



An event-driven bank stress indicator: The case of US regional banks

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ABSTRACT

Financial markets have been shaken by the surge of a banking crisis in early 2023. The failure of Silicon Valley Bank has raised concerns about the health of various financial institutions in a period of rapid monetary contraction and high interest rates. I discuss the stress levels of sixty US regional banks, by proposing a new “bank stress indicator”, based on an event study framework. The indicator suggests six highly stressed banks: First Republic Bank, Western Alliance Bancorporation, KeyCorp, Comerica Incorporated, Zions Bancorporation and PacWest Bancorp. Although most of these banks have been highly profitable and have built solid balance sheet positions over the past years, they have faced large shares of uninsured deposits, which have put them at risk. The new Bank Term Funding Program launched by the Fed is designed to help in this matter, lowering the risk of new failures.

1. Introduction

Financial markets have been shaken by the surge of a banking crisis in early 2023. The failure of Silicon Valley Bank (SIVBQ) has raised concerns about the stability of various regional banks in the US in a period of rapid monetary contraction and high interest rates. One key question surrounding the minds of market participants and policy makers is about the developments of this crisis, the policy measures to contain it, and the implications for the US economy.

In this paper, I propose a “bank stress indicator” that indicates the risk of distress of sixty regional banks in the US, following the failure of SIVBQ. The new indicator is constructed using an event study regression approach, where I regress the stock returns of each bank under analysis onto measures of monetary policy surprises (fed funds rate, forward guidance, and large-scale asset purchases) and financial stability programs, and use the predictive error of those regressions in the aftermath of the announcement of the Bank Term Funding Program by the Fed as the indicator of bank stress. Importantly, I discount the effects of instruments of monetary policy and financial stability to remove the effects of the expected monetary easing and financial stability measures provided by the Fed following the banking crisis, and that are concurrently priced into the stock returns of each bank.

The indicator suggests at least six banks with high levels of stress: First Republic Bank (FRCB), Western Alliance Bancorporation (WAL), followed by KeyCorp (KEY), Comerica Incorporated (CMA), Zions Bancorporation (ZION) and PacWest Bancorp (PACW). I analyze the financial health of the two most stressed banks, FRCB and WAL, and conclude that they have been highly profitable, and have built up strong balance sheet positions over the past years. The key issue faced by the stressed banks has been the large shares of deposits not covered by the FDIC insurance, which is limited to depositors with funds up to USD 250,000. This has increased the risk of these institutions facing a bank run. However, despite the increased risk of systematic instabilities, the Bank Term Funding Program

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launched by the Fed on March 12, 2023 is designed to help in this matter, by providing direct liquidity to the banks that are in need. The new program has lowered the likelihood that a “fire sale” of assets would be necessary to cover the lack of liquidity in case of a bank run, which could lead to insolvency, as it happened with SIVBQ.

This paper is related to other research that investigates bank stress indicators, derived from asset prices.¹ One first study using this approach is Merton (1974), which proposes the distance-to-default measure. Along this line, Acharya et al. (2012) propose the marginal expected shortfall and the long-run marginal expected shortfall, which measure the expected loss of an institution if the banking system suffers a sudden adverse shock. Adrian and Brunnermeier (2016) propose the ΔCoVaR indicator, which measures the increase in downside tail risk of a bank, conditional upon a system-wide shock. Avino et al. (2019) uses changes in CDS spreads as indicator. Distinguin et al. (2006) and Curry et al. (2008) provide evidence of forecasting ability of stock prices to act as a signal of bank fragility. Gropp et al. (2006) use equity market data to develop a distance-to-default metric as a complement to bond information. Considering a single distressed bank, Northern Rock, Hamalainen et al. (2012) determine that equity markets provide a stronger signal of bank distress than debt or CDS. The stress indicator proposed in this paper is also derived from equity prices. However, this is the first paper to build an event-based indicator that exploits the information content in the reaction of a central bank towards a banking crisis.

This paper is organized as follows. The following section introduces the econometric model used in this study. The third section introduces the data used. The fourth section shows the empirical results, the fifth section discusses the policy measures designed to contain the banking crisis and the financial positions of some of the stressed banks, and the sixth section concludes.

2. Econometric framework

2.1. Estimation of monetary policy surprise measures

To estimate the monetary policy surprise measures, I follow closely the approach of Gürkaynak et al. (2005; GSS henceforth), Swanson (2021) and Altavilla et al. (2019). First, I extend the dataset of GSS through December 2020 using data obtained from Bauer and Swanson (2022) in addition to data for the year of 2020, as well as March 13, 2023, the day after the Bank Term Funding Program was announced.² The dataset includes changes in several asset prices in a 30-minute window bracketing every FOMC announcement. The asset prices I use include federal funds futures (the current and following month contract rate), Eurodollar futures (contract rates for the next second, third and fourth quarters), and Treasury bond yields (2-, 5-, and 10-year). I collect the asset price responses into three $T \times n_f$ matrices X_f , with rows corresponding to FOMC announcements and columns to the 30-minutes asset price changes around FOMC announcements. As in GSS, one can think of these data in terms of factor models,

$$X_f = F_f \Lambda_f + \epsilon_f \quad (1)$$

where I set F_f to be a $T \times 1$ matrix containing $1 \leq n_f$ unobserved factors, Λ_f is a $1 \times n_f$ matrix of loadings of asset price responses on the factor F_f , and ϵ_f is a $T \times n_f$ matrix of white noise residuals that is uncorrelated over time and across assets. As I set the dimension of F_f to be $T \times 1$, this implies that X_f is well described by one single factor plus the uncorrelated white noise. As mentioned above I construct three matrices X_f comprising of: (i) scaled changes in the interest rates of the first and second federal funds futures continuous contracts, forming the matrix X_1 , (ii) changes in the interest rates of the second, third, and fourth Eurodollar futures contracts, forming the matrix X_2 , and (iii) changes in the 2-, 5-, and 10-year Treasury yields, forming the matrix X_3 . These assets are the most closely related to monetary policy, implying that natural candidates for F_1 , F_2 and F_3 are: (i) the surprise component of the change in the target federal funds rate, (ii) the surprise component of the change in forward guidance, and (iii) the surprise component of LSAP announcements, respectively.

I impose additional restrictions on the structure of F_1 , F_2 and F_3 above. First, following GSS, I impose that F_2 has no effect on F_1 . This identifying assumption is justified by defining forward guidance to be the component of FOMC announcements that conveys information about the future path of short-term interest rates above and beyond changes in the federal funds target rate itself, following the definition of forward guidance (or path) factor in GSS. Second, I impose that F_3 also has no effects on F_1 and on F_2 , so LSAPs convey information about the stance of monetary policy that is above and beyond the other two monetary policy instruments. To implement these restrictions, I orthogonalize F_2 with respect to F_1 by regressing F_2 onto F_1 and by collecting the residuals. Next, I orthogonalize F_3 with respect to F_1 and F_2 by regressing F_3 onto F_1 and F_2 , and collect the residuals. Finally, to give a clear interpretation to each factor I rescale F_1 to move one-to-one with the scaled changes in the interest rate of the first federal funds future contract, and rescale the collected residuals of F_2 to move one-to-one with the changes in the interest rate of the fourth Eurodollar future contract, and the residuals of F_3 to move one-to-one with changes in the 10-year Treasury yield. I denote the three orthogonal and rescaled factors as \bar{F}_1 , \bar{F}_2 and \bar{F}_3 .

2.2. The responses of banks' stock returns to central bank measures and the bank stress indicator

To assess the effects of monetary policy and financial stability measures on regional banks' stock returns, I estimate event study

¹ Another type of stress indicators is the one derived from accounting-based multiples.

² The data extension can be obtained from Michael Bauer's webpage, at <https://www.michaeldbauer.com/research/>.

Table 1
List of regional banks.

HDFC Bank Limited (HDB)	Banco Santander-Chile (BSAC)
U.S. Bancorp (USB)	Zions Bancorporation, National Association (ZION)
ICICI Bank Limited (IBN)	Western Alliance Bancorporation (WAL)
Truist Financial Corporation (TFC)	Prosperity Bancshares, Inc. (PB)
The PNC Financial Services Group, Inc. (PNC)	BOK Financial Corporation (BOKF)
Itaú Unibanco Holding S.A. (ITUB)	New York Community Bancorp, Inc. (NYCB)
Lloyds Banking Group plc (LYG)	SouthState Corporation (SSB)
Mizuho Financial Group, Inc. (MFG)	Valley National Bancorp (VLY)
Banco Bradesco S.A. (BBD)	Synovus Financial Corp. (SNV)
M&T Bank Corporation (MTB)	Pinnacle Financial Partners, Inc. (PNFP)
Deutsche Bank Aktiengesellschaft (DB)	Wintrust Financial Corporation (WTFC)
First Republic Bank (FRCB)	United Bankshares, Inc. (UBSI)
Fifth Third Bancorp (FITB)	Old National Bancorp (ONB)
Huntington Bancshares Incorporated (HBAN)	First Financial Bankshares, Inc. (FFIN)
Banco Santander (Brasil) S.A. (BSBR)	Glacier Bancorp, Inc. (GBCI)
Regions Financial Corporation (RF)	F.N.B. Corporation (FNB)
Citizens Financial Group, Inc. (CFG)	Popular, Inc. (BPOP)
KB Financial Group Inc. (KB)	Cadence Bank (CADE)
Shinhan Financial Group Co., Ltd. (SHG)	Hancock Whitney Corporation (HWC)
KeyCorp (KEY)	TFS Financial Corporation (TFSL)
First Horizon Corporation (FHN)	First Interstate BancSystem, Inc. (FIBK)
Credicorp Ltd. (BAP)	Home Bancshares, Inc. (HOMB)
Banco de Chile (BCH)	UMB Financial Corporation (UMBF)
Comerica Incorporated (CMA)	Independent Bank Corp. (INDB)
Webster Financial Corporation (WBS)	ServisFirst Bancshares, Inc. (SFBS)
Banco Santander México (BSMX)	United Community Banks, Inc. (UCBI)
Cullen/Frost Bankers, Inc. (CFR)	Associated Banc-Corp (ASB)
Commerce Bancshares, Inc. (CBSH)	CVB Financial Corp. (CVBF)
Bancolombia S.A. (CIB)	PacWest Bancorp (PACW)
Woori Financial Group Inc. (WF)	Arrow Financial Corporation (AROW)

Notes: This table shows the list of regional banks included in this paper. It is reported the bank name and the stock symbol.

regressions as the following,

$$r_{i,t} = \beta_{i,0} + \beta_{i,1}\tilde{F}_{1,t} + \beta_{i,2}\tilde{F}_{2,t} + \beta_{i,3}\tilde{F}_{3,t} \times LSAP_t + \beta_{i,4}FinStabil_t + \varepsilon_{i,t} \quad (2)$$

where t indexes FOMC announcements, $r_{i,t}$ is the daily stock return of the regional bank i , $LSAP_t$ is a dummy variable comprising the LSAP period in the US, which allows to capture the effect of LSAPs when that instrument of monetary policy was used, and $FinStabil_t$ is a dummy variable aimed at capturing the effects of financial stability programs announced by the Fed since Covid-19.³ I estimate this regression using data from July 1991 through December 2020, and set aside the estimated coefficients $\hat{\beta}_{i,0}$, $\hat{\beta}_{i,1}$, $\hat{\beta}_{i,2}$, $\hat{\beta}_{i,3}$ and $\hat{\beta}_{i,4}$. I then use these coefficients to construct the bank stress indicator using the following approach. First, I obtain the realized stock return of bank i , r_{i,t^*} , on $t^*=March\ 13,\ 2023$, the day after the Bank Term Funding Program announcement. Then, using the coefficients above, together with factors \tilde{F}_{1,t^*} , \tilde{F}_{2,t^*} , \tilde{F}_{3,t^*} , and the variable $FinStabil_{t^*}$, I predict the portion of r_{i,t^*} implied by monetary policy and financial stability programs only, and obtain the predictive error $\hat{\varepsilon}_{i,t^*}$ as below.

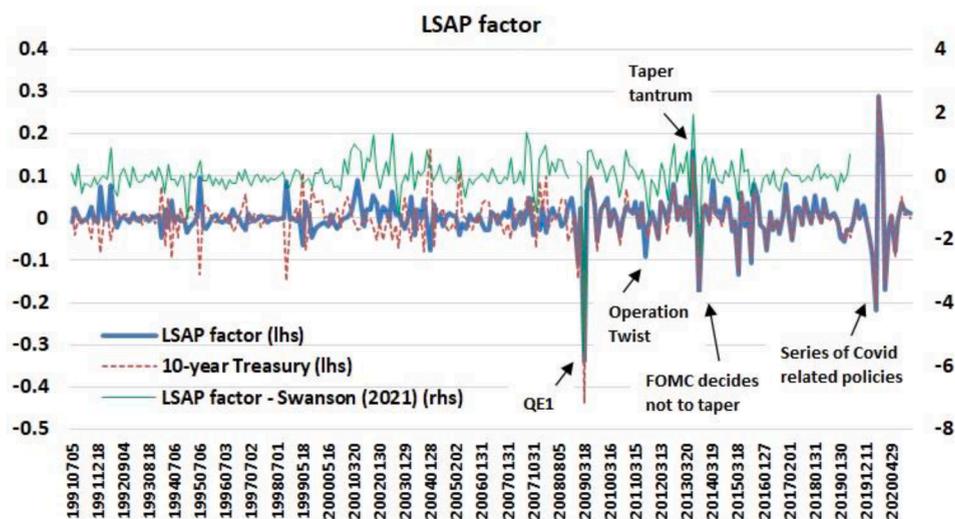
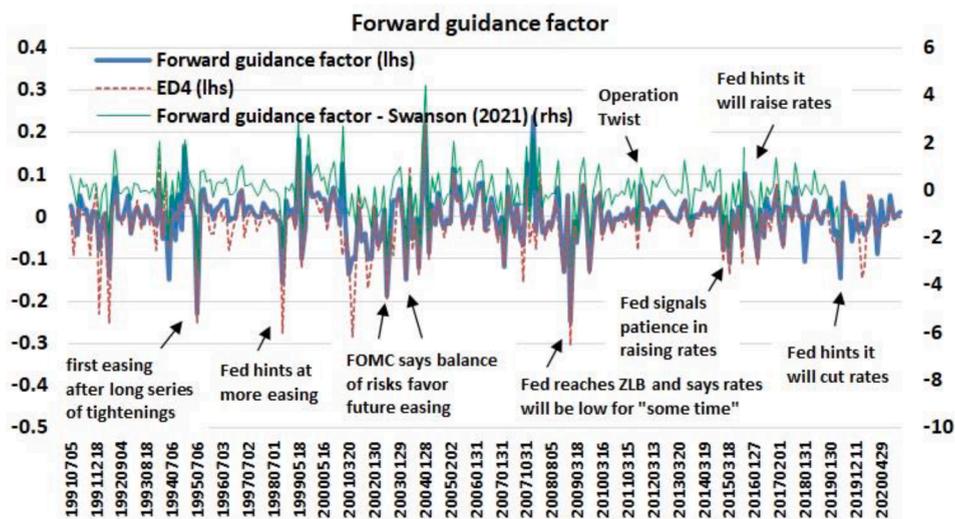
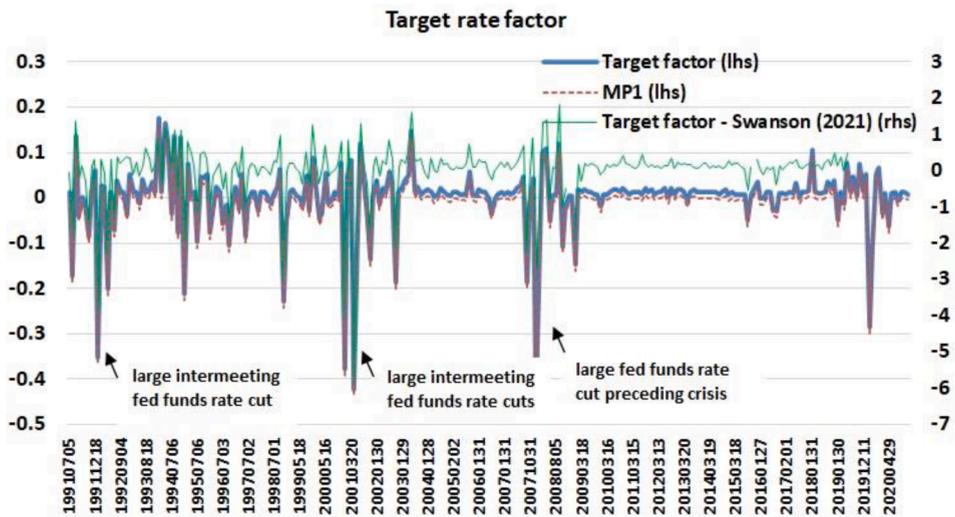
$$\hat{\varepsilon}_{i,t^*} = r_{i,t^*} - \hat{\beta}_{i,0} - \hat{\beta}_{i,1}\tilde{F}_{1,t^*} + \hat{\beta}_{i,2}\tilde{F}_{2,t^*} - \hat{\beta}_{i,3}\tilde{F}_{3,t^*} \times LSAP_{t^*} - \hat{\beta}_{i,4}FinStabil_{t^*} \quad (3)$$

The predictive error $\hat{\varepsilon}_{i,t^*}$ then becomes my measure of bank i stress. The intuition is that the announcement of the Bank Term Funding Program following the failure of the Silicon Valley Bank is an identifying event for the stress of regional banks, with the stock return observed on that day, r_{i,t^*} , discounted by the effects of traditional instruments of monetary policy (fed funds target rate, forward guidance and LSAP) and financial stability programs serving as the measure of bank i stress, $\hat{\varepsilon}_{i,t^*}$. Had the effects of instruments of monetary policy and financial stability programs not been discounted, the stock return r_{i,t^*} would incorporate the effects of the expected monetary easing and financial stability measures provided by the Fed due to the banking crisis, which are priced into r_{i,t^*} . Therefore, the importance of using the error $\hat{\varepsilon}_{i,t^*}$ as the bank stress indicator in this approach.

3. Data

To estimate the monetary policy surprise measures, I use changes in the interest rates of the first and second federal funds futures

³ $FinStabil_t$ comprises the following programs launched by the Fed from March 17, 2020 to March 23, 2020: [Commercial Paper Funding Facility](#), [Primary Dealer Credit Facility](#), [Money Market Mutual Fund Liquidity Facility](#), [Primary Market Corporate Credit Facility](#), [Secondary Market Corporate Credit Facility](#), [Term Asset-Backed Securities Loan Facility](#); in addition to the Bank Term Funding Program launched on March 13, 2023.



(caption on next page)

Fig. 1. Estimated measures of monetary policy surprises. Notes: This figure shows the estimated measures of monetary policy surprises, i.e. fed funds target rate surprise, forward guidance surprise and Large Scale Asset Purchase (LSAP) surprise, together with the MP1 surprise measure, changes in ED4 and changes in the 10-year Treasury bond yield. The scales are shown in the left-hand side (lhs) and the sample is from July 1991 to December 2020. It also shows measures of monetary policy surprises estimated as in Swanson (2021). The scale is shown in the right-hand side (rhs), and the sample comprises the period from July 1991 to June 2019. The x-axis of each chart shows FOMC announcements.

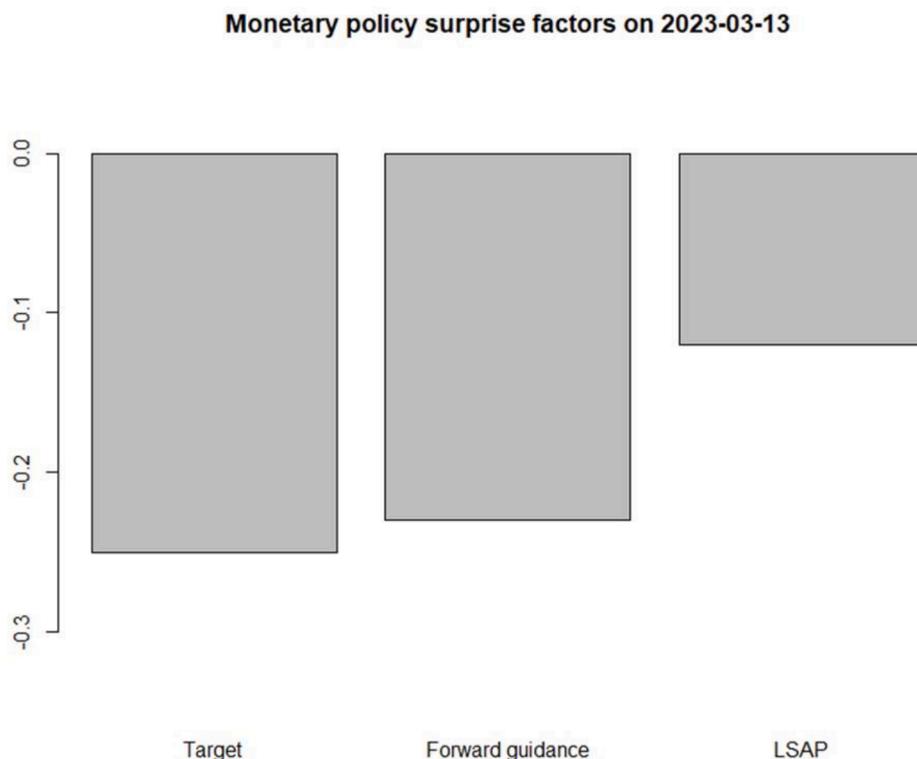


Fig. 2. Estimated measures of monetary policy surprises on 2023-03-13. Notes: This figure shows the estimated measures of monetary policy surprises, i.e. fed funds target rate surprise, forward guidance surprise and Large Scale Asset Purchase (LSAP) surprise on the day after the announcement of the Bank Term Funding Program on 2023-03-12 (Sunday).

continuous contracts, changes in the interest rates of the second, third, and fourth Eurodollar futures contracts, as well as changes in the 2-, 5-, and 10-year Treasury bond yields, all using a 30-minute window, with 10-minutes prior and 20 min after each FOMC announcement from July 1991 through December 2020, in addition to March 13, 2023. The changes in the first and second federal funds futures contracts are scaled as in GSS to account for the timing of FOMC meetings within the upcoming two months (see MP1 measure in the Appendix). Stock returns are computed using daily stock prices for 60 regional banks. The list of banks is provided by Table 1. The initial date of each stock return series varies according to when the stock went public.

4. Estimation results

4.1. Monetary policy surprise measures

Fig. 1 shows the estimates of the three monetary policy surprise measures for the period from July 1991 through December 2020, while Fig. 2 shows estimates for March 13, 2023. As can be seen from Fig. 1, the estimated factors capture well the zero-lower-bound (ZLB) period in the US. For instance, the target factor shows little variation in that period, when the fed funds target rate was kept at zero. Similarly, as quantitative easing was first announced at the end of 2008, the LSAP factor shows little variation prior to that, while shows a sensible level of variation from the moment the Fed started using LSAPs. The forward guidance factor, on the other hand, shows sensible variation during the whole sample, as forward guidance has been for long used as monetary policy instrument (GSS, De Rezende and Ristinemi 2023).

To further verify the robustness of the surprise measure estimates, I also plot in Fig. 1 changes in the asset prices that are most connected to each factor. As can be seen, the MP1 measure lines up quite well with the target factor, while the forward guidance factor moves together with changes in the fourth Eurodollar contract rate (ED4). Finally, the LSAP factor lines up with changes in the 10-year Treasury rate from the moment the Fed started its LSAP programs. Prior to that, the changes in the 10-year Treasury rate shows a

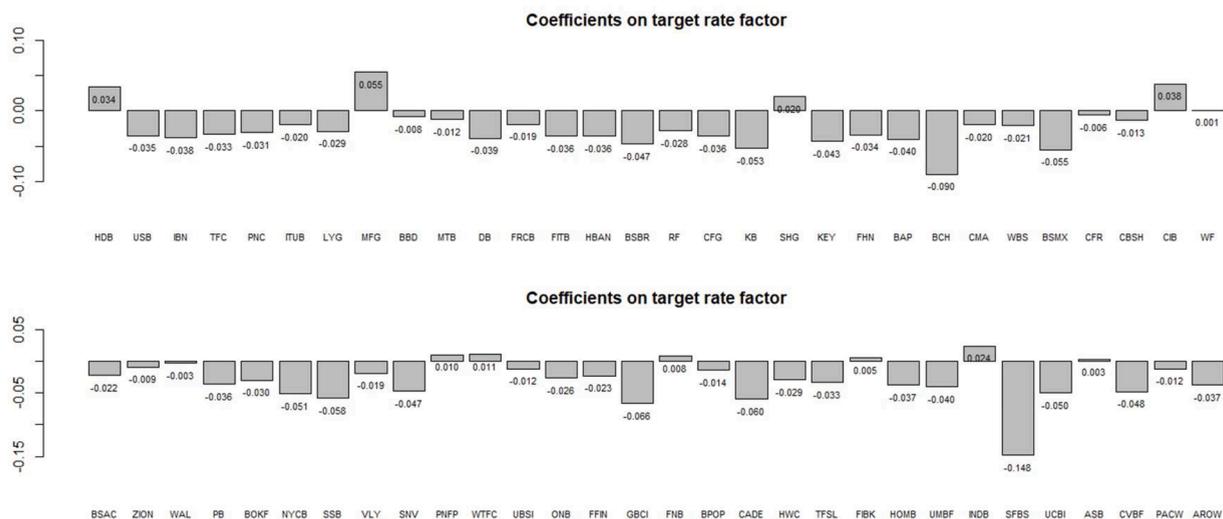


Fig. 3. Effects of target factor on banks stock returns. Notes: This figure shows the estimated coefficients $\hat{\beta}_{i,1}$ of bank i stock return on the fed funds target factor. The x-axis displays the stock symbol for each bank.

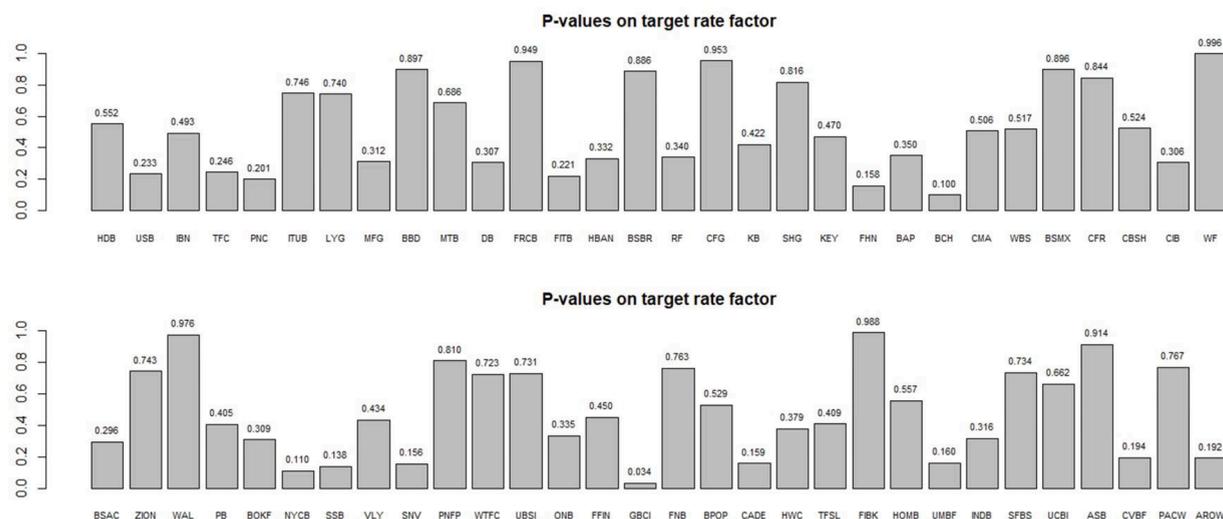


Fig. 4. Significance of effects of target factor on banks stock returns. Notes: This figure shows the p-values of the effects of the fed funds target rate factor on regional banks' stock returns. Standard errors for coefficients are estimated using the MacKinnon and White (1985) heteroskedastic consistent estimator. The x-axis displays the stock symbol for each bank.

higher level of variation compared to the LSAP factor, as LSAPs were not present.

I also describe how each factor behaves around FOMC announcements that had notable implications for the federal funds rate, forward guidance or LSAPs. As can be seen from Fig. 1, the target factor shows pronounced movements on several occasions. Important events are the intermeeting rate cuts. Regarding the forward guidance factor, I identify several important events, such as the “first easing after long series of tightening” on July 6, 1995, the date when the “Fed reaches the ZLB and indicates rates will be low for some time” on December 16, 2008, among others. Regarding LSAPs, important events are the announcement of QE1 on March 18, 2009, the announcements around the tapering of the Fed’s balance sheet in 2013, among others.

Finally, I verify how these factors behave compared to the factors provided by Swanson (2021).⁴ As can be seen from Fig. 1, the two sets of factors move closely together for the period when they are both available, from July 1991 to June 2019. The coefficient of correlation between the two target factors is 0.94, while it is 0.93 for the forward guidance factors. The coefficient of correlation

⁴ The factors estimated as in Swanson (2021) are provided at <https://sites.socsci.uci.edu/~swanson2/papers/pre-and-post-ZLB-factors-extended.xlsx>.

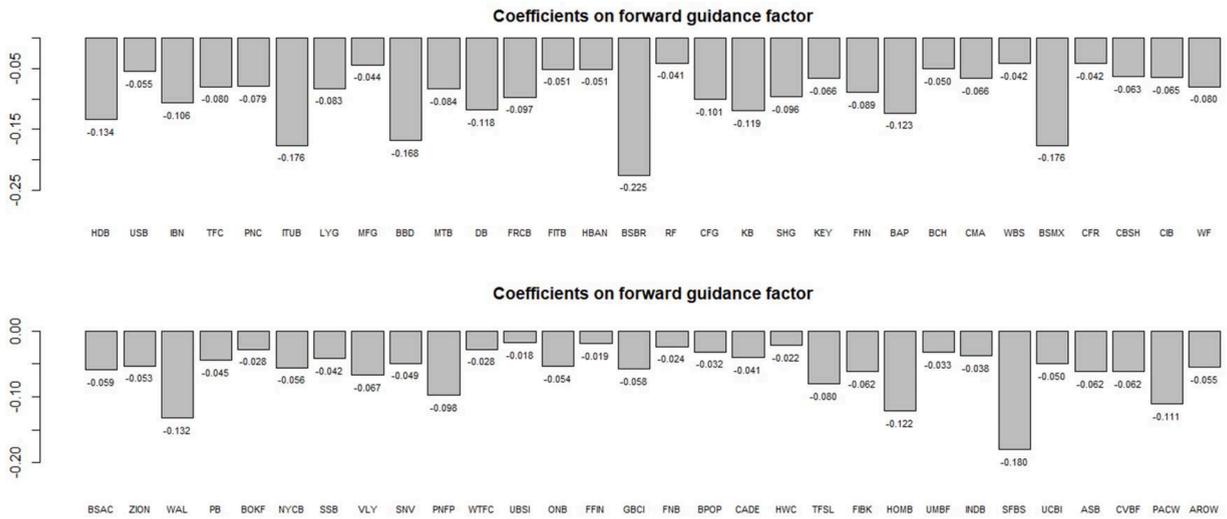


Fig. 5. Effects of forward guidance factor on banks stock returns. Notes: This figure shows the estimated coefficients $\hat{\beta}_{i,2}$ of bank i stock return on the forward guidance factor. The x-axis displays the stock symbol for each bank.

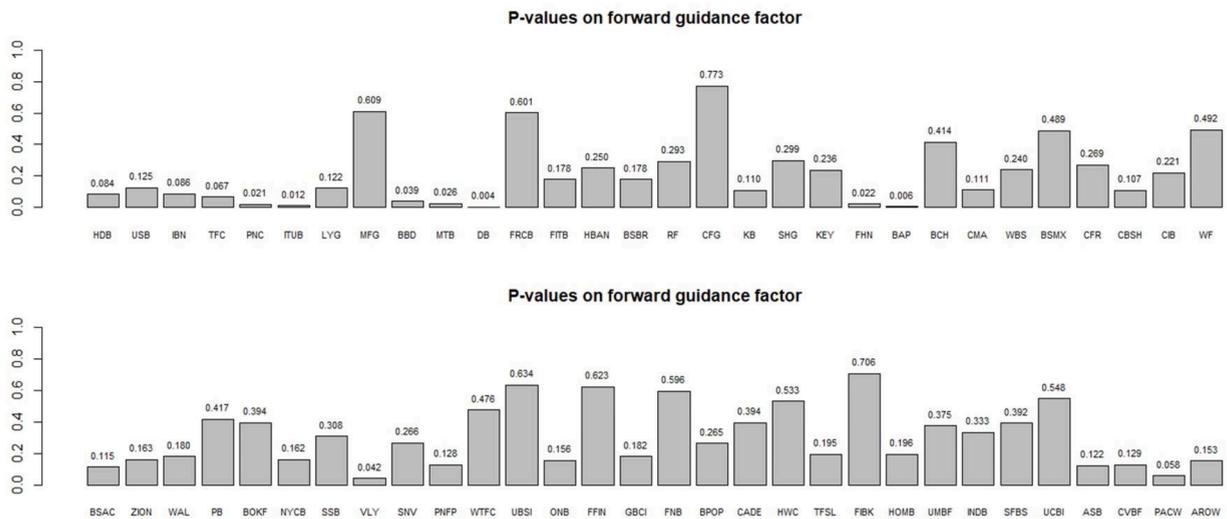


Fig. 6. Significance of effects of forward guidance factor on banks stock returns. Notes: This figure shows the p-values of the effects of the forward guidance factor on regional banks' stock returns. Standard errors for coefficients are estimated using the MacKinnon and White (1985) heteroskedastic consistent estimator. The x-axis displays the stock symbol for each bank.

between the LSAP factors is smaller though, 0.68. However, when considering the period from the end of 2008, when the Fed in fact started using LSAPs, the coefficient of correlation between the two LSAP factors increases to 0.8. Importantly, during that period, the coefficients of correlation between changes in the 10-year Treasury rate and the LSAP factors are 0.96 for the factor estimated in this paper and 0.86 for the factor as in Swanson (2021). It is also worth reporting the standard deviations of the two LSAP factors prior to the LSAP period, 0.03 for the factor of this paper, and 0.42 for the factor as in Swanson (2021).

4.2. The responses of bank's stock returns to central bank measures

After obtaining monetary policy surprises, I estimate event study regressions (2). Results for the target factor are shown in Fig. 3, which displays coefficient estimates, and Fig. 4, which displays the significance (p-values) of the coefficient estimates shown in Fig. 3. As can be seen, stock returns of most banks react negatively to increases in the fed funds target rate, with effects being significant at 5% level for Glacier Bancorp, Inc. (GBCI) and at 10% level for Banco de Chile (BCH).

Results for the forward guidance factor are shown in Figs. 5 and 6. Stock returns of most banks also react negatively to contractionary forward guidance. Effects are statistically significant at 5% level for PNC Financial Services Group, Inc. (PNC), Itaú Unibanco

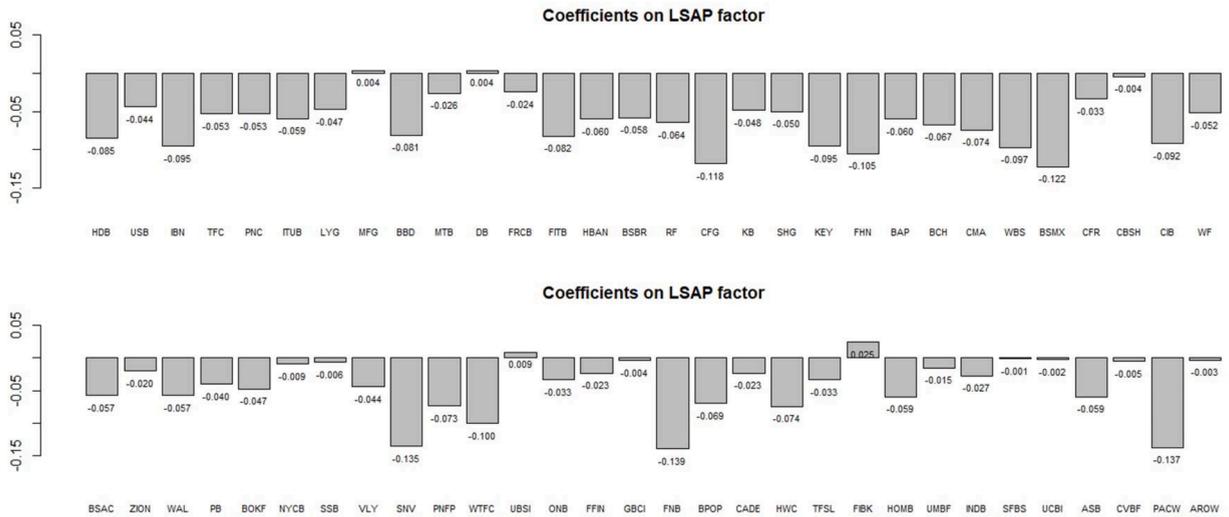


Fig. 7. Effects of LSAP factor on banks stock returns. Notes: This figure shows the estimated coefficients $\hat{\beta}_{i,3}$ of bank i stock return on the LSAP factor. The x-axis displays the stock symbol for each bank.

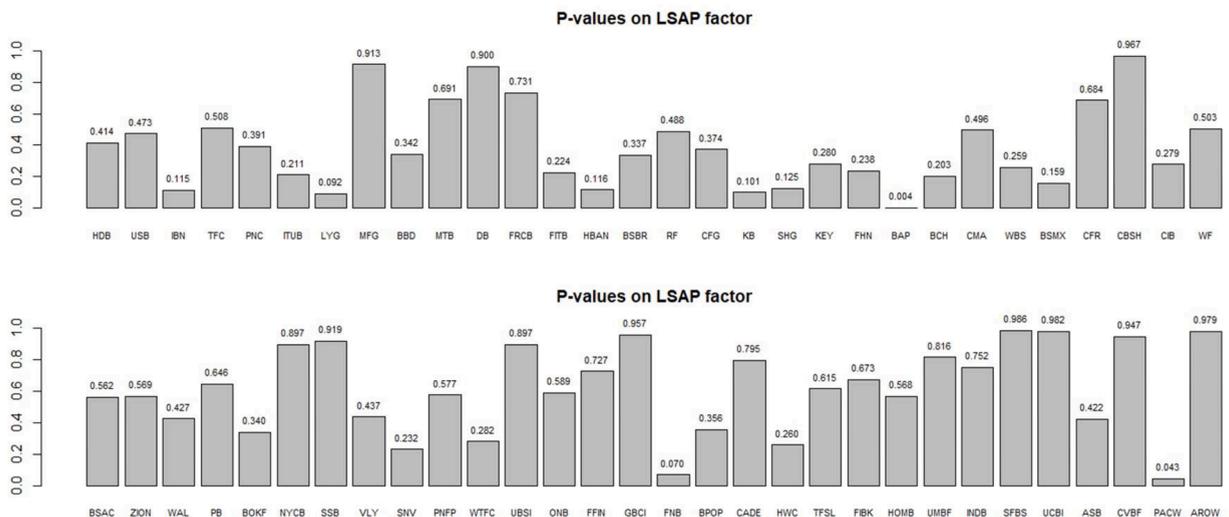


Fig. 8. Significance of effects of LSAP factor on banks stock returns. Notes: This figure shows the p-values of the effects of the LSAP factor on regional banks' stock returns. Standard errors for coefficients are estimated using the MacKinnon and White (1985) heteroskedastic consistent estimator. The x-axis displays the stock symbol for each bank.

Holding S.A. (ITUB), Banco Bradesco S.A. (BBD), M&T Bank Corporation (MTB), Deutsche Bank Aktiengesellschaft (DB), First Horizon Corporation (FHN), Credicorp Ltd. (BAP) and Valley National Bancorp (VLY).

Results for the LSAP factor are shown in Figs. 7 and 8. Again, stock returns of most banks also react negatively to contractionary LSAPs. Effects are statistically significant at 5% level for BAP and PACW. Coefficient estimates for the dummy variable $FinStabil_i$ are not significant for any bank and are not reported. However, I consider that this variable is a useful control that helps in the regression specification and in pinpointing $\hat{\varepsilon}_{i,t^*}$.

4.3. The new bank stress indicator

The bank stress indicator for US regional banks, estimated using the error term $\hat{\varepsilon}_{i,t^*}$, is provided by Fig. 9. As can be seen, the banks that have shown the highest levels of stress following the failure of the Silicon Valley Bank and the announcement of the Bank Term Funding Program by the Fed are the FRCB and WAL, followed by KEY, CMA, ZION and PACW.

To further verify this, I provide two checks. First, I consider March 9, 2023, the date when the deposit withdrawals faced by Silicon Valley Bank intensified, as the identifying event for the stress of regional banks, $t^*=March\ 9,\ 2023$. As both SIVBQ and the Signature

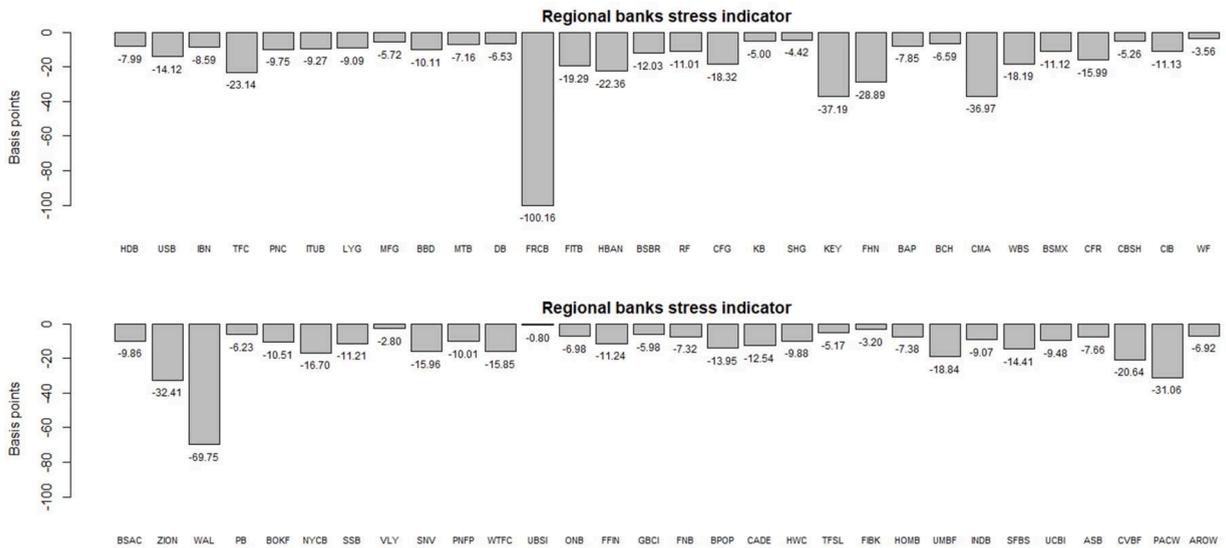


Fig. 9. Bank stress indicator. Notes: This figure shows the estimates of the bank stress indicator proposed in this paper. The x-axis displays the stock symbol for each bank.

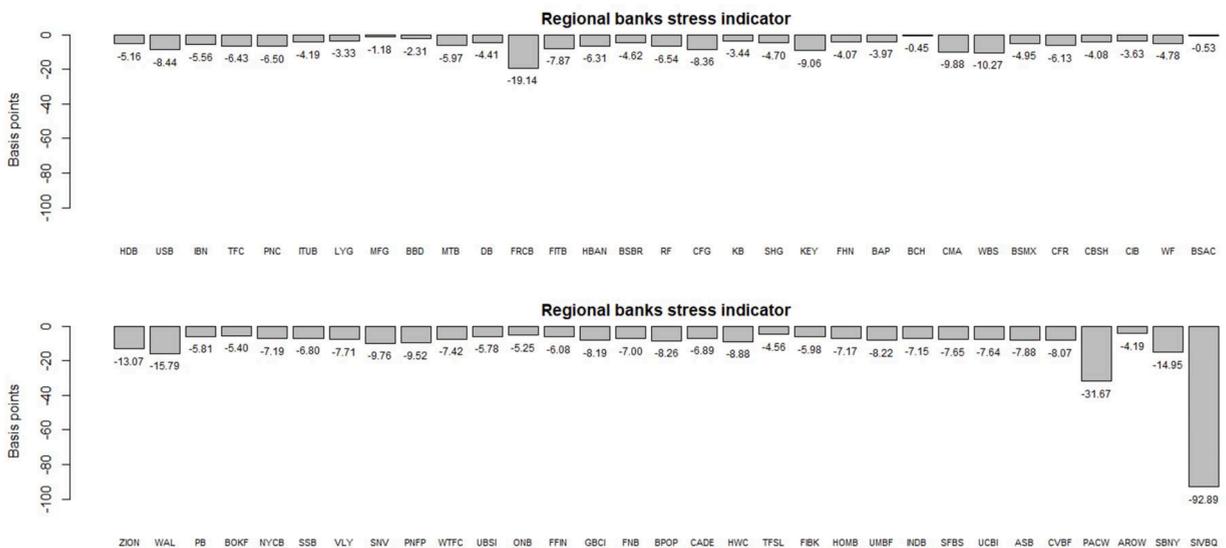


Fig. 10. Bank stress indicator - robustness. Notes: This figure shows the estimates of the bank stress indicator proposed in this paper when $t^* = \text{March } 9, 2023$. The x-axis displays the stock symbol for each bank, where the Signature Bank (SBNY) and the Silicon Valley Bank (SIVBQ) are added.

Bank (SBNY) had not failed by then, I include those two banks in the sample, comprising now sixty-two regional banks in total. As can be seen from Fig. 10, besides SIVBQ and SBNY, the bank stress indicator still suggests FRCB, ZION and PACW with higher-than-normal stress levels and provides some indication about WAL, KEY, CMA and Webster Financial Corporation (WBS).

As a second check, I compute the bank stress indicator $\hat{\varepsilon}_{i,t}$ using (i) \tilde{F}_1 , and (ii) \tilde{F}_1 and \tilde{F}_2 , in addition to the $FinStabil_t$ dummy variable. Although regression (2) is better specified with all the three factors, the list of highly stressed banks survives, with a few additions, as can be seen in Table 2. The most stressed bank, FRCB, continues to score high, 95.7 and 95.2, respectively.

5. Analysis and implications of the banking crisis

As discussed above, the proposed bank stress indicator consistently suggests six banks with high levels of stress following the failure of Silicon Valley Bank. Therefore, the important question that follows is regarding the potential sources of their financial instabilities. One first potential source is the financial health of these institutions. To shed light on this, I provide in Table 3 several indicators of long-term solvency and profitability for the two most stressed banks, FRCB and WAL. Both banks have been highly profitable and have

Table 2

List of highly stressed banks estimated with fewer factors.

<i>Target rate factor</i>		<i>Target rate + forward guidance factors</i>	
<i>Score > 20</i>	<i>Score > 30</i>	<i>Score > 20</i>	<i>Score > 30</i>
First Republic Bank (FRCB) KeyCorp (KEY) First Horizon Corporation (FHN)	First Republic Bank (FRCB) KeyCorp (KEY) Comerica Incorporated (CMA)	Truist Financial Corporation (TFC) First Republic Bank (FRCB) Huntington Bancshares Incorporated (HBAN)	First Republic Bank (FRCB) KeyCorp (KEY) Comerica Incorporated (CMA)
Comerica Incorporated (CMA)	Zions Bancorporation, National Association (ZION)	KeyCorp (KEY)	Zions Bancorporation, National Association (ZION)
Zions Bancorporation, National Association (ZION)	Western Alliance Bancorporation (WAL)	First Horizon Corporation (FHN)	Western Alliance Bancorporation (WAL)
Western Alliance Bancorporation (WAL)	–	Comerica Incorporated (CMA)	–
PacWest Bancorp (PACW)	–	Zions Bancorporation, National Association (ZION)	–
–	–	Western Alliance Bancorporation (WAL)	–
–	–	PacWest Bancorp (PACW)	–

Notes: This table shows the list of banks scoring high (>20 and >30) when the bank stress indicator is estimated using (i) \tilde{F}_1 , and (ii) \tilde{F}_1 and \tilde{F}_2 , in addition to the $FinStabil_t$ dummy variable.

Table 3

Indicators of financial health for FRCB and WAL.

%	<i>First Republic Bank (FRC)</i>		<i>Western Alliance Bancorporation (WAL)</i>	
	<i>2013–2022 (average)</i>	<i>2022</i>	<i>2012–2022 (average)</i>	<i>2022</i>
<i>Growth rate in Net income</i>	6.2	5.1	10.7	7
<i>Nonperforming Loans / Total Loans</i>	0.13	0.1	1.24	0.2
<i>Nonperforming Assets / Equity</i>	1.03	0.7	12.8	2
<i>Allowance for Credit Losses / Nonperforming Loans</i>	500.6	719.3	148.9	317.8
<i>Earning Assets / Interest Bearing Liabilities</i>	121.1	166.7	175.9	167.2
<i>Net Interest Income / Average Assets</i>	2.81	2.3	3.9	3.4
<i>Tier 1 Capital Ratio</i>	12.55	11.6	10.6	9.7

Notes: This table shows indicators of financial health for two of the most stressed banks, First Republic Bank (FRCB) and the Western Alliance Bancorporation (WAL). It shows the growth rate in Net income and several ratios on long-term solvency.

built up strong balance sheet positions over the past years. As can be seen, FRCB has shown steady growth in Net income, with a year-over-year average growth rate of 6.1% in the period of 2013–2022. Its indicators of long-term solvency have also been solid, with a low share of nonperforming loans and assets, while showing good levels of net interest margins, earning assets to interest bearing liabilities and top tier 1 capital ratio.⁵ WAL, in turn, has also built financial solidity over the past years, with a year-over-year average growth rate in Net income of 10.7% in the period 2012–2022, and 7% in 2022 alone. Regarding the indicators of long-term solvency, WAL shows a low share of nonperforming loans and assets in 2022, high levels of net interest margins and earning assets to interest bearing liabilities, and a good level of top tier 1 capital ratio. Therefore, the profitability of these banks aligned to their financial solidity has in fact contributed to lowering (not raising) their risk of insolvency.

The key source of instability is truly their large shares of deposits not covered by FDIC insurance, which only covers depositors with funds up to USD 250,000. To provide a picture of this, as of March 2023, the banks under stress showed the following shares of uninsured deposits: 97% for SIVBQ, 90% for SBNY, 68% for FRCB, 64% for CMA, 55% for WAL, 52% for PACW, 51% for ZION and 47% for KEY. This has increased the risk of these banks facing bank runs, which in turn could lead to insolvency. The risk of insolvency could also be exacerbated if withdrawals of uninsured deposits would force banks to sell any of their asset holdings in a "fire sale", leading to a loss in the value of their assets, as happened with Silicon Valley Bank, which sold its US Treasures holdings at a substantially lower price than purchased, leading to an asset value loss, which contributed to its insolvency.

The Bank Term Funding Program launched by the Fed on March 12, 2023 is designed to help avoid these type of "fire sales", by providing direct liquidity to the banks that are in need. Importantly, although it leads to an increase in the Fed's balance sheet, the Bank Term Funding Program is substantially different from LSAPs. The new program does not involve the direct purchase of financial assets in the market, as this could lead to the realization of losses by banks that purchased these assets at higher price, or to distortions in asset markets if done at the price that banks originally purchased the assets. Instead, the new program provides lending to banks,

⁵ The top tier 1 capital ratio measures a bank's equity capital with its total risk-weighted assets. According to Basel III, this ratio must be greater than 6%.

accepting securities as collateral *at par value*, which lowers the risk of losses by banks.⁶ As an example, during March 2023, bank borrowings from the Fed discount window surged to over \$150 billion in three days and surpassed the levels seen during the global financial crisis of 2008. Given that, in case of a bank run, it is less likely that a “fire sale” of assets would be necessary to cover the lack of liquidity, as happened with SIVBQ.

6. Concluding remarks

In this paper, I discuss the stress levels of sixty US regional banks, by proposing a new “bank stress indicator”. Results suggest at least six banks with high levels of stress following the failure of SIVBQ: FRCB, WAL, KEY, CMA, ZION and PACW. I analyze the financial health of the two most stressed banks, FRCB and WAL, and conclude that they have been highly profitable, and have built up strong balance sheet positions over the past years. The key issue with the stressed banks has been their large shares of deposits not covered by FDIC insurance. However, the new Bank Term Funding Program launched by the Fed is designed to help in this matter, lowering the likelihood that a “fire sale” of assets would be necessary to cover the lack of liquidity in case of a bank run, which could lead to insolvency, as it happened with SIVBQ.

CRedit authorship contribution statement

Rafael B. De Rezende: Conceptualization, Methodology, Investigation, Formal analysis, Software, Validation, Data curation, Writing – original draft, Writing – review & editing, Visualization, Supervision, Project administration, Resources.

Declaration of Competing Interest

No competing financial interests or personal relationships have appeared to influence the work reported in this article. A modified version of this article has circulated as a research report at Amuletum Invest AB, www.amuletuminvest.com, org. nr. 559376–7196, Sweden.

Appendix

To construct the fed funds target rate surprise measure, I follow [Gürkaynak et al. \(2005\)](#) and define the scaled fed funds target rate surprise measure for the upcoming FOMC meeting as the following,

$$mp1_t = (ff1_t - ff1_{t-\Delta t}) \frac{D1}{D1 - d1}$$

where $ff1_t$ is the interest rate on the continuous fed funds future front contract, $D1$ is the number of days of a given month, $d1$ denotes the day of the FOMC meeting within the month comprising the contract, and Δt is a window of ten minutes before and twenty minutes after each monetary policy announcement.

I also consider the scaled fed funds rate surprise measure for the second FOMC meeting to come,

$$mp2_t = \left[(ff2_t - ff2_{t-\Delta t}) - \frac{d2}{D2} mp1_t \right] \frac{D2}{D2 - d2}$$

where $ff2_t$ is the interest rate on the continuous fed funds future second contract, and $d2$ and $D2$ are the day of that FOMC meeting and the number of days in the month containing that FOMC meeting.

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⁶ The rate for term advances will be the one-year overnight index swap rate plus 10 basis points.

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