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The green energy transition and the 2023 Banking Crisis[☆]

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ABSTRACT

This study examines the stock price reactions of environmentally responsible stocks during the onset of the 2023 banking crisis, triggered by the collapse of Silicon Valley Bank (SVB). Our findings indicate that stocks poised to benefit from the shift to a low-carbon economy underperformed during the 2023 crisis. This suggests that investors anticipate a slowdown in climate tech development due to distress in the banking sector. Our results underscore the significance of considering not only the influence of the climate crisis on financial stability, but also the pivotal role that financial stability plays in ensuring a successful energy transition.

1. Introduction

In March 2023, suddenly, shares of several banks started crashing. Silicon Valley Bank (SVB) failed. So did Signature Bank. First Republic Bank's stock plunged (and it would later be taken over by JP Morgan Chase). A panic among depositors and a classic bank run occurred. Although these banks combined held more assets than all the US banks collapsed in 2008 (Russell and Zhang, 2023), the March 2023 crisis did not in the short term erupt into a fully fledged financial crisis like the Global Financial Crisis of 2007/08. However, some observers have highlighted a substantial uncertainty regarding the robustness of the financial and regulatory system (Acharya et al., 2023). This paper investigates the stock price reactions around these surprising events of stocks poised to benefit from the shift to a low-carbon economy. These reactions are of interest because asset price changes capture current expectations (Schwert, 1981); informally, the stock market can serve as a "crystal ball". If a heightened (perceived) probability of a financial crisis negatively affects stocks that benefit from a speedy and successful energy transition, this implies a link between financial stability and investor expectations for the feasibility and speed of the energy transition.

On the one hand, several observers predicted a negative effect on green stocks after the March 2023 bank failures due to the role of the involved banks in financing climate tech investments (Gelles, 2023; Bryan and Temple-West, 2023; Clifford, 2023). Indeed, SVB was a climate bank pioneer. Regional banks played an important role as lenders under the Inflation Reduction Act's (IRA) provisions.[1] More broadly, even publicly traded green stocks, which do not borrow from the affected banks directly, may experience a negative shock to expected cash flows (for example, due to the risk of a recession which would make it politically

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[1] The IRA was passed in August 2022 and boosted the value of stocks with opportunities from renewables and the transition to a low-carbon economy (Deng et al., 2023).

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less attractive to pursue climate-change policies and which would reduce consumers' inclination to buy climate-tech products) or a heightened risk perception by investors. However, environmentally responsible stocks also differ in other dimensions from other firms.

On the other hand, firms which score highly on the "Environment" (E) (and to some extent also on the "Social" (S) dimension) performed better during crises of trust such as the global financial crisis (Lins et al., 2017), COVID-19 (Albuquerque et al., 2020; Garel and Petit-Romec, 2021), and when inflation rises (Mão-de-Ferro and Ramelli, 2023), for example.[2]

While the 2023 banking crisis clearly also was about trust, the loss of trust was more specific to some banks and was arguably not a broader societal trust issue. Nonetheless, it is possible that investors perceived the 2023 banking crisis as the beginning of a broader trust crisis, and this could mean that environmentally responsible stocks were considered to be more resilient.

It is, therefore, both an important and a non-obvious question how valuations of "green stocks" reacted to the sudden demise of SVB and the developing banking crisis, when appropriately controlling for other differences among green and non-green stocks.

We use four different measures of firms' opportunities from the transition to a low-carbon economy, and a fifth one that captures overall environmental responsibility. Our key finding is that after the outbreak of the 2023 crisis, the market eyed the prospects of firms at the forefront of the transition critically. For example, firms with a one-standard-deviation higher climate change opportunity proxy as captured by the textual analysis of earnings calls conducted by Sautner et al. (2023) experienced cumulative returns during what we label the Avalanche Period (March 9–March 20, 2023) that were lower by 6.5% of their standard deviation. Similar results hold for a novel BERT-based measure provided by Deng et al. (2023), and for other measures. Overall, investors grew more skeptical about the economic viability of the green energy transition.

An emerging body of literature is trying to identify the factors that precipitated the wave of distress experienced by the banking system in March 2023. Chief among them is the reduction of banks' asset values originating from monetary policy tightening, as well as the excessive amount of uninsured deposits and market expectations on the share of withdrawals of uninsured deposits (Jiang et al., 2023; Dursun-de Neef et al., 2023; Flannery and Sorescu, 2023). Mid-sized banks (Choi et al., 2023; Caglio et al., 2023) and those with low branch density (Benmelech et al., 2023) experienced larger outflows of deposits than their peers. Notably, SVB was more exposed due to its heavier investments in long-dated securities compared to its peers, lower equity capital, and a deposits base concentrated among few venture capitalists (Vo and Le, 2023; Metrick and Schmelzing, 2023). Furthermore, Cookson et al. (2023) identify open communication on social media as a new channel for the propagation of bank-run risk.

Rather than studying the drivers of the banking crisis, our paper is about the potential consequences that market participants foresee.[3] To the best of our knowledge, this paper is the first to systematically examine green stock price reactions to the 2023 banking crisis (and, by controlling for a range of variables, also the first to document the role of leverage and other firm characteristics). A few papers have examined stock returns after the Silicon Valley Bank failure. For example, Yousaf and Goodell (2023) find that the financial, materials and real estate sectors exhibited negative and statistically significant abnormal returns on March 9, while investors did not consider SVB news a threat to other sectors. Pandey et al. (2023) show that developed markets exhibited more pronounced negative returns than other regions. We show that across and within industries, firms' climate opportunities were a major factor influencing the reaction to the SVB failure. Overall, our results highlight the importance of prudent management of financial institutions for ensuring an orderly energy transition.

2. Data and methods

2.1. Sample

The data are retrieved from Compustat North America and Compustat Global. We exclude stocks with prices below US$1 at the end of 2022 and those without valid prices in 2023. All non-ratio values expressed in different currencies are converted to dollar values using the exchange rate at the end of 2022, provided by IBES. We exclude companies operating in the financial GICS sector. For non-U.S. companies with dual-listing stocks, we use data sourced from their respective home countries. While the sample with control variables comprises 8,082 stocks, this is reduced to about 3,500 to 4,000 stocks in most regressions due to the availability of environmental measures.

2.2. Methods

We analyze three periods.[4] On March 8, 2023 at 4.04 p.m. (after regular trading hours) SVB announced booking a loss of US$1.8bn originated from the sale of US$21bn in securities to cover increasing depositors' withdrawals. SVB also announced seeking to raise US$2.25bn in capital by selling a mix of common and preferred stocks.

[2] It is worth noting that results for COVID-19 are not clear-cut. For example, Bae et al. (2021) and Demers et al. (2021) find that the effect on stock returns of ES ratings was not robustly significant during the COVID-19 crisis period. Glossner et al. (2022) document that institutional investors mostly relied on "hard" measures of resilience, such as higher cash holdings and lower leverage, during the COVID-19 market turmoil. Also, Deng et al. (2023) find that following the Russian invasion of Ukraine, ES scores did not explain stock price resilience.

[3] More broadly, we contribute to the literature on the effects of banking crises on financial markets (Longstaff, 2010; Fiordelisi et al., 2020; Liu, 2020; Perdichizzi and Reghezza, 2023).

[4] A more detailed timeline of events is in Figure A.1 in the Supplementary Appendix. Figure A.2 in the Supplementary Appendix illustrates the attention to the topic through both the Google Search Volume, as a proxy for retail investor attention, and the percentage of earnings conference calls covering the banking crisis as a proxy for companies and professional investors attention. The intensity of attention to SVB and related topics experienced a remarkable surge after March 9, reaching its peak and gradually subsiding thereafter.

Our main period of interest, the *Avalanche* period (March 9–March 20, 2023), begins with the first trading day following the SVB announcement. Its share price plummeted 60% that day. On March 10, U.S. regulators seized SVB, and on March 12, they seized Signature Bank. On March 11, First Republic Bank's shares plunged 60%, and President Biden had to emphasize the stability of the banking system. On March 17, SVB's parent company filed for Chapter 11 bankruptcy protection. March 20 marks the trading day preceding the Treasury Secretary's announcement of the federal authorities intention to protect the depositors of other banks.

To ascertain whether any effects we observe in the Avalanche period are in fact due to the events unfolding after the SVB announcement and not a continuation of a pre-existing trend, we also consider the *Precipice* period (February 23–March 8, 2023), which encompasses the two trading weeks before. Lastly, the *Aftermath* period (March 21–April 3, 2023) consists of the two trading weeks after the Avalanche period. On the weekend of March 18–19, UBS's emergency take-over of Credit Suisse took place. While this is a major event in its own right, we do not expect it to have differential consequences for environmental stocks.

Our empirical strategy consists of regressing cumulative stock returns, Ret, for each of the three periods on firm characteristics. Our main explanatory variable of interest is firms' climate change opportunity exposure, Opp. We control for market beta (β^{MKT}), book-to-market ratio (BTM), Cash ratio ($Cash$), $Leverage$, ROA, and $Size$. Following Deng et al. (2023), to control for a potential reversal in stock returns during highly volatile market phases, in the regressions of returns in the Avalanche and Aftermath periods, we also control for cumulative returns for the previous sub-period ($Ret_{(t-1)}$), that is, returns in the Precipice period and Avalanche period, respectively. Tables available on request show that the results do not depend on including these prior-period returns. While we initially present purely cross-sectional regressions, in the main specifications, we also include country (C) and industry (I) fixed effects. Thus, we estimate:

$$\begin{aligned} Ret_i =& \alpha + \beta_1 Opp_i + \beta_2 \beta_i^{MKT} + \beta_3 BTM_i + \beta_4 Cash_i + \beta_5 Leverage_i + \beta_6 ROA_i \\ &+ \beta_7 Size_i + \beta_8 Ret_{(t-1)i} + C_i + I_i + \epsilon_i \end{aligned} \tag{1}$$

2.3. Variables and descriptive statistics

We calculate stock returns after adjusting the prices for dividends using daily multiplication and price adjustment factors. Our main interest is in the role of firms' renewable energy opportunities. We use five different proxies (detailed definitions are in the Online Supplementary Appendix). (1) Opp^{ECC}, from Sautner et al. (2023), measures a firm's climate change exposure related to opportunities, using a machine learning and bigram matching approach on earnings conference call transcripts. (2) $RenewOpp^{ClimateBERT}$ is a renewables opportunities score generated from earnings conference call transcripts based on Climate-Bert (Deng et al., 2023). (3) $Opportunities\ in\ Clean\ Tech^{MSCI}$ assigns a higher score (0–10) to companies that proactively invest in products and services addressing issues of resource conservation and climate change. (4) $Carbon\ Emissions^{MSCI}$ assigns a higher score (0–10) to companies that proactively invest in low-carbon technologies and increase the carbon efficiency of their facilities. Finally, (5) E^{MSCI} represents the overall environmental score from MSCI (0–10).

For capturing firms' control variables, we retrieve from Compustat the latest quarterly data which refer to periods ending before January 1, 2023. The definitions are standard, and are presented in detail in the Supplementary Appendix.

Table 1 displays the descriptive statistics of our core variables. As for stock returns, during the Precipice period, firms experienced slightly positive performance on average (0.76%). During the Avalanche period, global stocks exhibit a significant decline, with an average return equal to −6.27%. Finally, we observe a reversal in stock returns in the Aftermath period, with an average cumulative return equal to 4.34%.

Table 1 also indicates that the firm characteristics exhibit the usual properties. What is noteworthy is that the climate exposure variables exhibit large variability across firms.

3. Main results

Table 2 presents the main results. Columns (1), (3), and (5) show purely cross-sectional regressions, while columns (2), (4), and (6) include country and industry fixed effects. The key findings are very similar with and without these fixed effects.[5] Notably, climate change opportunity exposure exhibits a negative and statistically significant impact on cumulative returns during the Avalanche period. In particular, based on the results of column (4), a one-standard-deviation higher opportunity exposure is associated with a decrease in cumulative return equal to 6.5% of their standard deviation (0.653/10.1) during the Avalanche period.[6] No effects occur during the Precipice or Aftermath periods.

[5] Moreover, Supplementary Appendix Table A.1 shows that similar results hold when we remove the industry or country fixed effects.

[6] Conventional t-statistics rely on the assumption of independently distributed errors and could, therefore, potentially be biased upward in the presence of the potential cross-sectional correlation of stock returns (Fama and French, 2000). We employ multiple approaches to address this concern. First, following Cohn et al. (2016), we test the statistical significance of the coefficients in our main regressions using adjusted t-statistics based on the empirical distribution of coefficient estimates. To do so, we consider the latest 252 trading days up to February 1, 2023 as our non-event period. We then combine returns in that pre-event period to replicate the 8-day cumulative returns of the Avalanche estimation window period. Thus, we run 31 cross-sectional regressions of the Avalanche period in the pre-event period. We compute the mean and standard deviation of the obtained series of coefficients. Then, we adjust the t-statistics in the Avalanche period by subtracting the mean time-series coefficients over the non-event period from the estimated event coefficients and then dividing the difference by the standard deviation of the time-series coefficients over the non-event period. With this approach, the t-statistics on the climate change opportunity exposure score drop somewhat, but the significance is retained. For robustness, we repeat the same approach with a shorter non-event period, equal to the latest 127 trading days up to February 1, 2023, to limit the impact of potential biases originating from the outbreak of the Russia–Ukraine war. Again, results prove robust. Second, we

Table 1
Descriptive statistics.

Variable	N	Mean	Std	Min	25%	50%	75%	Max
Stock returns								
$Ret^{Precipice}$	8082	0.76	11.77	−99.25	−2.92	1.03	4.73	348.53
$Ret^{Avalanche}$	8082	−6.27	10.10	−74.54	−9.95	−5.36	−1.63	233.33
$Ret^{Aftermath}$	8082	4.34	11.35	−79.04	0.58	4.12	7.61	300.42
Environmental measures								
Opp^{ECC}	3628	7.90	20.81	0.00	0.00	0.83	5.01	342.30
$RenewOpp^{ClimateBert}$	3424	7.27	15.41	0.00	0.00	1.88	6.59	179.91
$OpportunityCleanTech^{MSCI}$	1450	4.03	1.29	2.30	3.10	3.80	4.80	9.00
$CarbonEmissions^{MSCI}$	4140	7.44	2.10	1.80	6.20	7.40	9.60	10.00
E^{MSCI}	4140	5.13	2.21	1.00	3.40	5.00	6.60	10.00
Firm characteristics								
β^{MKT}	8082	0.71	0.54	−0.06	0.26	0.61	1.06	2.30
BTM	8082	−0.54	1.05	−4.04	−1.15	−0.44	0.19	1.43
Cash	8082	25.58	24.74	0.19	6.91	16.68	36.08	95.74
Leverage	8082	22.97	19.28	0.00	5.85	19.84	35.71	79.45
ROA	8082	0.08	10.27	−47.56	−1.48	1.71	4.94	22.45
Size	8082	6.18	2.23	1.91	4.45	6.08	7.76	11.58
Governance and social scores								
G^{MSCI}	4140	5.81	1.28	2.80	4.90	5.90	6.80	8.90
S^{MSCI}	4140	4.78	1.57	1.40	3.70	4.80	5.80	10.00

The table presents the summary statistics for the variables employed for the analysis. Stock cumulative returns are expressed in percentage points. Opp^{ECC} is a climate change exposure proxy related to transition opportunities generated using a machine learning and bigram matching approach on earnings conference call transcripts sourced from Sautner et al. (2023). We adjusted the measure by a factor of 10,000 for a better presentation. $RenewOpp^{ClimateBert}$ is a renewable energy opportunity proxy generated from earnings conference call transcripts based on ClimateBert (Webersinke et al., 2022), sourced from Deng et al. (2023). It is calculated by taking the average on a firm year-level of the ratios of the number of sentences related to renewable energy divided by the total number of sentences in each call. We adjusted the measure by a factor of 1,000 for a better presentation. $OpportunityCleanTech^{MSCI}$ measures companies' performance based on their clean tech innovation capacity, strategic development initiatives, and revenue generated from clean technologies. $CarbonEmission^{MSCI}$ measures companies' performance based on the carbon intensity of their operations and their efforts to manage climate-related risks and opportunities. E^{MSCI} measures the environmental company score based on the reported information in the environmental pillar. *Beta* is calculated by regressing one year of excess daily returns (from January 31, 2022, through January 31, 2023) on a constant and the market excess return, obtained from Kenneth French's website. *BTM* is the natural logarithm of the firm's book-to-market ratio. *Cash* represents cash and short-term investments divided by total assets (percentage points). *Leverage* is determined as the sum of long-term debt plus debt in current liabilities divided by total assets (percentage points). *ROA* is calculated as income before extraordinary items divided by total assets (percentage points). *Size* is the natural logarithm of the firm's market capitalization in millions. G^{MSCI} measures the governance company score based on the reported information in the governance pillar. S^{MSCI} measures the social score based on the reported information in the social pillar. All continuous explanatory variables are winsorized at the 1st and 99th percentiles.

To confirm that our results are not driven by the specific measure we use for climate opportunity exposure, Table 3 presents the results of the cross-sectional regressions obtained with different measures of firms' climate change opportunity exposure and environmental performance. Throughout, the findings indicate that firms that proactively invest more in clean technologies and the reduction in carbon emissions of their facilities experienced lower cumulative returns during the Avalanche period. Like in Table 2, the relationship is not significant in either the Precipice or the Aftermath periods.

To illustrate the findings, Fig. 1 displays the daily evolution of the impact of climate exposure opportunities and environmental performances on cumulative returns. The average daily effect of the opportunity proxy on cumulative returns exhibits no trend, on average, during the Precipice period. From March 9, when the panic is triggered by SVB deposit withdrawals, we observe a pronounced negative effect on cumulative returns for all the environmental measures employed in Table 3. For all our variables of interest, it takes a few days after the SVB failure for the steepest part of the decline during the Avalanche period to set in.[7]

The effects are sustained in the Aftermath period, with neither continuation nor a significant reversal of returns. The take-over of Credit Suisse by UBS does not appear to have had additional effects in the dimensions we focus on in this paper.

employ a bootstrapping method, following Cai and Walkling (2011). Specifically, we randomly select 8-day cumulative returns from the last 252 days before the event window. Then, we run the regression in column 4 of Table 2, using as the dependent variable the just-selected cumulative returns from this random non-event window. By repeating these steps 1,000 times, we generate an empirical distribution of the regression coefficients from the non-event period. We then compare the regression coefficients on climate change opportunity exposure from the estimated event window to the distribution of coefficients deriving from the non-event windows. The bootstrap p-value equals the percentage of the 1,000 coefficients that are lower than the estimated event coefficient (given that this coefficient is negative). In our case, the resulting p-value equals 0.026, indicating that the estimated event coefficient is statistically significant also based on this alternative method.

[7] This pattern is consistent with a slow processing of bad news, as documented in the literature (Hong and Stein, 1999; Hong et al., 2000).

Table 2
Cross-sectional regressions of cumulative returns.

Dependent variable	$Ret^{Precipice}$		$Ret^{Avalanche}$		$Ret^{Aftermath}$	
Sample	(1)	(2)	(3)	(4)	(5)	(6)
Opp^{ECC}	0.213	−0.052	−0.547***	−0.653***	−0.024	−0.094
	(0.141)	(0.175)	(0.166)	(0.175)	(0.126)	(0.158)
Beta	−0.457**	−0.191	−2.056***	−2.488***	0.613**	0.927***
	(0.207)	(0.258)	(0.201)	(0.246)	(0.241)	(0.301)
BTM	−0.159	−0.530**	−0.998***	−0.527**	−0.078	−0.250
	(0.250)	(0.264)	(0.199)	(0.217)	(0.274)	(0.287)
Cash	0.064	0.272	0.117	0.104	−0.759**	−0.643*
	(0.313)	(0.324)	(0.380)	(0.385)	(0.333)	(0.342)
Leverage	−0.170	−0.133	−1.592***	−1.462***	−0.222	0.033
	(0.228)	(0.237)	(0.181)	(0.188)	(0.260)	(0.266)
ROA	2.244***	1.744***	0.123	0.405	0.019	−0.209
	(0.341)	(0.371)	(0.287)	(0.301)	(0.428)	(0.464)
Size	0.188	−0.042	2.320***	2.488***	0.180	−0.042
	(0.208)	(0.227)	(0.224)	(0.234)	(0.250)	(0.295)
$Ret^{Precipice}$			0.003	0.029		
			(0.023)	(0.024)		
$Ret^{Avalanche}$					−0.082***	−0.056*
					(0.030)	(0.029)
Constant	−0.127	0.110	−6.429***	−8.482***	3.445***	2.423*
	(0.251)	(1.252)	(0.274)	(1.065)	(0.301)	(1.240)
Industry FE	No	Yes	No	Yes	No	Yes
Country FE	No	Yes	No	Yes	No	Yes
Observations	3,628	3,628	3,628	3,628	3,628	3,628
R^2	0.040	0.094	0.117	0.185	0.011	0.041
Adjusted R^2	0.038	0.075	0.115	0.168	0.009	0.021
F Statistic	11.786***	202.986***	58.210***	56.273***	3.258***	14.384***

This table provides a summary of the results obtained from cross-sectional regressions on cumulative stock returns. The dependent variables considered are the cumulative returns during the three periods: the Precipice, the Avalanche, and the Aftermath. The explanatory variables consist of the Opportunity Exposure proxy and various firm characteristics. *Beta* is calculated by regressing one year of excess daily returns (from January 31, 2022, through January 31, 2023) on a constant and the market excess return, obtained from Kenneth French's website. *BTM* is calculated as the natural logarithm of the firm's book-to-market ratio. *Cash* represents cash and short-term investments divided by total assets. *Leverage* is determined as the sum of long-term debt plus debt in current liabilities divided by total assets. *ROA* is calculated as income before extraordinary items divided by total assets. *Size* is determined as the natural logarithm of the firm's market capitalization in millions. All continuous explanatory variables are winsorized at the 1st and 99th percentiles and then standardized to have zero mean and unit variance. Robust standard errors in parentheses accompany the coefficient estimates. *; **; *** represent statistical significance at the 10%, 5% and 1% level respectively.

Firms with low leverage outperformed during the Avalanche Period.[8] These findings suggest that financial strength becomes highly relevant for investors when market uncertainty surges. Although cash holdings were a resilience driver in the Global Financial Crisis and in COVID-19, this does not appear to have been the case in the 2023 crisis. In fact, there is a weakly significant negative effect during the Aftermath period, possibly because of expectations of market participants that interest rates would not rise as much as expected.

Finally, we conduct several robustness checks. First, in Table 4 we control for firms' overall social and corporate governance scores. Investors might value good governance practices and socially responsible behavior as indicators of good management and higher levels of trust among corporate stakeholders during market turbulence. If climate-friendly companies have worse governance and social scores, this might explain the previous results. However, the main results still hold even controlling for these variables. Higher G^{MSCI} and S^{MSCI} scores did not contribute to better stock performance during the Avalanche period (which would be expected if these factors had been considered resilience-enhancing in this crisis). Nor did they contribute negatively which would have occurred if the crisis had induced generally changing views and a shift away from ESG investing.[9] Second, we add E^{MSCI} as control to all regressions. While this variable had a significantly negative effect on Avalanche period returns on its own, climate exposure opportunity measures still retain their significance because they have generally low correlations with the environmental score (not tabulated). Third, we obtain no robust evidence that financially constrained environmentally responsible firms suffered more, and the results continue to hold when we exclude the U.S. sample (where there is potentially a direct effect of the banks through financing). Both findings suggest that it was not primarily the bank financing channel at play, but rather that investors worried about the dark recessionary clouds that the brewing financial crisis cast over stocks with climate opportunities.

[8] Firms with higher leverage also suffered in the financial crisis (Giroud and Mueller, 2017; Duchin et al., 2010) and in the COVID-19 pandemic (Ramelli and Wagner, 2020; Ding et al., 2021; Fahlenbrach et al., 2021).

[9] For example, Kessler (2023) argues, in light of SVB's relatively diverse board of directors, that SVB "may have been distracted by diversity demands." Investors might, therefore, have in general put lower value on companies' diversity and other "S" efforts.

Table 3
Cross-sectional regressions of cumulative returns using alternative climate and environmental responsibility measures.

Dependent variable	$Ret^{Precipice}$				
Sample	(1)	(2)	(3)	(4)	(5)
Opp^{ECC}	−0.052				
	(0.175)				
$RenewOPP^{ClimateBert}$		0.109			
		(0.179)			
$OpportunityCleanTechScore^{MSCI}$			−0.083		
			(0.286)		
$CarbonEmissionsScore^{MSCI}$				0.041	
				(0.169)	
E^{MSCI}					0.054
					(0.178)
Controls and FE	Yes	Yes	Yes	Yes	Yes
Observations	3,628	3,424	1,450	4,140	4,140
Adjusted R^2	0.075	0.078	0.117	0.110	0.110
Dep.Variable	$Ret^{Avalanche}$				
Sample	(1)	(2)	(3)	(4)	(5)
Opp^{ECC}	−0.653***				
	(0.175)				
$RenewOPP^{ClimateBert}$		−0.706***			
		(0.148)			
$OpportunityCleanTechScore^{MSCI}$			−0.367**		
			(0.177)		
$CarbonEmissionsScore^{MSCI}$				−0.354**	
				(0.163)	
E^{MSCI}					−0.677***
					(0.163)
Controls and FE	Yes	Yes	Yes	Yes	Yes
Observations	3,628	3,424	1,450	4,140	4,140
Adjusted R^2	0.168	0.178	0.218	0.193	0.195
Dep.Variable	$Ret^{Aftermath}$				
Sample	(1)	(2)	(3)	(4)	(5)
Opp^{ECC}	−0.094				
	(0.158)				
$RenewOPP^{ClimateBert}$		0.014			
		(0.164)			
$OpportunityCleanTechScore^{MSCI}$			0.047		
			(0.230)		
$CarbonEmissionsScore^{MSCI}$				−0.053	
				(0.142)	
E^{MSCI}					−0.204
					(0.165)
Controls and FE	Yes	Yes	Yes	Yes	Yes
Observations	3,628	3,424	1,450	4,140	4,140
Adjusted R^2	0.021	0.018	0.048	0.068	0.068

This table presents a summary of the results obtained from cross-sectional regressions on cumulative stock returns using alternative climate and environmental responsibility measures. The dependent variables considered are the cumulative returns during the three periods: the Precipice, the Avalanche, and the Aftermath. The analysis includes country and industry fixed effects. Other control variables, such as *Beta*, *BTM*,*Cash*, *Leverage*, *ROA*, *Size* and prior-period returns, are included in the analysis. Still, their coefficients are not shown in the table to save space. All continuous explanatory variables are winsorized at the 1st and 99th percentiles and then standardized to have zero mean and unit variance. Robust standard errors in parentheses accompany the coefficient estimates.*; **; *** represent statistical significance at the 10%, 5% and 1% level respectively.

4. Conclusion

In March 2023, several U.S. banks collapsed, arguably initiating a potential banking and possibly a broader financial crisis. Our study shows that SVB's collapse and subsequent events in the banking sector had broad repercussions on a wide range of publicly listed companies. Specifically, firms at the forefront of environmental technologies significantly suffered from this banking crisis. Like in most crises, however, firms with lower leverage outperformed. The setback observed in green stocks' performance during the Avalanche period highlights the inherent vulnerability of green stocks and their sensitivity to financial conditions. Thus, they do not provide a sure-fire way for investors to safeguard their portfolios against market crises. We do not observe a similar setback

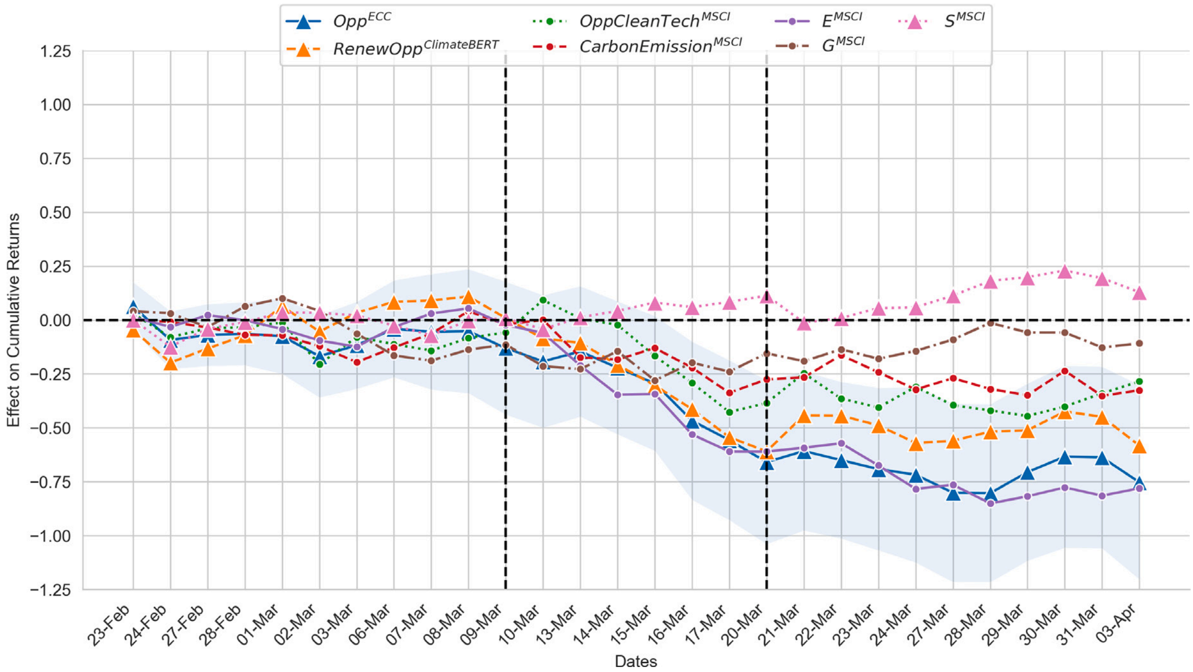

Fig. 1. Evolution of coefficients for proxies for firms' climate change opportunity exposure and environmental scores, G scores, and S scores. This graph shows the evolution of the coefficients on various environmental proxies in regressions with the cumulative returns from February 23, 2023 each day through April 3, 2023 as the dependent variable. The environmental proxies are the climate change opportunity exposure (Sautner et al., 2023), exposure to renewables (Deng et al., 2023), opportunities in clean tech score, carbon emissions score, and the overall environmental score sourced from MSCI. Additionally, we plot the evolution of the coefficients for G^{MSCI} and S^{MSCI} scores. The figure also displays 90% confidence intervals for Opp^{ECC}. The regressions control for the full set of controls from Table 2, except for the prior-period returns. We also account for country and industry fixed effects. The sample comprises global firms. The vertical lines are the beginning and end of the Avalanche period.

for stocks scoring highly on the "S" dimension, suggesting that the bank crisis did not add to the ongoing shift on views on the ESG movement in general.

There is much concern among policy-makers, central bankers, and practitioners how the energy transition and climate change can impact financial stability. However, our paper shows that, conversely, poor financial management, particularly in banks, can dramatically affect the energy transition. Much like the Global Financial Crisis of 2007/08 brought massive, long-run damage in terms of worse health outcomes during COVID-19 (Moreno et al., 2023), another global financial crisis might lead to severe losses of climate innovation. Given the narrow timeline that humanity appears to have for dealing with climate change, the real costs of such a financial crisis would be enormous. Our study, therefore, highlights the paramount importance of sound management of financial institutions and robust financial stability policies.

Declaration of competing interest

We declare that we have no relevant or material financial interests that relate to the research described in this paper.

Data availability

The authors do not have permission to share data.

Declaration of Generative AI and AI-assisted technologies in the writing process

During the preparation of this work the authors used ChatGPT in order to correct English language errors. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.frl.2023.104493.

Table 4
Alternative cross-sectional regressions of cumulative returns, controlling for firms' Social and Governance pillar scores.

Dependent variable	$Ret^{Precipice}$				
Sample	(1)	(2)	(3)	(4)	(5)
Opp^{ECC}	−0.089				
	(0.172)				
$RenewOPP^{ClimateBERT}$		0.058			
		(0.179)			
$OpportunityCleanTechScore^{MSCI}$			−0.094		
			(0.286)		
$CarbonEmissionScore^{MSCI}$				0.059	
				(0.169)	
E^{MSCI}					0.062
					(0.180)
S^{MSCI}	0.028	−0.010	0.185	−0.008	−0.009
	(0.191)	(0.196)	(0.203)	(0.145)	(0.146)
G^{MSCI}	−0.129	−0.078	−0.198	−0.144	−0.140
	(0.225)	(0.242)	(0.271)	(0.168)	(0.169)
Observations	2,891	2,766	1,450	4,140	4,140
Adjusted R^2	0.079	0.074	0.117	0.110	0.110
Dependent variable	$Ret^{Avalanche}$				
Sample	(1)	(2)	(3)	(4)	(5)
Opp^{ECC}	−0.591***				
	(0.186)				
$RenewOPP^{ClimateBERT}$		−0.667***			
		(0.147)			
$OpportunityCleanTechScore^{MSCI}$			−0.383**		
			(0.178)		
$CarbonEmissionScore^{MSCI}$				−0.375**	
				(0.159)	
E^{MSCI}					−0.709***
					(0.163)
S^{MSCI}	0.301*	0.243	0.209	0.143	0.188
	(0.183)	(0.191)	(0.188)	(0.138)	(0.140)
G^{MSCI}	0.125	0.138	−0.330*	0.008	−0.003
	(0.186)	(0.197)	(0.200)	(0.141)	(0.141)
Observations	2,891	2,766	1,450	4,140	4,140
Adjusted R^2	0.203	0.207	0.219	0.192	0.195
Dependent variable	$Ret^{Aftermath}$				
Sample	(1)	(2)	(3)	(4)	(5)
Opp^{ECC}	−0.107				
	(0.165)				
$RenewOPP^{ClimateBERT}$		−0.041			
		(0.157)			
$OpportunityCleanTechScore^{MSCI}$			0.045		
			(0.231)		
$CarbonEmissionScore^{MSCI}$				−0.067	
				(0.141)	
E^{MSCI}					−0.217
					(0.164)
S^{MSCI}	−0.073	−0.030	0.028	0.035	0.054
	(0.142)	(0.151)	(0.168)	(0.109)	(0.111)
G^{MSCI}	0.085	0.018	−0.035	0.070	0.072
	(0.141)	(0.165)	(0.188)	(0.139)	(0.137)
Observations	2,891	2,766	1,450	4,140	4,140
Adjusted R^2	0.071	0.059	0.047	0.067	0.068

This table presents a summary of cross-sectional regressions of cumulative stock returns with alternative environmental measures, controlling for S^{MSCI} and G^{MSCI} scores. The dependent variables considered are the cumulative returns during the three periods: the Precipice, the Avalanche, and the Aftermath. We include *Beta*, *BTM*,*Cash*, *Leverage*, *ROA*, *Size*, prior-period returns, country and industry fixed effects which are not displayed to save space. All continuous explanatory variables are winsorized at the 1st and 99th percentiles and then standardized to have zero mean and unit variance. The robust standard errors are reported below the coefficient estimates.*; **; *** correspond to the 10%, 5% and 1% significant level respectively.

References

Acharya, V.V., Richardson, M.P., Schoenholtz, K.L., Tuckman, B., 2023. SVB and Beyond: The Banking Stress of 2023. New York University.

Albuquerque, R., Koskinen, Y., Yang, S., Zhang, C., 2020. Resiliency of environmental and social stocks: An analysis of the exogenous COVID-19 market crash. Rev. Corp. Finance Stud. 9 (3), 593–621.

Bae, K.-H., El Ghoul, S., Gong, Z.J., Guedhami, O., 2021. Does CSR matter in times of crisis? Evidence from the COVID-19 pandemic. J. Corp. Finance 67, 101876.

Benmelech, E., Yang, J., Zator, M., 2023. Bank branch density and bank runs. Working Paper.

Bryan, K., Temple-West, P., 2023. Banking crisis threatens biden climate bill. Financ. Times URL https://www.ft.com/content/5cd9822e-6695-4a07-b261-bad90d8e0bde.

Caglio, C., Dlugosz, J., Rezende, M., 2023. Flight to Safety in the Regional Bank Crisis of 2023. Working Paper.

Cai, J., Walkling, R.A., 2011. Shareholders' say on pay: Does it create value? J. Financ. Quant. Anal. 46 (2), 299–339.

Choi, D.B., Goldsmith-Pinkham, P., Yorulmazer, T., 2023. Contagion Effects of the Silicon Valley Bank Run. Working Paper.

Clifford, C., 2023. Silicon Valley Bank seizure leaves a massive hole — and a large opportunity — in the world of climate finance. CNBC.com, URL https://www.cnbc.com/2023/03/15/what-the-silicon-valley-bank-collapse-means-for-climate-tech.html.

Cohn, J.B., Gillan, S.L., Hartzell, J.C., 2016. On enhancing shareholder control: A (dodd-) Frank assessment of proxy access. J. Finance 71 (4), 1623–1668.

Cookson, J.A., Fox, C., Gil-Bazo, J., Imbet, J.F., Schiller, C., 2023. Social Media as a Bank Run Catalyst. Working Paper.

Demers, E., Hendrikse, J., Joos, P., Lev, B., 2021. ESG did not immunize stocks during the COVID-19 crisis, but investments in intangible assets did. J. Bus. Finance Account. 48 (3–4), 433–462.

Deng, M., Leippold, M., Wagner, A.F., Wang, Q., 2023. War and Policy: Investor Expectations on the Net-Zero Transition. Working Paper.

Ding, W., Levine, R., Lin, C., Xie, W., 2021. Corporate immunity to the COVID-19 pandemic. J. Financ. Econ. 141 (2), 802–830.

Duchin, R., Ozbas, O., Sensoy, B.A., 2010. Costly external finance, corporate investment, and the subprime mortgage credit crisis. J. Financ. Econ. 97 (3), 418–435.

Dursun-de Neef, Ö., Ongena, S., Schandlbauer, A., 2023. Monetary Policy, HTM Securities, and Uninsured Deposit Withdrawals. Working Paper.

Fahlenbrach, R., Rageth, K., Stulz, R.M., 2021. How valuable is financial flexibility when revenue stops? Evidence from the COVID-19 crisis. Rev. Financ. Stud. 34 (11), 5474–5521.

Fama, E.F., French, K.R., 2000. Forecasting profitability and earnings. J. Bus. 73 (2), 161–175.

Fiordelisi, F., Minnucci, F., Previati, D., Ricci, O., 2020. Bail-in regulation and stock market reaction. Econom. Lett. 186, 108801.

Flannery, M.J., Sorescu, S.M., 2023. Partial Effects of Fed Tightening on US Banks' Capital. Working Paper.

Garel, A., Petit-Romec, A., 2021. Investor rewards to environmental responsibility: Evidence from the COVID-19 crisis. J. Corp. Finance 68, 101948.

Gelles, D., 2023. Silicon valley bank collapse threatens climate start-ups. N.Y. Times URL https://www.nytimes.com/2023/03/12/climate/silicon-valley-bank-climate.html.

Giroud, X., Mueller, H.M., 2017. Firm leverage, consumer demand, and employment losses during the great recession. Q. J. Econ. 132 (1), 271–316.

Glossner, S., Matos, P., Ramelli, S., Wagner, A.F., 2022. Do Institutional Investors Stabilize Equity Markets in Crisis Periods? Evidence From COVID-19. Working Paper.

Hong, H., Lim, T., Stein, J.C., 2000. Bad news travels slowly: Size, analyst coverage, and the profitability of momentum strategies. J. Finance 55 (1), 265–295.

Hong, H., Stein, J.C., 1999. A unified theory of underreaction, momentum trading, and overreaction in asset markets. J. Finance 54 (6), 2143–2184.

Jiang, E.X., Matvos, G., Piskorski, T., Seru, A., 2023. Monetary Tightening and US Bank Fragility in 2023: Mark-to-Market Losses and Uninsured Depositor Runs? Working Paper.

Kessler, A., 2023. Who killed silicon valley bank?. Wall Street Journal URL https://www.wsj.com/articles/who-killed-silicon-valley-bank-interest-rates-treasury-federal-reserve-ipo-loan-long-term-bond-capital-securities-startup-jpmorgan-bear-stearns-lehman-brothers-b9ca2347.

Lins, K.V., Servaes, H., Tamayo, A., 2017. Social capital, trust, and firm performance: The value of corporate social responsibility during the financial crisis. J. Finance 72 (4), 1785–1824.

Liu, K., 2020. Chinese banking failure: The case of baoshang bank and its implications. J. Financ. Econ. Policy 13 (4), 424–441.

Longstaff, F.A., 2010. The subprime credit crisis and contagion in financial markets. J. Financ. Econ. 97 (3), 436–450.

Mão-de-Ferro, A., Ramelli, S., 2023. Inflation, the Corporate Greed Narrative, and the Value of Corporate Social Responsibility. Working Paper.

Metrick, A., Schmelzing, P., 2023. The March 2023 Bank Interventions in Long-Run Context–Silicon Valley Bank and Beyond. Working Paper.

Moreno, A., Ongena, S., Ventula Veghazy, A., Wagner, A.F., 2023. 'Long GFC'? The Global Financial Crisis, Health Care, and COVID-19 Deaths. Working Paper.

Pandey, D.K., Hassan, M.K., Kumari, V., Hasan, R., 2023. Repercussions of the Silicon Valley Bank collapse on global stock markets. Finance Res. Lett. 104013.

Perdichizzi, S., Reghezza, A., 2023. Non-significant in life but significant in death: Spillover effects to euro area banks from the SVB fallout. Econom. Lett. 111231.

Ramelli, S., Wagner, A.F., 2020. Feverish stock price reactions to COVID-19. Rev. Corp. Finance Stud. 9 (3), 622–655.

Russell, K., Zhang, C., 2023. 3 Failed banks this year were bigger than 25 that crumbled in 2008. N.Y. Times URL https://www.nytimes.com/interactive/2023/business/bank-failures-svb-first-republic-signature.html.

Sautner, Z., van Lent, L., Vilkov, G., Zhang, R., 2023. Firm-level climate change exposure. J. Finance 78 (3), 1449–1498.

Schwert, G.W., 1981. Using financial data to measure effects of regulation. J. Law Econ. 24 (April), 121–158.

Vo, L.V., Le, H.T., 2023. From Hero to Zero-The Case of Silicon Valley Bank. Working Paper.

Webersinke, N., Kraus, M., Bingler, J., Leippold, M., 2022. ClimateBERT: A pretrained language model for climate-related text. In: Proceedings of the AAAI 2022 Fall Symposium: The Role of AI in Responding To Climate Challenges.

Yousaf, I., Goodell, J.W., 2023. Responses of US equity market sectors to the Silicon Valley Bank implosion. Finance Res. Lett. 103934.