, equity, trading assets, trading liabilities, other assets (assets net of cash, reverse repo, securities, loans, and trading assets), and other liabilities (assets net of deposits, repo, trading liabilities, other borrowed money, and equity). The omitted categories are large time deposits, fed funds and repo on the liabilities side and cash and securities on the asset side. The sample is from 2015q4 to 2019q4.

	Net non-interest expense %					
	(1)		(2)		(3)	
Core dep %	1.322***	(0.435)				
Uninsured ZM dep %			1.149**	(0.514)	1.084**	(0.501)
Insured ZM dep %			1.552***	(0.447)		
Small time dep %			1.521**	(0.754)		
Insured ZM dep % × Size						
1					1.563***	(0.529)
2					1.432***	(0.539)
3					1.736***	(0.544)
4					1.293**	(0.539)
Small time dep % × Size						
1					1.766**	(0.795)
2					1.676	(1.135)
3					1.185*	(0.717)
4					0.884	(0.712)
Size						
1	−0.100	(0.376)	−0.172	(0.411)	−0.207	(0.430)
2	−0.084*	(0.050)	−0.088*	(0.049)	−0.016	(0.250)
3	−0.273***	(0.054)	−0.270***	(0.055)	−0.253	(0.361)
4	−0.419***	(0.063)	−0.390***	(0.069)	−0.162	(0.254)
Controls	Yes		Yes		Yes	
Time FE	Yes		Yes		Yes	
Obs.	12.074		12.074		12.074	
R^2	0.195		0.198		0.201	

Table IA.IV: Deposit franchise values

The table reports our estimates of deposit franchise values. Panel A is for all banks in our sample and Panel B is for large banks. Deposit franchise values are calculated using the formula in Proposition 1 and our empirical estimates of deposit betas, costs, and the exogenous outflow rate (see Tables IA.II and IA.III). We report the values of the insured and uninsured deposit franchise separately, as well as their sum at each of the three dates, December 2021, February 2023, and February 2024. Deposit franchise values are scaled relative to assets. Standard deviations in parentheses.

Panel A: All banks

Deposit Franchise Value	All banks		
	Dec 2021	Feb 2023	Feb 2024
	(1)	(2)	(3)
DF_I (Insured)	−1.43	7.74	5.16
	(1.21)	(2.78)	(2.49)
DF_U (Uninsured)	0.11	3.38	1.94
	(0.61)	(1.90)	(1.46)
$DF_I + DF_U$	−1.32	11.12	7.10
	(1.53)	(3.25)	(3.40)
Obs.	714	714	685

Panel B: Large banks

Deposit Franchise Value	Large banks		
	Dec 2021	Feb 2023	Feb 2024
	(1)	(2)	(3)
DF_I (Insured)	−0.17	5.55	4.97
	(0.29)	(2.70)	(1.69)
DF_U (Uninsured)	−0.09	3.76	1.95
	(0.58)	(1.34)	(0.83)
$DF_I + DF_U$	−0.25	9.30	6.92
	(0.80)	(3.35)	(2.40)
Obs.	17	17	14

IV Sensitivity to exogenous outflow rate δ

Our baseline rate of exogenous outflows is $\delta = 0.1$, implying an average deposit life of 10 years. This is consistent with Sheehan (2013) but higher than the average deposit life estimates in the OCC's "Interest Rate Statistics Report." The latest OCC report shows an average life of about six years for zero-maturity deposits. To see what impact this has, we re-run our estimates with $\delta = 1/6 = 0.167$.

Table IA.VI reproduces our main Table II with $\delta = 1/6$. The results are broadly similar. The main difference is that bank values decline. The average bank value in a run in February 2023 falls from 9.76% to 7.26%. The fraction of banks with negative run values rise from 0.70% to 1.40%. For large banks, run values decline from 8.50% to 6.70%. The number of large banks with a negative run value remains the same (one).

The impact is larger on bank values if there is no run. For all banks they fall from 13.14% to 9.54% and for large banks from 12.37% to 9.25%. A higher exogenous outflow rate lowers deposit franchise values. This has a larger impact on no-run values because they include the uninsured deposit franchise value.

Figure IA.5 similarly reproduces Figure 8. As in Table IA.VI, the impact is concentrated in the no-run values (yellow dots), which decrease substantially. Run values fall too but, importantly, they do not fall appreciably for the vulnerable banks (First Republic, Signature, and SVB). The reason is that these banks do not have a significant insured deposit franchise, so raising outflow rates does not hurt their run values much. Our results are therefore robust to using a different exogenous outflow rate.

We also consider a lower exogenous outflow rate of $\delta = 0.05$, or an average deposit life of 20 years. This affected results to the opposite direction, with the average bank value in a run in February 2023 rising from 9.76% to 14.10% and the fraction of banks with negative run values falling from 0.70% to 0.28%. For large banks, the average bank value with no run rose from 8.50% to 11.61%. Again, the number of large banks with negative run values is unchanged. If there is no run, the average bank value rises by more, from 13.14% to 19.37% for all banks and from 12.26% to 17.47% for large banks. Figure IA.6 plots these bank values of the large banks against their uninsured deposits share.

V Partial runs by insured depositors

Our main empirical results assume that the bank retains (or is able to sell) its entire insured deposit franchise in a run. This assumption is supported by the experience of the regional bank crisis. Nevertheless, it is also plausible that some share of insured depositors would leave in a run so that the insured deposit franchise is partly lost.

Table IA.VIII reestimates Table II under the assumption that 15% of insured depositors leave. This implies that only a fraction $\lambda^I = 85\%$ of the insured deposit franchise is retained in a run. Bank values without the deposit franchise ($A - D$) and without a run ($V(1, r)$) are unaffected, while bank values in a run ($V(0, r)$) decline due to the partial loss of the insured deposit franchise.

For all banks in February 2023, the average value in a run drops from 9.76% to 8.60%.

For large banks, it drops from 8.50% to 7.67%. While adding to the stress of the banking system, these values are still only slightly below the values in December 2021. Interestingly, for the most exposed banks (SBV, First Republic, Signature), insured depositor outflows have almost no impact because these banks had very few insured deposits.

VI Partial retention of uninsured depositors

Our main empirical results assume that all uninsured depositors leave in a run. It is plausible that some remain, especially since the FDIC's preferred resolution process is a sale to another bank. We can easily implement this by adjusting the run value of the bank, $V(0, r)$ to include a fraction of the uninsured deposit franchise.

Table IA.IX re-estimates Table II under the assumption that 15% of the uninsured deposit franchise is retained in a run. Bank values in a run increase, as expected.

The interesting effect of this policy is that it benefits precisely those banks most at risk of a deposit franchise run. To illustrate, we also re-estimate Figure 8 and present the results in Figure IA.7. The main difference is that SVB now has a run value of -0.20%, which is only marginally negative. First Republic and Signature bank are in the green with 2.78% and 2.46%, respectively.

VII Interest rate stress test

Our main results focus on the actual level of interest rates on the eve of the regional bank crisis. In this section we ask what would have happened if interest rates increased even further. The exercise is in the spirit of a stress test, a common tool used by regulators.

Figure IA.8 reproduces Figure 8 but with an interest rate of 10% instead of 3.92%. To create it, we recompute the values of banks in the following way. For the deposit franchise (insured and uninsured) we simply plug the new interest rate into the deposit franchise formula (Proposition 1). For the asset losses, we extrapolate by rescaling them by the ratio of the hypothetical interest rate change from December 2021 to 10% divided by the actual change from December 2021 to February 2023.

Figure IA.8 shows that if interest rates had risen to 10%, a large number of large banks would have been exposed to deposit franchise runs. The run values of four additional large banks become negative, and all but four are below 5%. This shows that deposit franchise runs are a broader concern than the specific banks that failed.

VIII Capital requirements on uninsured deposits

Figure IA.9 reproduces Figure 8 under a counterfactual policy that requires banks to hold 10% additional capital per dollar of uninsured deposits (Panel A) and per dollar of uninsured deposit franchise value (Panel B). These policies are interesting because they specifically target banks that are vulnerable to deposit franchise runs. In both cases, the values of exposed banks (SVB, First Republic, and Signature) rise significantly above zero, including conditional on a run. The policies are therefore effective at deterring such runs. Note, however, that the more nuanced policy in Panel B is particularly well-targeted: it raises the values of the most exposed banks the most. The reason is that deposit franchise run risk is precisely tied to the value of the uninsured deposit franchise.

IX Capping uninsured deposits

Figure IA.10 considers an alternative policy where uninsured deposits are capped at 60%. This exercise can also be interpreted as increasing the deposit insurance limit. We implement it by assuming that nothing else changes: the betas and costs of banks remain the same. The counterfactual simply re-allocates a sufficient fraction of uninsured deposits to insured.

The figure shows that this policy also helps to deter deposit franchise runs. The reason is that it raises the run equilibrium values of banks with very high uninsured deposit such as SVB, First Republic, and Signature Bank. It does not affect their value absent a run or their value without including the deposit franchise. In this way it has a narrowly targeted effect on the run risk of the deposit franchise.

X Event Study: The regional bank crisis

Our framework can also shed light on changes in bank values during the regional bank crisis in March 2023. If the failure of SVB was a deposit franchise run, then other banks with a large uninsured deposit franchise value should have experienced larger declines in market value during the episode. We can use bank stock prices to test this prediction.

We construct an "SVB beta" for each public bank in our sample. The SVB beta is simply the bank's stock return in a window around the failure of SVB. We use March 6 and March 13, 2013, as the start and end points of the window. March 6 is just before SVB's ill-fated earnings announcement, and March 13 is the Monday after its takeover by the FDIC. Since not all banks in our sample are public, we obtain 171 SVB betas.

Table IA.X shows the results of regressing the SVB beta on the uninsured share of deposits, the uninsured deposit beta, and both. Our model predicts that these are the two main ingredients of the uninsured deposit franchise. Banks with a lot of uninsured low-beta deposits have a large uninsured deposit franchise and are therefore more exposed to a deposit franchise run.

Column (1) shows that banks with a larger uninsured share of deposits had a more negative SVB beta. The relationship is strong, with an R^2 of 28% and a constant of zero, implying that banks with no uninsured deposits are predicted to have an SVB beta of zero.

Column (2) adds in the uninsured deposit beta, as well as its interaction with the uninsured deposit share.[4] The reason for the interaction is that according to the model uninsured deposits increase the risk of a deposit franchise run only if they are low-beta deposits.

This is indeed what we find. Summing the stand-alone coefficient on the uninsured deposit share and the interaction coefficient, a bank with an uninsured deposit beta of one has a flat relationship between uninsured deposit share and SVB beta. In contrast, a bank with an uninsured deposit beta of zero has a steeply decreasing relationship. Uninsured deposits therefore only matter if they are low-beta, consistent with our model. Relative to column (3), the R^2 is also increased to 35.7%, hence the uninsured beta and its interaction add significant explanatory power.

Column (3) replaces the right-hand variables with the product of the uninsured share and one minus the uninsured beta, $u\left(1-\beta^U\right)$. This is a simplified expression for the value of the uninsured deposit franchise that holds at very high interest rates (see Proposition 4). As such, it should predict the SVB beta about as well as the reduced-form interaction regression. We find that this is roughly the case. The R^2 declines slightly (this is not surprising since we are in effect restricting the coefficients) but remains high. The coefficient is large: a bank with uninsured beta of zero and uninsured share of one (a large uninsured deposit franchise) is predicted to have a 63.8% lower stock return than a bank with either an uninsured beta of one or uninsured share of zero (small uninsured deposit franchise).

Column (4) uses our actual estimate of the uninsured deposit franchise, DF_U. We scale it by the total bank value ($V\left(1,r\right)$) to turn it into a percentage loss of value in case of a run. The dependent variable, the SVB beta, is a return, hence it measures the actual percentage loss of value during the crisis. The result shows that banks with a large uninsured deposit franchise had significantly lower returns during the SVB crisis. The coefficient implies

[4] We use the December 2021 beta, which is estimated from the previous cycle. The reason is that the February 2023 may already incorporate information about deposit flight.

that banks on average lost 41.8% of their uninsured deposit franchise values. The R^2 is slightly lower than the reduced-form estimates but still high.

Column (5) adds the insured deposit franchise, DF_I, as an additional control. Unlike the uninsured deposit franchise, the insured deposit franchise comes in with a positive and significant coefficient that roughly offsets the negative constant. Thus, banks with only an insured deposit franchise are predicted to have an SVB return of about zero, whereas banks with only an uninsured deposit franchise are predicted to have an SVB return of -54%.

The opposing signs of the coefficients on the insured and uninsured deposit franchise values show that markets perceived one as a source of stability and the other as a source of instability. This confirms our assumption that uninsured deposits are runnable while insured deposits are not. Overall, the results in Table IA.X support the prediction of our model that an uninsured deposit franchise is a source of run risk for banks.

XI Further extensions

A Fixed and variable operating costs

Recall that in the main model we assume that c is a cost per dollar of remaining deposits hence the franchise value is

$$DF\left(r'\right) = D\left[1 - w\left(r'\right)\right]\frac{(1-\beta)\,r' - c}{r' + \delta}. \quad \text{(IA.30)}$$

In practice operating costs are a combination of pre-determined costs that do not fully respond to withdrawals, and costs that scale with the amount of deposits in each period. Here we extend the model by allowing the bank to decide the scale of the branch network and services offered before the interest rate shock, which corresponds to costs κD that must be paid even if deposits are withdrawn at $t = 0$.

For simplicity we assume that the costs κ stop being paid on the exogenous withdrawals at rate δ (otherwise nothing substantial changes except that expressions are slightly more complex because the last term is $-D\kappa/r'$ instead). Define the total cost

$$C = c + \kappa. \quad \text{(IA.31)}$$

Results are mostly unchanged under this formulation except for two points:

First, since outflows do not help to economize on the fixed operating costs κ, if all costs are fixed ($C = \kappa, c = 0$) then outflows always hurt the franchise value, even when $DF < 0$. We can generalize Proposition 6 as follows:

PROPOSITION IA.1 (Deposit franchise valuation with fixed costs): *If there are no runs, then the value of the deposit franchise with fixed costs after the interest rate shock is*

$$DF\left(r'\right) \quad = \quad \left[1-w\left(r'\right)\right]\left[\frac{\left(1-\beta\right)r'-c}{r'+\delta}\right]D-\frac{\kappa}{r'+\delta}. \tag{IA.32}$$

The dollar duration of the deposit franchise with fixed costs before the interest rate shock is

$$T_{DF} \;\equiv\; -\left.\frac{\partial DF\left(r'\right)}{\partial r'}\right|_{r'=r} \quad = \quad -\frac{\left(1-\beta\right)\delta+C}{\left(r+\delta\right)^2}+w'\left(r\right)\left[\frac{\left(1-\beta\right)r-c}{r+\delta}\right]. \tag{IA.33}$$

Proof: Equation (IA.32) comes from the fact that outflows do not affect the fixed cost κ. Equation (IA.33) comes from differentiating it with respect to r' and evaluating at $r'=r$.

Proposition (IA.1) shows that, holding total costs $C=c+\kappa$ fixed, higher fixed costs (lower c) make the duration of the deposit franchise less negative. The reason is that fixed costs are not recouped due to rate-driven outflows. This makes their present value decrease less when interest rates go up, so the deposit franchise appreciates less. All else equal, the bank needs a lower asset duration to hedge interest rate risk.

Second, the analysis of uninsured depositor runs is unchanged, except that in a run ($\lambda=0$) the uninsured deposit franchise can become negative instead of zero, since the fixed costs κ still need to be paid. This only affects the expressions for v and Λ as follows. The solvency ratio of the bank after the interest rate shock as a function of λ is still

$$v\left(\lambda,r'\right) \quad = \quad v\left(0,r'\right)+u\lambda\frac{\left(1-\beta^U\right)r'-c}{r'+\delta} \tag{IA.34}$$

as in (24), but the solvency ratio when all uninsured depositors run ($\lambda=0$) is

$$v\left(0,r'\right) \quad = \quad \frac{A\left(r'\right)-D+DF_I\left(r'\right)}{D}-u\frac{\kappa}{r'+\delta} \tag{IA.35}$$

instead of (25). The cost κ implies that the bank should hold some long-term assets to cover κ per period even to hedge liquidity risk, that is, to stabilize $v(0,r')$. However, the dilemma between hedging interest rate and liquidity risk persists for two reasons: first, a bank hedging interest rate risk in the no-run equilibrium must account for total operating costs $C=c+\kappa$, and second, the term $\frac{(1-\beta^U)r'-c}{r'+\delta}$ increases with r' even if $c=0$, hence the uninsured deposit franchise still drives a wedge between $v\left(0,r'\right)$ and $v\left(1,r'\right)$ that is increasing in r'.

B Lender of Last Resort

We end by showing how a lender of last resort can eliminate the run equilibrium ex post and thus avoid the risk management dilemma ex ante. We caution, however, that in a richer model this could lead to moral hazard or adverse selection.

Suppose that the central bank (henceforth, the Fed) gives a long-term loan to the bank

$$B(\lambda, r')$$

contingent on the extent of the run $1-\lambda$, with $B(1, r') = 0$. After borrowing from the Fed the solvency ratio entering uninsured depositors' run function $\lambda(v)$ is $v = \frac{A(r')+\lambda DF_U(1,r')+B(\lambda,r')}{D} - 1$. Importantly the denominator is given by deposits D hence does not take into account the long-term loan from the Fed, which is not runnable and effectively junior to current uninsured deposits. This is why the long-term loan improves v. More generally, it is enough if the denominator includes the government loan B discounted by a "runnability" factor $\alpha < 1$.

By setting

$$B(\lambda, r') = (1-\lambda) DF_U(1, r')$$

the Fed can ensure that

$$v(\lambda, r') = v(1, r')$$

for any λ. Therefore, the Fed policy eliminates the run equilibrium, in the sense that if the bank is hedged against interest rate risk in the good, run-free, equilibrium, then there is no run equilibrium. Moreover, since there is no run, the intervention ends up costless in equilibrium.

PROPOSITION IA.2: *Suppose that for any λ, a bank facing an uninsured deposit run $1-\lambda$ can borrow*

$$B(\lambda, r') = (1-\lambda) DF_U(1, r') \tag{IA.36}$$

long-term from the Fed. Then $\lambda = 1$ is the unique equilibrium and the equilibrium cost of the Fed intervention is zero.

One particular implementation resembles the Bank Term Funding Program (BTFP) introduced by the Federal Reserve in March 2023 allowing banks to borrow from the Fed at par, that is against a collateral value $A(r)$ instead of $A(r')$. Starting from an interest rate r such that $DF_U(1, r) = 0$, this corresponds to a loan size

$$B(\lambda, r') = (1-\lambda) \left[A(r) - A(r') \right],$$

which is exactly (IA.36).

In principle complete private insurance markets could also implement this allocation: banks would buy insurance contracts contingent on their idiosyncratic realization of λ and not just on the aggregate interest rate r'. In the model featuring only interest rate risk and purely idiosyncratic runs, these contracts would prevent runs from happening in the first place hence the equilibrium price of such insurance would be zero. However, in a richer setting featuring contagion and widespread runs, or in the presence of other aggregate shocks s as in Section III.B in the main article, such private insurance markets would be insufficient, which is why we focus on government-provided insurance.

There are two main drawbacks of the Fed policy we describe: moral hazard and adverse selection, both of which are outside the model. The equilibrium cost for the Fed is zero because banks hold high-quality liquid assets such as agency MBS and Treasuries whose value depends only on r. Banks therefore have no "bad" assets to offload on the Fed. In a model with more complex bank incentives and assets, the intervention may lead to excessive risk-taking and adverse selection in asset purchases, in particular because it is targeted at the ex post weakest institutions instead of favoring the healthiest ones.[5] The expectation of ex-post Fed intervention may also reduce private incentives to hedge ex-ante.

C Endogenous deposit pricing

Our results take advantage of the fact that the endogenous variables β and w' can be used as "sufficient statistics" for the bank's hedging problem. Here we discuss how they are related in a more micro-founded setting.

Let $\omega(s_d', r')$ be the household deposit withdrawal rate, where $s_d' = r' - r_d'$ is the deposit spread. The bank is thus left with deposits

$$D_0 \;=\; \left[1 - \omega\left(s_d', r'\right)\right] D \tag{IA.37}$$

after the interest rate shock. Let the withdrawal rate ω be increasing in the deposit spread s_d' and, holding s_d' fixed, decreasing in r'. The two arguments capture the "deposits channel" of monetary policy (Drechsler, Savov, and Schnabl, 2017): depositors withdraw if the deposit spread widens. The dependence on r' captures the fact that deposit demand becomes less elastic at higher rates as the opportunity cost of cash rises. The lower elasticity allows banks to charge a higher spread s_d', as we see in practice. Given the assumption

[5] See, for example, Philippon and Skreta (2012) and Tirole (2012) for an analysis of the cost of intervention with adverse selection, and Philippon and Schnabl (2013) and Philippon and Wang (2022) for the design of ex post interventions that mitigate moral hazard.

that the deposit rate is proportional to the market interest rate (see (3)), the date-0 withdrawal rate can be rewritten as a function of r' only:

$$w\left(r'\right) \equiv \omega\left(\left(1-\beta\right)r', r'\right). \tag{IA.38}$$

This is the reduced-form withdrawal rate in our main model.

While β depends on w' through the bank's profit maximization problem, and w' depends on β through the deposit demand function, in general neither is fully pinned down by the other, which is why we treat them as separate. Indeed, without additional restrictions on the deposit demand function $\omega\left(s_d, r\right)$, the correlation between β and $w'\left(r\right)$ can take any sign, as w' is given by

$$w' = (1-\beta)\omega_s + \omega_r,$$

where $\omega_s = \partial\omega/\partial s_d$ and $\omega_r = \partial\omega/\partial r$. Banks facing relatively inelastic depositors (low ω_s) have more market power, which allows them to set a low β. But given their low β, these banks could see more or less outflows when rates go up, as w' depends on the product $(1-\beta)\omega_s$. Empirically, Drechsler, Savov, and Schnabl (2017) find a negative correlation between β and w': low β banks face stronger rate-driven outflows w'.

D Variable deposit beta

We can easily extend the model to allow for non-linear deposit pricing with a deposit beta $\beta(r)$ that depends on r. In that case, the optimal modified duration is

$$T_{DF} = T_{DF}^{\beta'(r)=0} - \beta'(r)\frac{r}{r+\delta}, \tag{IA.39}$$

where $T_{DF}^{\beta'(r)=0}$ is given by Proposition 1. Betas tend to increase with rates: as rates rise the composition of deposits shifts from low-beta checking and savings accounts to higher-beta time deposits (Drechsler, Savov, and Schnabl, 2017; Greenwald, Schulhofer-Wohl, and Younger, 2023); betas also increase for given products (Wang, 2022). An increasing beta, $\beta'(r) > 0$, makes the duration of the deposit franchise less negative and hence calls for a shorter asset duration. Unlike for outflows, this duration-shortening effect is present at both low and high rates because an increase in β always hurts the deposit franchise value, even if it is negative.

E Quantifying Rate-Driven Outflows

Figures IA.1 and IA.2 show the deposit franchise duration and effective beta $\tilde{\beta}$ as functions of w' for three values of the deposit beta.

The average correction $\tilde{\beta} - \beta$ is not negligible. There is also substantial heterogeneity across banks. Most importantly, equation (38) shows that the correction $\tilde{\beta} - \beta$ is higher for low-β banks (as they earn higher deposit spreads hence stand to lose more from outflows) and high w' banks, which also tend to be the low-β banks (Drechsler, Savov, and Schnabl, 2017). For instance, their estimates imply that going from $\beta = 0.2$ (high market power) to $\beta = 0.4$ (low market power), outflow betas decline from $w' = 3.5$ to $w' = 2.5$. Therefore, the effective betas for hedging are

$$\beta = 0.2 \quad \rightarrow \quad \tilde{\beta} = 0.28 \quad \text{(high market power)} \tag{IA.40}$$

$$\beta = 0.4 \quad \rightarrow \quad \tilde{\beta} = 0.43 \quad \text{(low market power)} \tag{IA.41}$$

Thus, correcting for outflows has a modest effect for competitive banks, but a strong effect for banks with high deposit market power.[6]

[6] Interestingly, Drechsler, Savov, and Schnabl (2021) show that banks' income is slightly more interest-sensitive than their deposits. This is consistent with banks setting asset duration using an effective beta that is slightly higher than their deposit beta, as in Proposition 7.

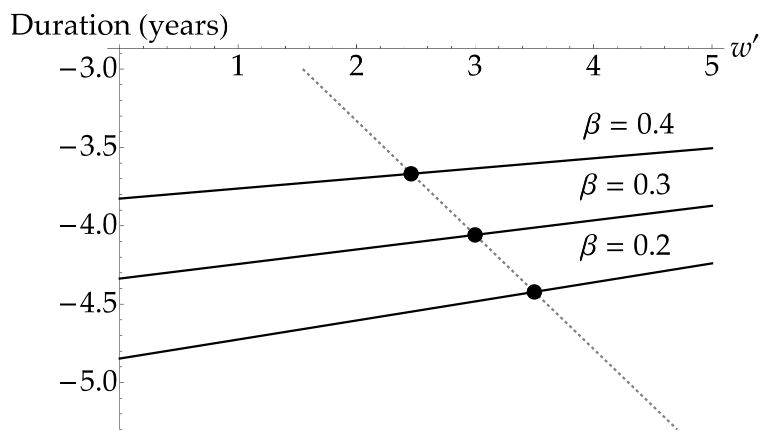

Figure IA.1: Deposit franchise duration T_{DF}/D as a function of the outflow elasticity w' for three values of the deposit beta $\beta = 0.2, 0.3, 0.4$. The dotted gray line captures the negative correlation between β and w' estimated by Drechsler, Savov, and Schnabl (2017).

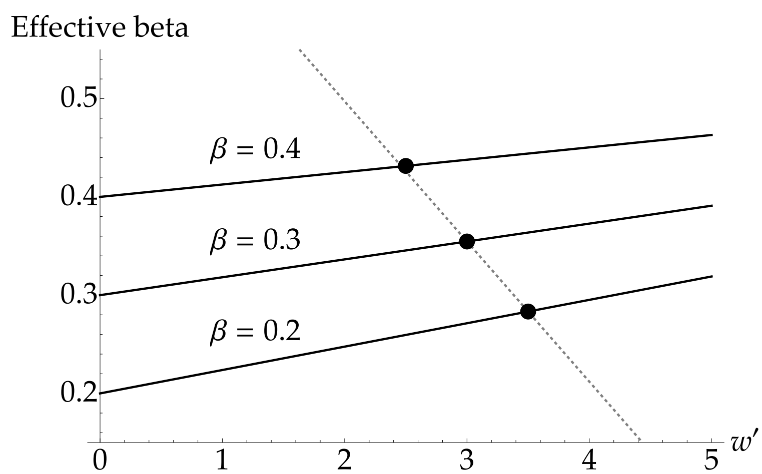

Figure IA.2: Effective beta as a function of outflow elasticity w' for three values of rate beta $\beta = 0.2, 0.3, 0.4$. The dotted gray line captures the negative correlation between β and w' estimated by Drechsler, Savov, and Schnabl (2017).

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Table IA.V: Bloomberg indices matched to call reports

This table provides the Bloomberg indices matched to each call report asset class and maturity bucket.

Asset class	**Repricing maturity bucket**	**Matched Bloomberg Index Price Change (Name)**	**Matched Bloomberg Index Price Change (Ticker)**
Non mortgage loans and securities	Less than 3m	Treasury index 0y-1y	I22917US
	3m-1y	Treasury index 0y-1y	I22917US
	1y-3y	Treasury index 1y-3y	LT01TRUU
	3y-5y	Treasury index 3y-5y	LT02TRUU
	5y-15y	4/15*(Treasury index 5y-7y) + 2/5*(Treasury index 7y-10y) + 1/3*Treasury index 10y-20y	4/15*LT03TRUU + 2/5*LT09TRUU + 1/3*I00059US
	Over 15y	Treasury index 10y-20y	I00059US
Mortgage loans and RMBS	Less than 3m	Treasury index 0y-1y	I22917US
	3m-1y	Treasury index 0y-1y	I22917US
	1y-3y	US Aggregate MBS 1y-5y	I27402US
	3y-5y	US Aggregate MBS 1y-5y	I27402US
	5y-15y	FNMA MBS 15y	I00854US
	Over 15y	2/3*FNMA MBS 15y + 1/3*Fixed Rate Conventional MBS 30y	2/3*I00854US + 1/3*I00109US
Other MBS	Less than 3y	As matched for mortgage loans and RMBS less than 3y, weighted by bank's holding of each asset class	-
	Over 3y	As matched for mortgage loans and RMBS over 3y, weighted by bank's holding of each asset class	-

Table IA.VI: Bank values with a higher exogenous outflow rate

The table reports our estimates of bank values under the alternative assumption that the deposit decay rate $\delta = 1/6 = 0.167$, indicating an average maturity of 6 years, instead of 0.1. Panel A is for all banks and Panel B is for large banks. The first row is without the deposit franchise. Assets are marked to market using matched Bloomberg indices by asset class and repricing maturity. The second row is the bank value if a deposit franchise run occurs, $V(0,r) = A - D + DF_I + DF_U$. The third value is if there is no run, $V(1,r) = A - D + DF_I + DF_U$. Deposit franchise values are calculated using the formula in Proposition 1 and our empirical estimates of deposit betas, costs, and the exogenous outflow rate (see Tables IA.II and IA.III). Bank values are reported on three dates, December 2021, February 2023, and February 2024. Bank values are scaled relative to assets. Standard deviations in parentheses; % and # ≤ 0 are the percentage and number of banks with non-positive value, respectively.

Panel A: All banks

Bank Value	All banks		
	Dec 2021	Feb 2023	Feb 2024
	(1)	(2)	(3)
$A - D$ (No DF)	10.24	2.02	2.86
	(2.07)	(3.20)	(3.18)
% ≤ 0	0.00	26.47	17.23
$V(0,r) = A - D + DF_I$ (Run)	9.34	7.26	6.37
	(2.16)	(3.34)	(3.22)
% ≤ 0	0.00	1.40	1.31
$V(1,r) = A - D + DF_I + DF_U$ (No run)	9.40	9.54	7.69
	(2.21)	(3.42)	(3.38)
% ≤ 0	0.00	0.28	1.17
Obs.	714	714	685

Panel B: Large banks

Bank Value	Large banks		
	Dec 2021	Feb 2023	Feb 2024
	(1)	(2)	(3)
$A - D$ (No DF)	9.96	2.95	4.20
	(1.68)	(2.57)	(1.83)
# ≤ 0	0	2	0
$V(0,r) = A - D + DF_I$ (Run)	9.86	6.70	7.59
	(1.64)	(3.59)	(2.04)
# ≤ 0	0	1	0
$V(1,r) = A - D + DF_I + DF_U$ (No run)	9.80	9.25	8.92
	(1.60)	(3.64)	(2.31)
# ≤ 0	0	0	0
Obs.	17	17	14

Table IA.VII: Bank values with a lower exogenous outflow rate

The table reports our estimates of bank values under the alternative assumption that the deposit decay rate $\delta = 0.05$, indicating an average maturity of 20 years, instead of 0.1. Panel A is for all banks and Panel B is for large banks. The first row is without the deposit franchise. Assets are marked to market using matched Bloomberg indices by asset class and repricing maturity. The second row is the bank value if a deposit franchise run occurs, $V(0,r) = A - D + DF_I + DF_U$. The third value is if there is no run, $V(1,r) = A - D + DF_I + DF_U$. Deposit franchise values are calculated using the formula in Proposition 1 and our empirical estimates of deposit betas, costs, and the exogenous outflow rate (see Tables IA.II and IA.III). Bank values are reported on three dates, December 2021, February 2023, and February 2024. Bank values are scaled relative to assets. Standard deviations in parentheses; % and # ≤ 0 are the percentage and number of banks with non-positive value, respectively.

Panel A: All banks

	All banks		
Bank Value	Dec 2021	Feb 2023	Feb 2024
	(1)	(2)	(3)
$A - D$ (No DF)	10.24	2.02	2.86
	(2.07)	(3.20)	(3.18)
% ≤ 0	0.00	26.47	17.23
$V(0,r) = A - D + DF_I$ (Run)	7.71	14.10	10.81
	(2.88)	(4.80)	(4.35)
% ≤ 0	0.14	0.28	0.58
$V(1,r) = A - D + DF_I + DF_U$ (No run)	7.90	19.37	13.80
	(3.25)	(5.31)	(5.34)
% ≤ 0	0.42	0.00	0.44
Obs.	714	714	685

Panel B: Large banks

	Large banks		
Bank Value	Dec 2021	Feb 2023	Feb 2024
	(1)	(2)	(3)
$A - D$ (No DF)	9.96	2.95	4.20
	(1.68)	(2.57)	(1.83)
# ≤ 0	0	2	0
$V(0,r) = A - D + DF_I$ (Run)	9.67	11.61	11.86
	(1.61)	(5.59)	(3.01)
# ≤ 0	0	1	0
$V(1,r) = A - D + DF_I + DF_U$ (No run)	9.52	17.47	14.86
	(1.83)	(6.13)	(3.94)
# ≤ 0	0	0	0
Obs.	17	17	14

Table IA.VIII: Bank values with a partial run by insured depositors

The table reports our estimates of bank values under the alternative assumption that $1-\lambda^I = 15\%$ of insured depositors leave in a run. Note that relative to the main results in Table II, this only affects run values, $V(0,r)$. Panel A is for all banks and Panel B is for large banks. The first row is without the deposit franchise. Assets are marked to market using matched Bloomberg indices by asset class and repricing maturity. The second row is the bank value if a deposit franchise run occurs, $V(0,r) = A - D + \lambda^I DF_I$. The third value is if there is no run, $V(1,r) = A - D + DF_I + DF_U$. Deposit franchise values are calculated using the formula in Proposition 1 and our empirical estimates of deposit betas, costs, and the exogenous outflow rate (see Tables IA.II and IA.III). Bank values are reported on three dates, December 2021, February 2023, and February 2024. Bank values are scaled relative to assets. Standard deviations in parentheses; % and # ≤ 0 are the percentage and number of banks with non-positive value, respectively.

Panel A: All banks

	All banks		
Bank Value	Dec 2021	Feb 2023	Feb 2024
	(1)	(2)	(3)
$A - D$ (No DF)	10.24	2.02	2.86
	(2.07)	(3.20)	(3.18)
$\% \leq 0$	0.00	26.47	17.23
$V(0,r) = A - D + DF_I$ (Run)	9.03	8.60	7.24
	(2.25)	(3.55)	(3.37)
$\% \leq 0$	0.00	0.98	1.31
$V(1,r) = A - D + DF_I + DF_U$ (No run)	8.92	13.14	9.96
	(2.46)	(3.97)	(3.97)
$\% \leq 0$	0.00	0.14	0.73
Obs.	714	714	685

Panel B: Large banks

	Large banks		
Bank Value	Dec 2021	Feb 2023	Feb 2024
	(1)	(2)	(3)
$A - D$ (No DF)	9.96	2.95	4.20
	(1.68)	(2.57)	(1.83)
$\# \leq 0$	0	2	0
$V(0,r) = A - D + DF_I$ (Run)	9.82	7.67	8.42
	(1.63)	(3.95)	(2.19)
$\# \leq 0$	0	1	0
$V(1,r) = A - D + DF_I + DF_U$ (No run)	9.71	12.26	11.12
	(1.62)	(4.48)	(2.85)
$\# \leq 0$	0	0	0
Obs.	17	17	14

Table IA.IX: Bank values with a partial retention of uninsured depositors

The table reports our estimates of bank values under the alternative assumption that $\lambda = 15\%$ of uninsured depositors remain in a run. Note that relative to the main results in Table II, this only affects run values, $V(0,r)$. Panel A is for all banks and Panel B is for large banks. The first row is without the deposit franchise. Assets are marked to market using matched Bloomberg indices by asset class and repricing maturity. The second row is the bank value if a deposit franchise run occurs, $V(0,r) = A - D + DF_I + \lambda DF_U$. The third value is if there is no run, $V(1,r) = A - D + DF_I + DF_U$. Deposit franchise values are calculated using the formula in Proposition 1 and our empirical estimates of deposit betas, costs, and the exogenous outflow rate (see Tables IA.II and IA.III). Bank values are reported on three dates, December 2021, February 2023, and February 2024. Bank values are scaled relative to assets. Standard deviations in parentheses; % and # ≤ 0 are the percentage and number of banks with non-positive value, respectively.

Panel A: All banks

	All banks		
Bank Value	Dec 2021	Feb 2023	Feb 2024
	(1)	(2)	(3)
$A - D$ (No DF)	10.24	2.02	2.86
	(2.07)	(3.20)	(3.18)
$\% \leq 0$	0.00	26.47	17.23
$V(0,r) = A - D + DF_I$ (Run)	8.83	10.27	8.31
	(2.34)	(3.73)	(3.56)
$\% \leq 0$	0.00	0.70	1.02
$V(1,r) = A - D + DF_I + DF_U$ (No run)	8.92	13.14	9.96
	(2.46)	(3.97)	(3.97)
$\% \leq 0$	0.00	0.14	0.73
Obs.	714	714	685

Panel B: Large banks

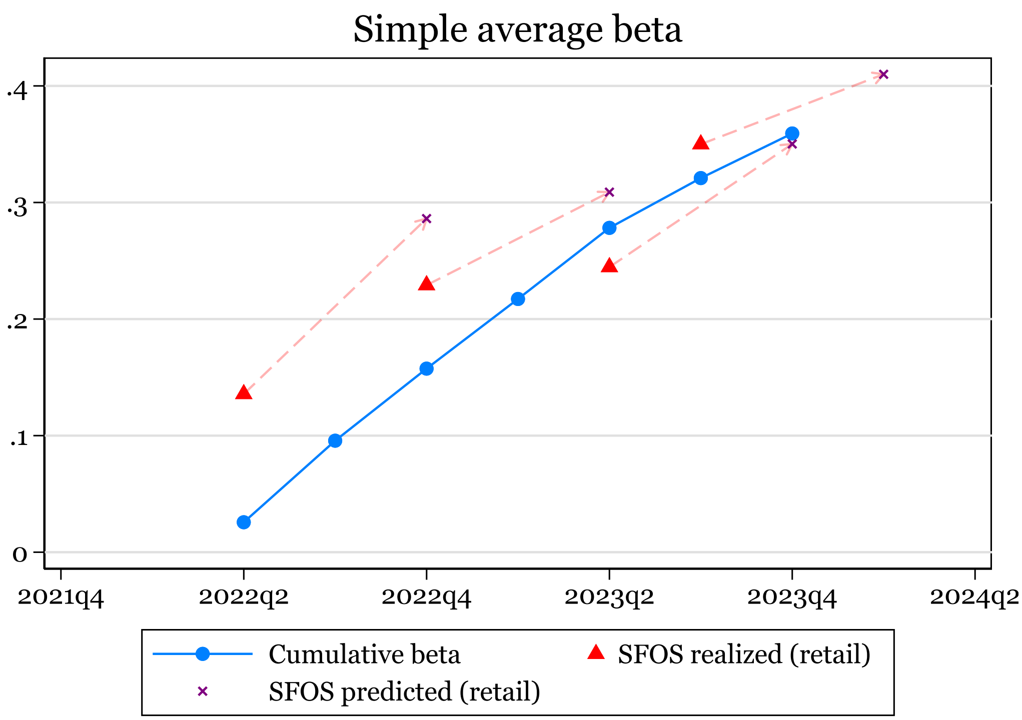
	Large banks		
Bank Value	Dec 2021	Feb 2023	Feb 2024
	(1)	(2)	(3)
$A - D$ (No DF)	9.96	2.95	4.20
	(1.68)	(2.57)	(1.83)
$\# \leq 0$	0	2	0
$V(0,r) = A - D + DF_I$ (Run)	9.78	9.06	9.46
	(1.61)	(4.28)	(2.41)
$\# \leq 0$	0	1	0
$V(1,r) = A - D + DF_I + DF_U$ (No run)	9.71	12.26	11.12
	(1.62)	(4.48)	(2.85)
$\# \leq 0$	0	0	0
Obs.	17	17	14

Table IA.X: regional bank crisis event study

The table shows regression results of SVB betas (a bank's SVB beta is its stock return during the SVB crisis, from March 6 to March 13, 2023) on uninsured deposits shares, uninsured deposit betas, and deposit franchise values. The uninsured deposit beta is measured during the previous cycle from 2015 to 2019. Column 3 replaces the variables with the product of the uninsured deposit share and one minus the uninsured deposit beta, as implied by Proposition 4. Column 4 replaces the variables with the uninsured deposit franchise in February 2023, scaled by the total bank value. Column 5 adds the insured deposit franchise in February 2023, also scaled by total bank value.

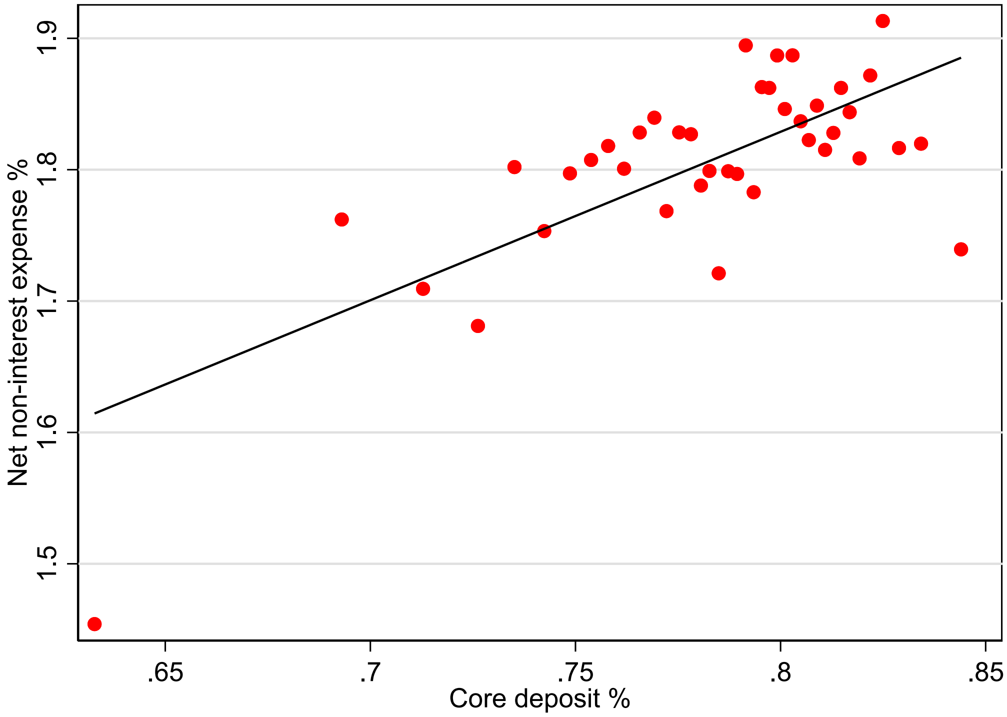
	SVB beta				
	(1)	(2)	(3)	(4)	(5)
Uninsured share	−0.457***	−1.106***			
	(0.056)	(0.159)			
Uninsured beta 2019		−0.746***			
		(0.201)			
Unins beta × Unins share		1.849***			
		(0.430)			
(1 − Unins beta) × Unins share			−0.638***		
			(0.078)		
Uninsured deposit franchise				−0.409***	−0.389***
				(0.060)	(0.060)
Insured deposit franchise					0.112**
					(0.050)
Constant	0.004	0.263***	−0.015	−0.085***	−0.151***
	(0.025)	(0.073)	(0.023)	(0.018)	(0.034)
Obs.	171	171	171	171	171
R^2	0.282	0.357	0.285	0.215	0.238

Figure IA.3: Call report betas and survey betas



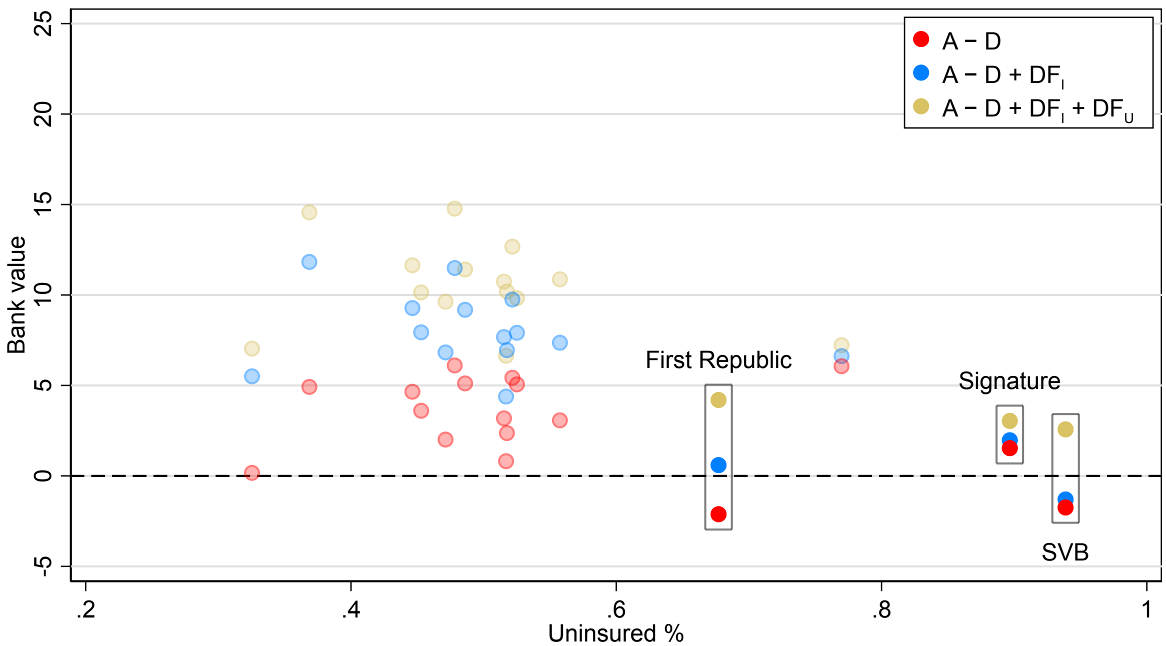
These figure plots the average beta calculated from the call reports and the realized and predicted retail betas reported in the Fed's Senior Financial Officer Survey. The dashed lines connect the current and expected betas from each survey.

Figure IA.4: Deposit cost and core deposits



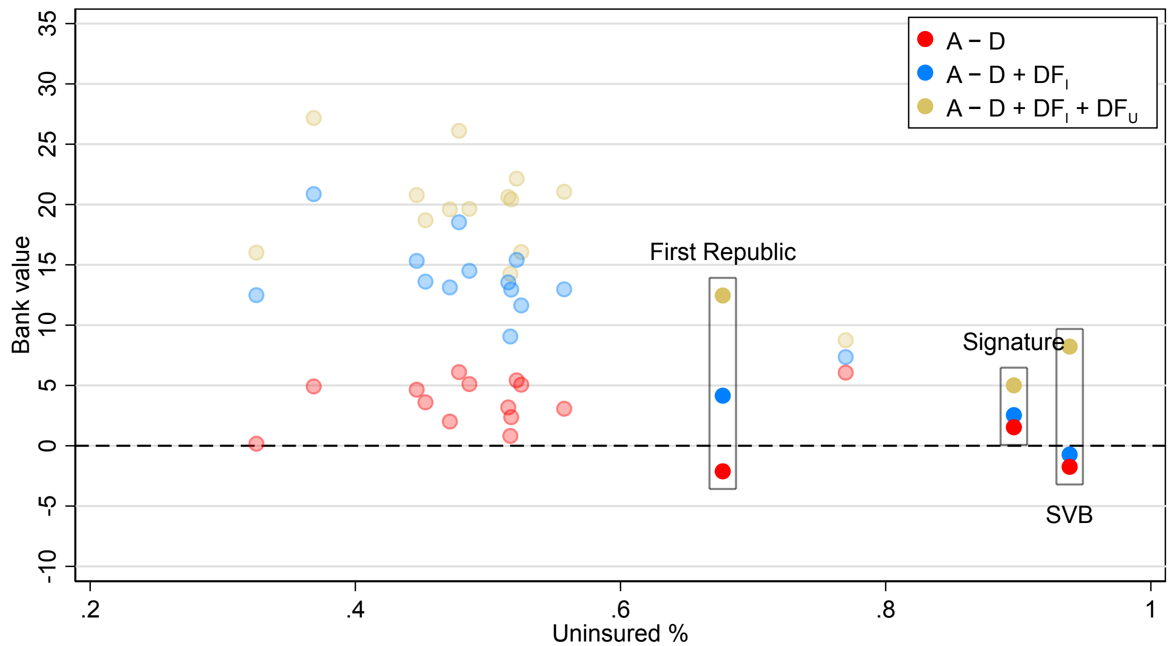
This figure shows a binscatter plot of the relationship between deposit cost, as measured by the net non-interest expense to assets, and core deposits to assets, controlling for time fixed effects and the asset shares of loans, foreign deposits, other borrowed money, equity, trading assets, trading liabilities, other assets (assets net of cash, reverse repo, securities, loans, and trading assets), and other liabilities (assets net of deposits, repo, trading liabilities, other borrowed money, and equity). The data is from the period 2015q4 to 2019q4.

Figure IA.5: Large bank values with a higher exogenous outflow rate



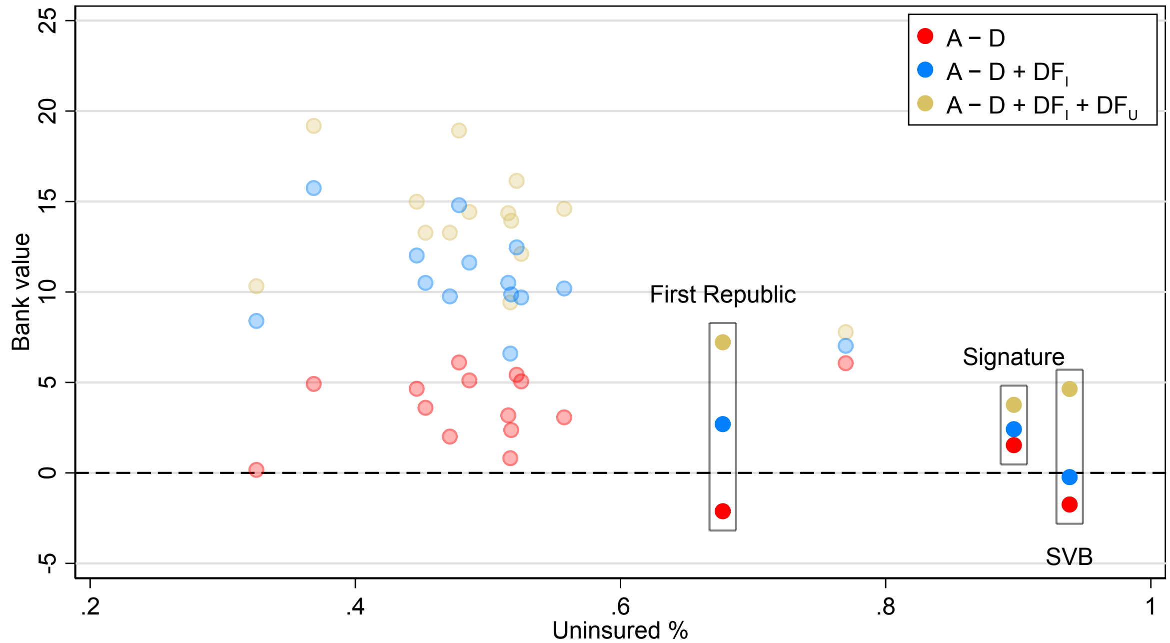
This figure plots bank values against the uninsured share of deposits, for the 17 large banks in our sample as of February 2023, under the alternative assumption that the deposit decay rate $\delta = 1/6 = 0.167$, indicating an average maturity of 6 years, instead of 0.1. The red circles show bank values without the deposit franchise, $A - D$, the blue circles show the value in a run, which add in the insured deposit franchise, $V(0, r) = A - D + DF_I$, and the yellow circles show the value without a run, $V(1, r) = A - D + DF_I + DF_U$. All values are scaled by assets.

Figure IA.6: Large bank values with a lower exogenous outflow rate



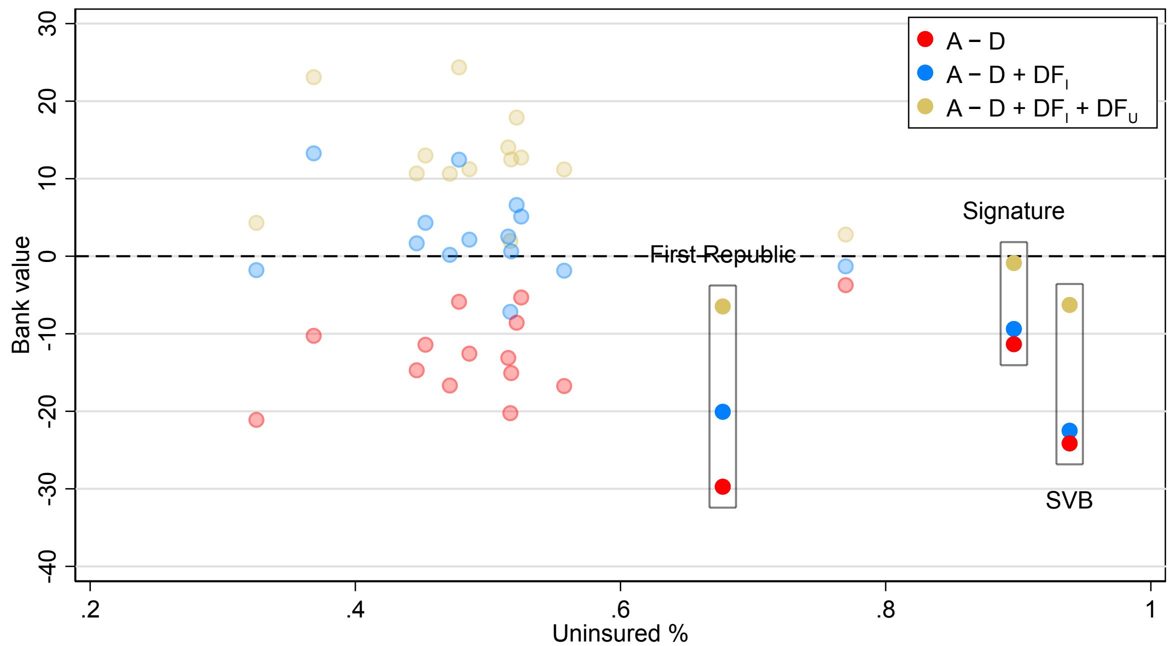
This figure plots bank values against the uninsured share of deposits, for the 17 large banks in our sample as of February 2023, under the alternative assumption that the deposit decay rate $\delta = 0.05$, indicating an average maturity of 20 years, instead of 0.1. The red circles show bank values without the deposit franchise, $A - D$, the blue circles show the value in a run, which add in the insured deposit franchise, $V(0, r) = A - D + DF_I$, and the yellow circles show the value without a run, $V(1, r) = A - D + DF_I + DF_U$. All values are scaled by assets.

Figure IA.7: Large bank values with partial retention



This figure plots bank values against the uninsured share of deposits, for the 17 large banks in our sample as of February 2023, under the alternative assumption that 15% of the uninsured deposit franchise is retained in a run. The red circles show bank values without the deposit franchise, $A - D$, the blue circles show the value in a run, which add in the insured deposit franchise, $V(0, r) = A - D + DF_I + 0.15 \times DF_U$, and the yellow circles show the value without a run, $V(1, r) = A - D + DF_I + DF_U$. All values are scaled by assets.

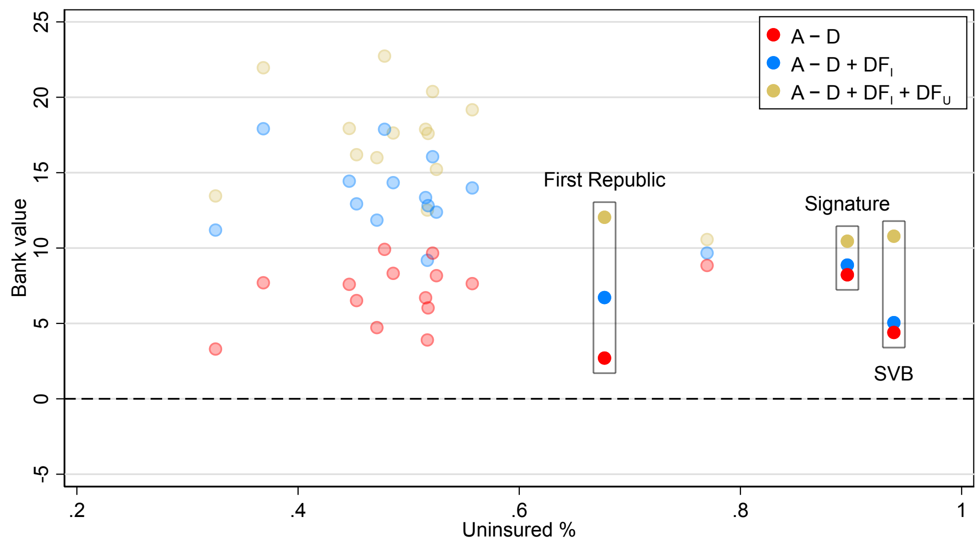
Figure IA.8: Large bank values with higher interest rate shock in Feb 2023



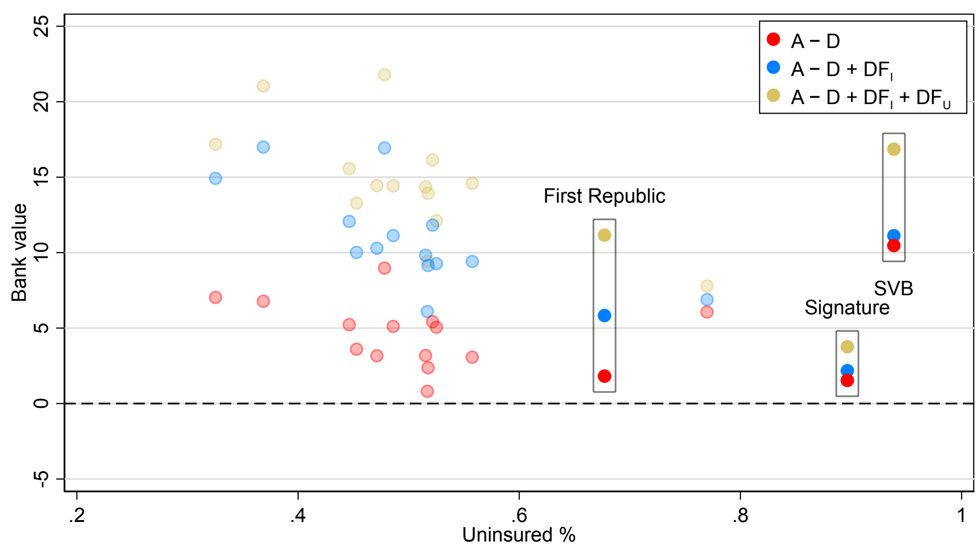
This figure plots bank values against the uninsured share of deposits, for the 17 large banks in our sample as of February 2023, under the alternative assumption that the 10-year treasury yield spiked to 10% instead of 3.92% in February 2023. We linearly extrapolate the change in the price indices of the various asset buckets to recalculate asset losses under this hypothetical scenario. The red circles show bank values without the deposit franchise, $A - D$, the blue circles show the value in a run, which add in the insured deposit franchise, $V(0, r) = A - D + DF_I$, and the yellow circles show the value without a run, $V(1, r) = A - D + DF_I + DF_U$. All values are scaled by assets.

Figure IA.9: Large bank values with additional capital

Panel A: 10% of uninsured deposits

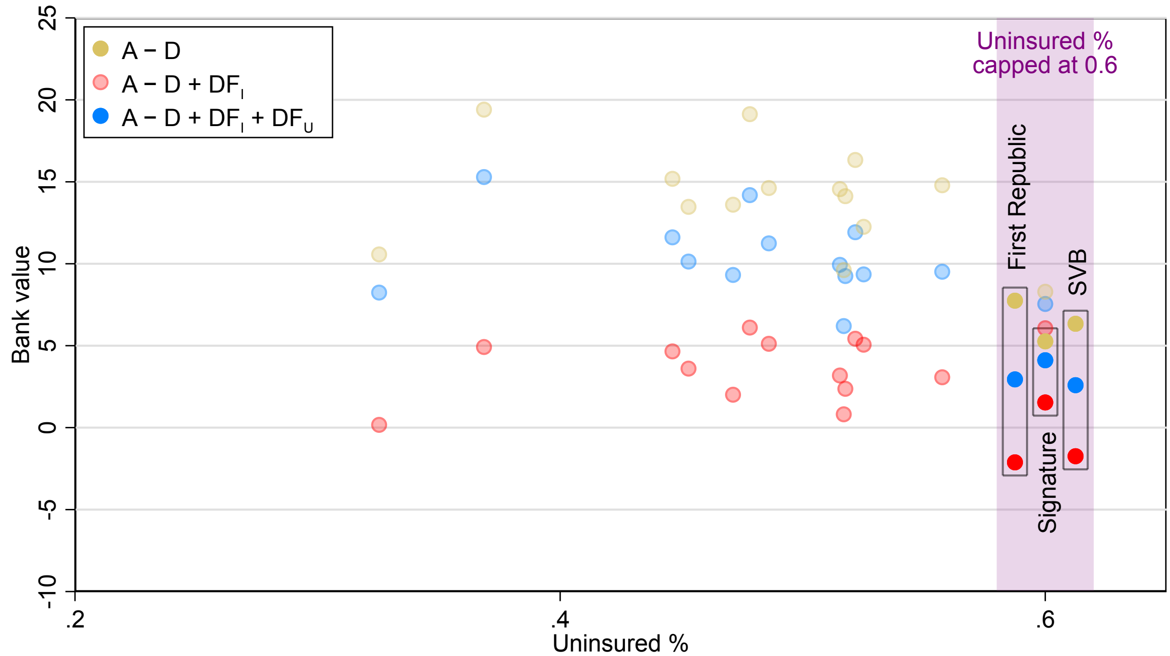


Panel B: 10% of uninsured deposit franchise



This figure plots bank values against the uninsured share of deposits, for the 17 large banks in our sample as of February 2023, under the scenarios that banks have to hold additional capital based on their uninsured deposits. In Panel A, banks have to hold 10% additional capital for every dollar of uninsured deposits. In Panel B, banks have to hold 10% additional capital for every dollar of the uninsured deposit franchise. We assume that the additional capital is reflected in additional assets with the same composition as initial assets. The red circles show bank values without the deposit franchise, $A - D$, the blue circles show the value in a run, which add in the insured deposit franchise, $V(0, r) = A - D + DF_I$, and the yellow circles show the value without a run, $V(1, r) = A - D + DF_I + DF_U$. All values are scaled by assets.

Figure IA.10: Large bank values with capped uninsured deposits



This figure plots bank values against the uninsured share of deposits, for the 17 large banks in our sample as of February 2023, under the scenario that the uninsured share of deposits is capped at 60%. The red circles show bank values without the deposit franchise, $A - D$, the blue circles show the value in a run, which add in the insured deposit franchise, $V(0, r) = A - D + DF_I$, and the yellow circles show the value without a run, $V(1, r) = A - D + DF_I + DF_U$. All values are scaled by assets.