Environmental Reputation and Bank Liquidity under Climate Change Risk*

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* We thank Philip Dybvig, Zhichao Li, and conference/seminar participants at the 2021 Financial Markets and Corporate Governance (FMCG) Conference and Southwestern University of Finance and Economics for valuable comments and suggestions.

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Abstract

This study empirically investigates how a bank's environmental reputation affects its deposits and credit provision in regions with severe climate change risks. We find that banks with higher reputational risks for environmental issues tend to experience declining deposits in the regions exposed to severe climate change risks. Banks with a poor environmental reputation also reduce mortgage origination in the same regions. Such banks diminish liquidity creation if they have high deposit shares in the regions sensitive to climate change. This paper suggests that a bank's reputation for environment-related ESG practices can be an important source underlying bank liquidity in areas sensitive to climate change.

Keywords: ESG risk, Climate change, Branch banking, Bank deposits, Mortgages
JEL classification: G20, G21, Q50, Q54

1. Introduction

As climate change poses new threats to the global economy, bank management of reputational risks for ESG issues has received increased attention from practitioners as well as regulators. For example, the Bank for International Settlements highlighted how incorporating climate-related risks into financial risk monitoring is challenging but critical to preserving long-term global financial stability.[2] In consultation with Credit Suisse and KPMG, the World Wide Fund for Nature (WWF) released an analytical report that focuses on potential channels through which banks' ESG risks affect bank performance and stability.[3] Yet, despite the growing importance of environmental-related ESG issues along with climate change risks in the topics relating to the banking sector's fragility, the specific channels between environmental-related bank ESG practices and financial stability are underexplored.

In our paper, we focus on the behaviors of bank depositors as a channel through which environmental-related ESG risks trigger banks' fragility in markets that are exposed to severe climate change. Depositors are a key stakeholder that can discipline the banks through their deposit flows (Chavaz & Slutzky, 2018). A growing body of literature addresses the importance of stakeholders' roles in engaging in firms' ESG risk controls. The literature focuses on the role of customers (Dai, Liang, & Ng, 2020; Schiller, 2018), mutual funds (Shive & Forster, 2020), auditors (Burke, Hoitash, & Hoitash, 2019a), and lenders (Houston & Shan, 2019) in shaping firms' ESG practices. Stakeholders can change corporate ESG policies through market discipline in the form of, for example, customer boycotts of producers (Gantchev, Giannetti, & Li, 2020), auditor resignations (Burke, Hoitash, & Hoitash, 2019a), and lender termination of a lending relationship

[2] See details from "The green swan: Central banking and financial stability in the age of climate change." Available at www.bis.org/publ/othp31.pdf.

[3] See details from "Environmental, Social, and Governance Integration for Banks: A Guide to Implementation." Available at wwf.panda.org/?226990.

with borrowers (Houston and Shan, 2019). Given stakeholder disciplinary actions, we predict that a bank's depositors will discipline the bank by reducing their deposits from a bank that mismanages its reputation through poor ESG-related practices.[4] With this in mind, we investigate whether a bank's deposit funding is negatively related to its environmental reputation in the regions exposed to severe climate change risks from a rising sea level—regions where residents are expected to have a special concern about environmental issues.

To test our predictions, we rely on the *RepRisk* database to obtain each US bank's ESG rating. The *RepRisk* measures and quantifies each firm's reputational risk exposure related to ESG practices by monitoring 28 ESG-related issues[5] through media, NGOs, government bodies, regulators, newsletters, social media (Twitter and blogs), and other online sources. Among the 28 ESG-related issues covered by the *RepRisk*, the environmental-related issues include the impact on ecosystem and the overuse of resources. In our study, to measure a bank's environmental reputational risk, we construct a proxy index by multiplying the bank's total ESG risk index and its percentage of environmental issues among the total issues comprising the bank's ESG risk index. We convert original monthly indices to an annual frequency by taking their mean value in each calendar year. We relate the index as of the previous year to the bank's branch deposits in the current year in counties exposed to severe climate change risk. In this study, our key identifying

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[4] According to a media report by the CBS Minnesota (December 1, 2016), people across the US planned to close their deposit accounts with the U.S. Bank and Wells Fargo, which provided loans to the Dakota Access Pipeline (DAPL) project, as part of a protest against the DAPL. See details from "DAPL Protesters Close Accounts with Wells Fargo, US Bank." Available at https://minnesota.cbslocal.com/2016/12/01/dapl-protesters-close-accounts.

[5] The 28 ESG-related issues consist of 6 environmental issues (①Impacts on ecosystems/landscapes, ②Global pollution, ③Local pollution, ④Overuse and wasting of resources, ⑤Waste issues, and ⑥Animal mistreatment), 10 social issues (①Impact on communities, ②Human rights abuses and corporate complicity, ③Local participation issues, ④Social discrimination, ⑤Child labor, ⑥Forced labor, ⑦Occupational health and safety issues, ⑧Poor employment conditions, ⑨Freedom of association and collective bargaining, and ⑩Discrimination in employment), 7 governance issues (①Corruption, bribery extortion and money laundering, ②Fraud, ③Tax evasion, ④Tax optimization, ⑤Anti-competitive practices, ⑥Executive compensation, and ⑦Misleading communication), and 5 supplementary issues (①Products and services, ②Controversial products and services, ③Supply chain, ④Violation of international standards, and ⑤Violation of national legislation).

assumption is that if a bank's mismanagement of environmental issues is seriously addressed by various media outlets, which is incorporated into the *RepRisk* index, depositors are better aware of the bank's poor environmental reputation.[6,7] This ultimately affects depositors' decisions to deposit or withdraw their savings from their bank accounts. WWF's 2014 report states, "There is also the potential for reputational risk impacting brand value, which could be critical for banks funding themselves with retail deposits." The DAPL-related news reports, which listed the names of banks funding the DAPL projects and documented protestors' responses to those banks, are important anecdotal evidence for this identifying assumption. Concerned with depositors' awareness of banks' negative ESG activities featured in media, and for promotion of sound banking activities, banks are more inclined to offer their commitment to environmentally friendly banking practices such as green deposits and green banking.[8]

Table 1 provides the list of US counties exposed to severe climate change risks. Following the method used in Painter (2020), we first identify the list of cities exposed to climate change risks, with each city's expected mean annual losses from a 40-cm rise in the sea level, scaled by the city's GDP. In this study, if a city's expected mean annual loss is higher than 0.01% of its

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[6] Capelle-Blancard and Petit (2019) find that stakeholders react more to ESG information disclosed by the media rather than a firm's press releases. McWilliams and Siegel (2000, 2001) argue that ESG related media coverage leads to the higher demand of shareholders for socially responsible behavior.

[7] *RepRisk* screens all the activities of a bank to assess whether a bank's intention (e.g., lending policies, commitment, etc.) is integrating into due diligence processes, such as client and transaction reviews. As such, the *RepRisk* index is created based on risk incidents linked to all the entities including borrowers mentioned in the original sources (https://www.reprisk.com). Relatedly, we empirically find that a bank's poor environmental reputation identified by the index is highly related to the bank's loan origination to a firm with a poor environmental reputation in the same year (Table B.1 in the Online Appendix). We further find that our main regression results still hold even when we replace the index for a bank's environmental reputation with a dummy variable for the bank's loan origination to a firm with a poor environmental reputation (Table B.2 in the Online Appendix).

[8] See the article of "Citi Launches Green Deposits, a New Sustainable Investment Solution." Available at https://www.citibank.com/tts/about/press/2020/2020-1123.html. See the article of "HSBC launches 'green deposit' product for financing eco-friendly projects." Available at https://timesofindia.indiatimes.com/business/india-business/hsbc-launches-green-deposit-product-for-financing-eco-friendly-projects/articleshow/77668301.cms. See the webpage of "Green Banking." Available at https://www.td.com/ca/en/personal-banking/solutions/green-banking.

annual GDP, the city is assumed to have severe climate change risk. [9] Next, we define each county that contains cities with severe climate change risks as a county exposed to severe climate risk.

[Insert Table 1 about here]

Figure 1 illustrates maps for the counties with and without severe climate change risks. Figure 1a covers all US counties with and without severe climate change risks. The regions with severe climate change risks are clustered in some of the coastal areas. This clustering may raise the endogeneity concern that the existence of severe climate change risks in the coastal areas is not random but is highly correlated with local economic characteristics, which may affect the local branch deposits and environmental reputations of banks with business in those areas. To mitigate this endogeneity concern, we use alternative samples by dropping inland regions and limiting local areas to the states or the metropolitan statistical areas (MSAs) with at least one county exposed to severe climate change risks from a rising sea level, as displayed in Figures 1b or 1c.

[Insert Figure 1 about here]

In the first set of empirical tests, we find that banks with poor environmental reputations are more likely to experience declining branch-level deposits in the following year in counties exposed to severe climate change risks. Notably, we include a set of bank-, bank-county-, and county-level variables to control for the bank- or county-specific characteristics that may affect branch deposits as well as the bank's environmental reputation. Further, we add bank-state-year fixed effect and branch fixed effect to control for bank-level and state-level unobservable characteristics in the given year and time-invariant branch specific factors. By employing those

[9] The results still hold even when we define all cities (and their corresponding counties) with non-zero expected mean annual losses from a 40-cm rise in the sea level, scaled by their annual GDPs, as the regions with severe climate change risks (Table B.3 in the Online Appendix). Our results also still hold even when we limit samples to counties with moderate climate risk by dropping Orleans, Miami-Dade, Hillsborough, and Pinellas from samples, which are top 10 percent counties in terms of the climate risk index (in which the expected mean annual loss from a 40-cm rise of sea level is above 0.3 % of the city's GDP), as reported in Table B.4 in the Online Appendix.

sets of fixed effects, we only measure the variations within each bank and each state in the given year by absorbing the variations across banks or across states. By focusing on the within-bank variation across branches in different regions, we can effectively control for the potential confounding effect of a bank's increasing insolvency risk on the depositors' disciplinary actions. Moreover, it is important to note that the results still hold even when we limit samples to the states or the MSAs with at least one county exposed to the severe climate change risks from a rising sea level. We further employ a potential variation of depositors' sensitivity to environmental issues across periods and regions in our regressions. The results are stronger in the periods (post-crisis or years with natural disasters nearby) or regions (with more banks, high social capital, or higher young population) in which the sensitivity of the residents to environmental issues is deemed relatively high. From the set of regression results, we can conclude that a bank's poor reputation on environmental issues is highly related to the reduction of the local deposit size of the branches located in the regions sensitive to severe climate changes from a rise in the sea level. In contrast to the results on the branch deposits, we cannot find any negative relationship between the banks' poor environmental reputation and the deposit interest rates of the bank branches located in the regions exposed to severe climate risks. Those results support the argument that the declining deposits of the banks with poor environmental reputations in the climate-sensitive regions are mainly driven by the depositors' decisions to withdraw their deposits from the banks rather than the banks' actions to downsize their total deposits.

Next, we examine the consequences of declining branch deposits at banks with poor environmental reputations in the area exposed to severe climate change risks. The drawdown of aggregate deposits in local branches may have a negative spillover effect on the bank's lending activities and liquidity creation (e.g., Acharya & Mora, 2015; Cornett, McNutt, Strahan, &

Tehranian, 2011; Khwaja & Mian, 2008). To test this prediction, we use a bank's aggregate mortgage origination in each county during a year as the outcome variable. We find that banks with a poor reputation for environmental issues were more likely to originate reduced mortgages in the counties exposed to severe climate change risks in the following year. The negative results on mortgages are significant only for retained mortgages and nonsignificant for sold mortgages. Sold mortgages are known to be less sensitive to the banks' liquidity constraints, such as their deposits' drawdown, due to a high likelihood of securitization in the market (e.g., Gilje, Loutskina, & Strahan, 2016). This condition may be the underlying reason for the finding that only the retained mortgage origination is negatively affected by the bank's poor environmental reputation via the bank's deposit drawdown. The contrasting results between the effects on retained mortgages and those on sold mortgages will be important evidence against the alternative possibility that the mortgage applicants are also sensitive to banks' environmental reputations, which directly reduce the size of mortgage loan origination. If the mortgage applicants are the underlying driver for reduced mortgage origination from the banks with poor environmental reputation, the results should be significant for both retained and sold mortgages.[10]

As the next step, we analyze the effect on banks' liquidity creation. The results show that a bank with high deposit shares in areas with severe climate change risks is more likely to reduce its liquidity creation if the bank's reputation is damaged by environmental issues in the previous year. The results are mostly driven by banks' off-balance sheet items. Overall, the results suggest that a bank's reputational risk for environmental issues ultimately has a negative spillover effect on banks' lending activities as well as their liquidity creation via the liquidity shocks of their local deposit drawdown.

[10] In untabulated results, we cannot find a significant reduction of the number of mortgage loan applications for the banks with high environmental reputational risks in the regions exposed to severe climate change risks.

Finally, we find that banks with high deposit shares in the counties exposed to severe climate change risks are more likely to reduce the fraction of their branches in such counties in the subsequent year. Simultaneously, the banks with high deposit shares in counties that suffer from severe climate changes are more likely to lessen their reputational risks for environmental issues in the following year. These results imply that the banks with high exposure to climate change risks, through their geographical deposit distributions, tend to strictly manage the risk of potential deposit outflows by redistributing their branches across counties as well as improving their reputation for environmental issues.

This paper adds to several strands of the literature. Our paper highlights the important role of depositors in affecting the banks' management of their environmental reputation. In this regard, our findings make an important contribution to the growing literature on stakeholders' roles in affecting firms' ESG practices. Shive and Forster (2020) document that increased oversight over companies through expanded mutual fund ownership and board size decreases the manufacturing firms' greenhouse gas emissions. Dai et al. (2020) and Schiller (2018) find that environmentally and socially responsible policies can propagate from customers to suppliers through global supply chain relationship (see also Burke et al., 2019a; Chava, 2014; Dimson, Karakaş, & Li, 2015; Gantchev et al., 2020; Lins, Servaes, & Tamayo, 2017; Starks, Venkat, & Zhu, 2017). Among others, our paper is highly related to Houston and Shan's (2019) work, which documents how the banking relationship positively influences the borrower firm's ESG policies. Houston and Shan (2019) focus on the banks' role as a lender in shaping borrowers' ESG policies. In contrast, our study highlights how banks' ESG policies can be disciplined by their depositors, a key stakeholder. By identifying the role of depositors in affecting banks' ESG policies, our paper fills the gap in understanding what motivates banks to make more environmentally or socially responsible lending decisions, ultimately promoting borrowers' ESG performance. Our paper is also directly related to Homanen (2018), which focuses on the deposit growth of banks that financed the DAPL in the regions near the pipeline around the time of the DAPL event. Unlike Homanen (2018), we use the coverage of banks' environmental reputation in media (including local, national, and international), NGOs, government bodies, or customer-driven social media (e.g., Twitter), which is reflected on the banks' *RepRisk* index, as the main variable of our interest. By using this index, we can reflect all possible important events that may affect individual banks' environmental reputations and effectively control for the event or anecdote specific characteristics. Further, our results highlight stronger effects of banks' poor environmental reputations on their branch deposits in the regions exposed to severe climate change risks, which are different from a prior study that mainly focuses on distance from the event as the main driver for the branch deposit growth.

Our paper also adds to the literature that addresses the financial consequences of climate change risks. Painter (2020) documents that counties exposed to high climate change risks pay more in underwriting fees and initial yields when issuing their long-term municipal bonds. Bernstein, Gustafson, and Lewis (2019) find that the price of homes exposed to the risk of rises in the sea level is discounted relative to those of unexposed homes. In keeping with this literature, we employ the risks of rising sea levels as an important factor differentiating financial consequences in the local markets.[11] Our finding adds to the literature through our focus on how the climate change risks affect the banks' operations in terms of their deposit collection and credit provision in local markets.

Our paper also makes an important contribution to the literature on what drives the severe deposit outflows from banks (Artavanis, Paravisini, Robles-Garcia, Seru, & Tsoutsoura, 2019;

[11] Among several types of climate change risk (e.g., extreme drought, urban heat islands), rising sea levels is considered one of the most salient risks and often cited by climatologists (Painter, 2020; Bernstein, Gustafson, & Lewis, 2019).

Chen, Goldstein, Huang, & Vashishtha, 2020). One explanation is a *panic-based run* (Allen, Carletti, Goldstein, & Leonello, 2018; Diamond & Dybvig, 1983; Keister, 2016; Rochet & Vives, 2004), in which depositors rush to withdraw their funds due to the fear that others will withdraw available resources from the bank, regardless of the bank's fundamentals or performance. Another explanation is a *fundamental-based run* (Allen & Gale, 1998; Chari & Jagannathan, 1988; Jacklin & Bhattacharya, 1988), in which the withdrawal of deposits is triggered by the banks' deteriorated fundamentals without any indication of depositor panic. In our study, we explore another important factor seemingly unrelated to panic- or fundamental-based bank runs that may affect depositors' behaviors; namely, a bank's reputational risk for environmental-related ESG issues along with its exposure to severe climate change risks.

Another strand in the literature is the effects of banks' liquidity shocks on their lending activities (Bernanke & Blinder, 1992; Chava & Purnanandam, 2011; Choi, Gam, Park, & Shin, 2020; Drechsler, Savov, & Schnable, 2017; Ivashina & Scharfstein, 2010; Kashyap & Stein, 2000; Khwaja & Mian, 2008; Loutskina & Strahan, 2009; Peek & Rosengren, 2000; Schnabl, 2012). Our paper addresses how the drawdown of banks' local deposits—triggered by their poor environmental reputation—affects the bank's mortgage origination in areas sensitive to climate risk. Thus, our paper contributes to this literature by identifying banks' reputational risks for environmental issues as one of the underlying factors that leads to banks' liquidity problems and their subsequent lending contraction in the regions exposed to severe climate change.

The remainder of the paper is organized as follows. Section 2 presents our research motivation. Section 3 provides the data and summary statistics. Section 4 provides the results of the empirical tests. Section 5 concludes.

2. Motivation

Our research is motivated by the growing attention to stakeholders' roles in engaging in firms' ESG risk controls. A large body of literature examines the role of key stakeholders, including customers (Dai et al., 2020; Schiller, 2018), mutual funds (Shive & Forster, 2020), auditors (Burke, Hoitash, & Hoitash, 2019a), and lenders (Houston & Shan, 2019) in shaping the firms' ESG practices. Those stakeholders widely employ the suspension of transactions in many different forms against companies when they encounter the firms' diminished ESG reputation.[12] Houston and Shan (2019) further document that banks have faced increased pressure to be more accountable to their customers. This pressure is one of the main forces that motivates the banks to make more accountable lending decisions.[13] One important gap in the literature is the role of the banks' stakeholders, especially depositors who are responsible for the main source of bank funding (Chavaz & Slutzky, 2018), in shaping the banks' ESG practices. If we apply the stakeholders' general transaction suspension against the companies to the depositor-bank relationship, we can predict that depositors will take actions to discipline banks by withdrawing their funds from the banks' deposit accounts and reallocating them to competing banks in response to negative shocks on banks' ESG-related reputations.

Among various ESG practices, our paper focuses on banks' reputational risk management of environmental issues that have come into greater prominence recently as climate change risks gain more attention. The Dakota Access Pipeline protest (Homanen, 2018) serves as important

[12] Krüger (2015) and Capelle-Blancard and Petit (2019) show that investors strongly and adversely react to firms' negative ESG events disclosed by the media. Krueger, Sautner, and Starks (2020) find that institutional investors consider environmental issues a major factor in selecting investment portfolio components. Other examples include customers' boycotting producers (Gantchev et al., 2020), auditors' resignation (Burke et al., 2019a), and lenders' terminating lending relationship with borrowers (Houston & Shan, 2019).

[13] Houston and Shan (2019) introduce some anecdotal evidence for the increased pressures to banks such as a release of a report that ranks banks on their relationships with firearm manufacturers or organizations by a group supporting gun control and a criticism against Wells Fargo during a Congressional hearing for making loans to firms operating private prisons and energy pipelines.

anecdotal evidence for depositors' disciplinary actions against banks with a poor environmental reputation. In regard to this case, an environmental activist declared that "until the banks withdraw all support for fossil fuel companies that violate indigenous treaty rights and put our drinking water and climate at risk, we will withdraw our money from the banks" in an interview with a local media.[14] Relatedly, the WWF specifies bank deposits as one possible key channel between a bank's ESG reputational risk and its stability by documenting that depositors may shift their funds away from banks due to concerns over the banks' environmental-related reputations.[15], [16] From the above anecdotes, we first hypothesize that environment-sensitive depositors can discipline a bank by withdrawing their deposits from the bank account if those depositors receive negative news that may seriously hurt the bank's environmental reputation, such as its new lending to firms with poor environmental practices.

As mentioned earlier, climate change risk is gaining attention from practitioners and regulators as a key source of financial fragility. The macroeconomic literature provides evidence that climate risk affects industrial and agricultural outputs, labor productivity, health, energy demand, and overall economic growth (Burke et al., 2015; Dell, Jones, & Olken, 2009, 2012;

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[14] See details from "DAPL Protesters Close Accounts with Wells Fargo, US Bank." Available at https://minnesota.cbslocal.com/2016/12/01/dapl-protesters-close-accounts.

[15] See details from "Environmental, Social, and Governance Integration for Banks: A Guide to Implementation." Available at wwf.panda.org/?226990.

[16] Other literature and anecdotes related to banks' reputational risks for environmental issues are listed as follows: Cowton and Thompson (2000) argue that one ethical business practice for lending institutions is to avoid the lending relationship with borrowers that produce hazardous chemicals or discharge toxic pollutants into the air, land, or water; indirect involvement in environmental degradation is another. Sarokin and Schulkin (1991) and Harvey (1995) document that banks doing commercial business with firms involved in degrading the natural environment can be seen as facilitators of natural environmental damage, which in turn weakens the bank's profitability. Weber (2012) and Weber, Hoque, and Islam (2015) show that environmental issues are of growing importance to bank reputations, and in an effort to build a sound level of trust with customers, more and more banks have supported proactive environmental engagement in recent years. We have several anecdotal evidence for banks' reputational risk management for environmental issues: Citi group announced that the group will cut its credit-exposure to coal-mining companies in half by 2025. See the article, "Citi Promises to cut lending to coal miners." (https://www.ft.com/content/ec6e6f26-6b99-11e5-aca9-d87542bf8673.

Hsiang & Jina, 2014; Jones & Olken, 2010).[17] At the microeconomic level, several studies have discussed the impact of climate change on firms and investors. Addoum, Ng, and Ortiz-Bobea (2019) suggest that a greater level of climate risk has a negative impact on corporate earnings. Chava (2014) shows that firms ignoring environmental issues tend to have a higher cost of capital.[18] Other studies generally consider environmental risk a significant factor affecting firm valuation (Beatty & Shimshack, 2010; Konar & Cohen, 2001; Matsumura, Prakash, & Vera-Muñoz, 2014).[19] In the banking sector, a considerable number of analytical reports or speeches by practitioners and policymakers stress the growing importance of environment- or climate-related ESG risks in preserving bank stability and suggest their potential channels toward banking sector fragility as well. For example, Professor Joachim Wuermeling, an executive board member of Deutsche Bundesbank, highlights a broad consensus that ESG risks and in particular climate-related ESG risks are financial risks but the integration of the ESG risks into banks' risk management is still in the early stages.[20] Despite the growing attention to the relationship between banks' environment-related reputational risks and banks' stability in the markets exposed to severe climate changes, empirical evidence is not well explored.

Based on the background presented above, we empirically investigate how a bank's deposits are affected by the bank's environmental-related ESG practices in the regions with severe

[17] Relatedly, Painter (2020) finds that counties more likely to be affected by climate risks experience a high cost of issuing municipal bonds. Bansal, Kiku, and Ochoa (2019) show that climate risks, as long-run factors, are incorporated into the financial market. Other studies show that climate risks are still mispriced in financial markets (Hong, Li, & Zu, 2019; Daniel, Litterman, & Wagner, 2017; Kumar, Zin, & Zhang, 2019).
[18] Huynh and Xia (forthcoming) further show that investors give a higher premium to bonds issued by firms focusing on improving environmental performance and such effect is stronger when climate change risk is concerned in the market.
[19] Choi, Gao, and Jiang (2020), Zaval, Keenan, Johnson, and Weber (2014), and Akerlof, Maibach, Fitzgerald, Cedeno, and Newman (2013) show that people revise their beliefs about climate change due to greater attention on global warming, and they reallocate their assets to firms pursuing sound ESG initiatives, lowering climate sensitivities. Likewise, individual investors update their investment portfolio concerning real estate price changes associated with climate change risk (Giglio, Maggiori, Stroebel, & Weber, 2018; Baldauf, Garlappi, & Yannelis, 2020).
[20] See details from: Joachim Wuermeling: A new world ahead. What do sustainable finance and digitalisation mean for supervision? Available at https://www.bis.org/review/r191017f.pdf.

climate risks. We connect a bank's reputational risk for environmental issues to its deposits in the regions that are exposed to severe climate change risks from rising sea levels where residents may be highly sensitive to environmental issues. We hypothesize that banks with diminished reputations for environmental issues are more likely to experience a reduction of local deposits in the regions exposed to severe climate change risks.

3. Data and summary statistics

3.1. Data source

For the empirical tests, we rely on several sets of data sources. First, we use *RepRisk* to identify each bank's reputational risk for environmental issues as well as its overall ESG rating, which is included in the regressions as a control variable. The *RepRisk* measures and quantifies each firm's reputational risk exposure related to ESG issues (Li & Wu, 2020; Asante-Appiah, 2020; Burke, Hoitash, & Hoitash, 2019b; Kölbel, Busch, & Jancso, 2017).[21] The *RepRisk* database covers more than 120,000 companies around the world as of 2015. To measure the reputational risk, *RepRisk* monitors 28 ESG-related issues through media, NGOs, government bodies, regulators, newsletters, social media (Twitter and blogs), and other online sources in 15 languages.[22] Among the 28 ESG-related issues covered by the *RepRisk*, the environmental-related issues include impacts on ecosystem, wasting of resources, and animal mistreatment, among others.

Second, we identify the counties exposed to severe climate change risks, based on Painter (2020), which provides a list of cities facing climate change risks. Painter also documents the cities'

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[21] Compared with the KLD (MSCI) database, the *RepRisk* database is well suited for our study. For example, while KLD data is created based on the firm's self-reported information, which can be biased with the manager's discretion, ESG data provided by *RepRisk* relies on significant media coverage concerning the negative news about the firm's ESG activities, providing a more objective assessment of the effect of the bank's environmental-related reputational risk. Beyond the benefit mentioned above, *RepRisk* data may also reduce the concern of endogeneity in that it is difficult for managers to endogenously manipulate negative news detection across various sources of media channels.
[22] The 15 languages are English, Chinese, Danish, Dutch, Finnish, French, German, Italian, Japanese, Korean, Norwegian, Portuguese, Russian, Spanish, and Swedish.

expected mean annual losses from a 40-cm rise in the sea level, scaled by the cities' GDPs. In our study, if a city's expected mean annual loss is higher than 0.01 percent of its annual GDP, we assume that the city is exposed to severe climate change risks. We further assume that if a county contains cities exposed to severe climate change risks, the county is assumed to be exposed to severe climate change risks as well.[23]

Third, we rely on the summary of deposits (SOD) provided by the Federal Deposit Insurance Corporation to measure a branch-level deposit balance as of June 30 in each year. This variable is one of our main outcome variables in the regressions. Bank branch distribution is also identified from the SOD data. Using the SOD data, we can calculate the Herfindahl-Hirschman Index (HHI) for a county-level deposit market as well as each bank's deposit market shares in the county. Both variables are included as control variables.

Fourth, our study relies on the Federal Financial Institutions Examination Council to obtain mortgage origination of each bank in each county. The data provides information on the types of lending (e.g., retained by the originators vs. securitized in the markets) of each mortgage loan. From this information, we analyze how a bank's mortgage origination is affected by the bank's reputational risks for environmental issues in counties with severe climate change risks by each type of lending. Subcategories of mortgages are explained in Section 4.3.

In addition, we use Dealscan to identify the relationship between a bank and its borrower. Using this data, we can see how a bank's environmental reputation is related to its loan origination to a firm with a poor environmental reputation in the same year. For branch-level deposit interest rates, we rely on RateWatch through which we can identify branch-level weekly interest rates for

[23] The results still hold even when we define all cities (and their corresponding counties) with non-zero expected mean annual losses from a 40-cm rise in the sea level, scaled by their annual GDPs, as the regions with severe climate change risks (Table B.3 in the Online Appendix).

various types of deposits such as the certificate of deposits and the money market accounts. In this study, we collapse the original weekly rates for each type of deposits into its annual average for each branch. The Call Reports from the Federal Reserve Bank of Chicago contain each bank's balance sheet, income statement, and off-balance-sheet items. From the Call Reports, we calculate bank-level control variables, such as total asset size, capital structure, and loan quality. County-level annual population and aggregated personal income are available from the Bureau of Economic Analysis. We obtain quarterly bank liquidity creation data from Christa Bouwman's website.[24] Finally, we obtain county-level annual unemployment rates from the Bureau of Labor Statistics.

3.2. Summary statistics

Table 2 presents the summary statistics for the key dependent and independent variables used in the empirical tests that relate banks' reputational risks for environmental issues to the bank's branch deposits, local lending activities, and liquidity creation in the counties exposed to severe climate change risks.

[Insert Table 2 about here]

The first row provides the summary statistics for banks' branch-level deposits, which are used as the main outcome variable for the regressions. The second to fourth rows contain the statistics for the banks' aggregate mortgage origination in the counties. Those variables are employed as outcome variables that identify the effect on banks' lending activities in the counties with severe climate change risks. The fifth to ninth rows provide summary statistics for banks' liquidity creation (*LiquidityCreation*) and the change of banks' branch distribution (*ΔBranchFrac*). From the tenth row to the end, we report the summary statistics of the main independent variables,

[24] The data for banks' liquidity creation is available at https://sites.google.com/a/tamu.edu/bouwman/data.

which are the index for a bank's reputational risks for environmental issues (*EnvRepRisk*) and an indicator for the counties exposed to severe climate change risks (*SevereClimateRisk*). In our study, the number of counties with severe climate change risks is only 34, which is around 1 percent among total number of counties (3,243). According to the mean value of *SevereClimateRisk*, however, those counties with climate risks represent approximately 14 percent of our sample because those areas have relatively more bank branches than the inland rural areas not exposed to severe climate change risks, as triggered by a rise in the sea level. Indicator variables for post-crisis period (*PostCrisis*) and for the years with natural disasters in other areas in the same state (*DisasterNearby*) are employed to identify the period when residents' sensitivity to environmental issues is relatively high. Quartile variables for the number of banks scaled by population in each county (*NumBank*), for the level of social capital in each state (*SocCap*), and for the fraction of young population (age <40) in each state (*YoungPop*) are also used to measure the relative sensitivity of residents to environmental issues across regions in the US. The remaining variables represent the bank-, bank-county- or county-level control variables included in our regressions.

4. Empirical results

In this section, we present the empirical results that relate a bank's reputational risk for environmental issues to the bank's deposit volume, lending activities, and liquidity creation in the counties exposed to severe climate change risks.

4.1. Reputational risk for environmental issues and bank deposits

First, we examine how a bank's reputational risk for environmental issues affects local deposits of the bank's branches located in the counties exposed to severe climate change risks. The regression model is as follows:

$$Ln(BranchDeposits)_{j,y} = \beta_0 + \beta_1\, EnvRepRisk_{i,y-1} + \beta_2\, SevereClimateRisk_c + \beta_3\, EnvRepRisk_{i,y-1} \times SevereClimateRisk_c + \Gamma X_{j,y-1} + \delta_j + \delta_{i,s,y} + \epsilon_{j,y} \quad (1)$$

The subscripts *i, j, c*, *s*, and *y* refer to the bank, branch, county, state, and year, respectively. *Ln(BranchDeposits)*, the outcome variable, is the natural log of a bank's branch-level deposits as of June 30 in the current year. *EnvRepRisk* is the proxy index for the bank's environmental reputational risk as of the previous year. This index is constructed by multiplying the bank's total ESG risk index provided by *RepRisk* and its percentage of environmental issues among total issues that make up the bank's ESG risk index. The ESG risk index is constructed mainly based on the extent to which a firm's or a bank's poor ESG practices are covered by media outlets, social media, and so on. To convert the original monthly variables to an annual frequency, we take the mean value of the monthly observations during the calendar year. The higher the value for *EnvRepRisk*, the worse the bank's reputation for the environmental issues as of the previous year.[25] Our key identifying assumption underlying the employment of *EnvRepRisk* as our main regressor can be described as follows: If a bank's mismanagement of environmental issues is seriously addressed by various media outlets, as reflected on the *EvnRepRisk*, depositors are better aware of the bank's poor management of its environmental reputation. This will influence depositors' decisions to deposit or withdraw their savings in the bank with poor environmental reputation. The media reports that listed the names of banks providing funds to the DAPL projects and documented the depositors' threats to withdraw their savings from those banks are important anecdotal evidence. Finally, *SevereClimateRisk* is a dummy variable that identifies the county that is exposed to severe

[25] We find that a bank's high environmental reputational risk measured by *EnvRepRisk* is highly related to the bank's loan origination to a firm with a poor environmental reputation in the same year (Table B.1 in the Online Appendix). We further find that our main regression results still hold even when we replace the index for a bank's environmental reputation with a dummy variable for the bank's loan origination to a firm with a poor environmental reputation (Table B.2 in the Online Appendix).

climate change risks. *SevereClimateRisk* is time-invariant over the sample period (from 2008 to 2015).

X is a set of bank-, bank-county-, or county-level control variables that control for each bank's or each county's specific characteristics that may be highly correlated with the bank's branch deposits in the counties exposed to severe climate change risks. *X* includes *RepRiskIndex*, which represents the bank's total ESG reputational risks provided by the *RepRisk*. This variable will absorb the effect of a bank's overall ESG reputational risks on the bank's branch deposits. Other bank-level control variables listed in *X* encompass *Ln(Assets)*, *CapitalRatio*, *LeverageRatio*, *C&ILoanRatio*, *EstateLoanRatio*, *NPLRatio*, *Small*, *Local*, *LoanDeposit*, and *DepositLiab*. *X* also includes bank-county-level or county-level control variables, including *CountyMktShare, HHI*, *Ln(Population)*, *Ln(Income)*, and *UnemploymentRate*. The values of those control variables are measured at the previous year-end. Appendix A provides a description of each variable. These variables control for the effect of the bank- or county-specific characteristics, such as the bank's asset/liability structures and the county's banking market competition, which may be highly correlated with the bank's management of its environmental reputation or the bank's branch-level deposits. δ_j and $\delta_{i,s,y}$ indicate the branch fixed effect and bank-state-year fixed effect, respectively. The set of fixed effects enables us to absorb time-invariant branch specific factors and any unobservable variation generated by bank-level (e.g., banks' increasing insolvency risks) and state-level (e.g., local economic conditions) characteristics in the given year. By employing those sets of fixed effects, we effectively capture the variation of local branch deposits within each bank and each state in the given year conditional on the variation of the bank's environmental reputation indices over time, as well as the variation of whether the local areas suffer from severe climate change risks or not. Standard errors are clustered at the bank level.

In Table 3, we present the results of the regression that relates a bank's reputational risk for environmental issues to the bank's branch deposits in the counties exposed to severe climate change risks. In the table's first column, all US counties are included in the sample. In the second and third columns, the sample is limited to the states or the MSAs with at least one county exposed to severe climate change risks. Regardless of the sample coverage, the results are consistent across all columns in the table.[26]

[Insert Table 3 about here]

EnvRepRisk is the index that measures the bank's environmental reputational risk. The higher the index, the worse the bank's reputation for environmental issues. This variable is absorbed by the bank-state-year fixed effect because no variation remains for this variable within a bank in the given year.[27] The main coefficient of our interest is the interaction term of *EnvRepRisk* × *SevereClimateRisk*, which identifies the relationship between a bank's environmental reputation and its branch deposits in its subsequent year in counties exposed to severe climate change risks. The estimated value of the interaction term is negative and statistically significant at 1 percent level in all three columns;[28] meaning that if a bank's environmental reputation worsens, the branch-level deposits decrease significantly in counties with severe climate change risks in the following year. This result suggests that depositors in the regions with severe

[26] For brevity, bank-county and county-level control variables are not reported in Table 3. The estimation results for those control variables are reported in Table B.5 in the Online Appendix.

[27] Because some bank branches changed their location across counties during our sample period, variation still remains in the *SevereClimateRisk* dummy variable even after employing the branch fixed effect. If we limit samples to the branches without location change across counties during our sample period, all variation in *SevereClimateRisk* will be absorbed by the branch fixed effect. Our results are robust to limiting branches to those without any location change across counties during our sample period (Table B.6 in the Online Appendix).

[28] As a robustness check, we add lagged variables for a bank's *EnvRepRisk* as of two or three years prior to the current year and their interaction terms with *SevereClimateRisk* in addition to the existing *EnvRepRisk* (as of the previous year) and the interaction term of *EnvRepRisk* × *SevereClimateRisk* in the regressions. The results show that the negative effect on the current year's bank branch deposits in the regions exposed to severe climate change risks is most significant by the bank's environmental reputational risk as of the previous year but nonsignificant or weakly significant by the bank's environmental reputational risk as of two or three years prior to the current year (Table B.7 in the Online Appendix).

climate change risks may be more sensitive to environmental issues and, thus, reallocate their deposits from banks with worse environmental reputations to banks with better environmental reputations. The results are robust to limiting samples to the states or MSAs with at least one county exposed to severe climate change risks, as shown in Figures 1b and 1c. Notably, our results are not driven by local economic conditions or bank-level unobservable characteristics because the bank-state-year fixed effect absorbs the cross-sectional variations across states and banks in the same year.[29]

The coefficients presented in this table also are economically significant. In Columns 1 and 2, the coefficients for the interaction term (*EnvRepRisk* × *SevereClimateRisk*) are around –0.004, which means one index point increase in *EnvRepRisk* is related to 0.4 percent higher reduction of branch deposits in counties exposed to severe climate change risks. If we assume one standard deviation increase (5.846) in *EnvRepRisk* of a bank, its local deposit volume will decline by 2.3 percent (–0.004 × 5.846) more in branches located in counties exposed to severe climate change risks in the next year. If we limit the sample to the MSAs with at least one county exposed to severe climate change risks, as reported in Column 3, the economic significance for the interaction term becomes even larger. One standard deviation increase (5.846) in *EnvRepRisk* is associated with a 3.5 percent decrease (–0.006 × 5.846) of local deposit volume in branches located in the counties with severe climate change risks.[30]

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[29] We further control for the effect of regional characteristics on branch deposits by matching high climate change risk counties with low climate change risk counties within the same state and the same year in terms of lagged income and population using nearest neighbor matching. Additionally, we employ bank-MSA-year fixed effect instead of bank-state-year fixed effect to further absorb the effects of MSA-level local economic conditions. All results are robust to matching observations and employing different fixed effect specifications. The results are reported in Table B.8 in the Online Appendix.

[30] The mean value of branch-level deposits in counties with severe climate change risks is around $235 million per branch during our sample period. The 2.3 percent reduction of branch-level deposits can be translated into $5.4 million reduction of deposits per branch in the counties exposed to severe climate change risks.

In contrast to the results on the branch deposits, we cannot find any negative relationship between the banks' environmental reputational risks and deposit interest rates of the bank branches that are located in the regions exposed to severe climate change risks. The insignificant results for the deposit interest rates can support our main idea that the declining deposits of the banks with poor environmental reputations in the climate-sensitive regions are mainly driven by the depositors' decisions to withdraw their deposits from the banks rather than by the banks' actions to reduce their deposit sizes.[31]

4.2. Heterogeneity of depositors' sensitivity to environmental issues

In Tables 4 and 5, we move one step further by employing a potential variation of depositors' sensitivity to environmental issues across periods and regions. In those tables, we limit samples to the MSAs with at least one county exposed to severe climate change risks (as displayed in Figure 1c). In Table 4, we focus on the variation across periods by decomposing samples into the periods with relatively high and low sensitivity by residents to environmental issues. In Column 1, we define the period following the 2007-2009 financial crisis as the period with a relatively high sensitivity of depositors to environmental issues compared to the crisis period, in which solvency or bank stability issues might be the priority over banks' ESG practices.[32] *PostCrisis* is a dummy variable that identifies the post-crisis period (2010 to 2015). The result shows that the triple interaction term (*PostCrisis* × *EnvRepRisk* × *SevereClimateRisk*) is negative and strongly significant.[33] In Column 2, we define the year when at least one natural disaster hits the same state

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[31] The regression results on branch-level deposit interest rates are reported in the Online Appendix (Table B.9).

[32] Stakeholders started paying more attention to firms' long-term ESG investment practices after the 2008 financial crisis. See the article of "Why Your Company Should Be Paying Attention to ESG." (https://legacy-site.c2fo.com/resources/why-your-company-should-be-paying-attention-to-esg). See another article of "ESG awareness is an enduring legacy of the global financial crisis." (https://www.fidelityinternational.com/editorial/blog/pesg-awareness-is-an-enduring-legacy-of-the-global-financial-crisisp-a5a9f2-en5). See another article of "The Global Financial Crisis: Ten years on." (https://www.msci.com/financial-crisis).

[33] In Column 1 of Table 4, the coefficient for *EnvRepRisk* × *SevereClimateRisk* is insignificant and close to zero, meaning we cannot find a significant difference in deposit volume change of the branches located in the regions with

other than the MSAs as the period with a relatively high sensitivity by residents to climate or environmental issues. *DisasterNearby* is a dummy variable that takes a value of one if at least one natural disaster occurs in the same state other than the MSAs during the year and zero otherwise. Again, the triple interaction term (*DisasterNearby* × *EnvRepRisk* × *SevereClimateRisk*) is negative and statistically significant. The results in Table 4 highlight that branch deposits are more sensitive to the banks' environmental issues in the counties exposed to severe climate risks when the depositors' sensitivity to environmental issues are deemed to be relatively high.

[Insert Table 4 about here]

In Table 5, we move forward to the variation of residents' sensitivity to environmental issues across the regions. For these tests, we employ three variables that identify the variation across the regions – *NumBank*, *SocCap*, and *YoungPop*. In Column 1, we posit that if more bank brands exist in the same county, the local depositors can more easily move their deposits from the banks with a poor environmental reputation to other banks. This means banks' deposits may be more sensitive to their environmental issues in the regions with more banks. Thus, we define the counties with larger numbers of banks as the area with a relatively high sensitivity of depositors to climate risks. *NumBank* is a quartile variable for the number of banks in a county scaled by the county's population. In Column 2, we define the states with higher social capitals as the areas with residents who have a relatively high sensitivity to environmental issues. *SocCap* is a quartile variable for the state-level social capital. Prior studies show that reginal social capital is tightly associated with civic norms and local altruism in the community, facilitating norm-consistent behaviors of residents and organizations within the community (Hoi, Wu, & Zhang, 2018; Li, Tang, & Jaggi, 2018; Huang & Shang, 2019; Coleman, 1988). Thus, we expect the local depositors in

severe climate risks between the banks with better environmental reputations and those with poor reputations during the financial crisis.

the regions with higher social capital to react more adversely to the banks with higher environmental reputational risk. In Column 3, we define the states with higher fractions of young populations as the area with residents who have a relatively high sensitivity to climate risks. Recent KPMG articles show that the younger generation is more concerned about climate change risks and chooses their bank based on its ESG credentials.[34] *YoungPop* is a quartile variable for the state-level fraction of young population (younger than age 40) among total population in the state. In all three columns, we find that the triple interaction terms are all negative and significant, supporting our prediction that if a region is characterized by the condition that its residents are relatively more sensitive to environmental issues, then the effect of a bank's worse environmental reputation on branch deposits in the county exposed to severe climate risks becomes stronger.

[Insert Table 5 about here]

4.3. Reputational risk for environmental issues and mortgages

In previous sections, we found that banks with higher reputational risks for environmental issues are more likely to face deposit reductions in their local branches located in the regions exposed to severe climate change risks. Because deposits are the main funding sources for banks' lending, a reduction in deposits will have a negative spillover effect on banks' lending activities in the regions with severe climate change risks (e.g., Acharya & Mora, 2015; Cornett et al., 2011; Khwaja & Mian, 2008).[35] To test this prediction, we employ banks' mortgage originations in each county as a new outcome variable. Because mortgage origination is available at the bank-county-

[34] See article: "Embedding ESG into banks' strategies" (https://home.kpmg/xx/en/home/insights/2020/05/embedding-esg-into-banks-strategies.html). See KPMG report. (https://assets.kpmg/content/dam/kpmg/xx/pdf/2020/05/frontiers-in-finance.pdf). See another article of "Young voices grow louder in company strategies and values" (https://www.ft.com/content/0e06fed2-382a-40b3-82ef-1b91fff48b65).

[35] Several empirical papers provide evidence of friction in the internal capital market within a bank (e.g., Dlugosz, Gam, Gopalan, & Skrastins, 2020). If the friction exists in a bank's internal capital market, the reduced local deposit funding could affect local lending.

year level rather than branch-year level, we need to adjust the existing regression model, as described below:

$$
\begin{aligned}
Ln(Mortgage)_{i,c,y} &= \beta_0 + \beta_1\, EnvRepRisk_{i,y-1} + \beta_2\, SevereClimateRisk_c \\
&+ \beta_3\, EnvRepRisk_{i,y-1} \times SevereClimateRisk_c + \Gamma X_{i,c,y-1} + \delta_{i,c} \\
&+ \delta_{i,s,y} + \epsilon_{i,c,y}
\end{aligned} \tag{2}
$$

As described in Equation (1), the subscripts *i, c, s,* and *y* refer to the bank, county, state, and year, respectively. *Ln(Mortgage),* the outcome variable, is the natural log of a bank's aggregated mortgage origination in each county in the current year. Accordingly, the branch fixed effect is replaced with bank-county fixed effect for this regression. The bank-county fixed effect absorbs all variation in *SevereClimateRisk* because *SevereClimateRisk* is time-invariant in each county during our sample period.

Table 6 provides the regression results. In all three columns, the coefficient of the interaction term, *EnvRepRisk* × *SevereClimateRisk*, is negative and statistically significant. Similar to the effect on branch deposits, a bank's mortgage origination is negatively affected by the bank's reputational risk for environmental issues in the counties exposed to severe climate change risks. These results indicate that mortgages are susceptible to the banks' liquidity constraints following branch-level deposit reduction. Our subsequent question is whether the effect of declined branch deposits on mortgage origination can be differentiated by the likelihood of mortgage securitization or not. If there is a greater chance of mortgage securitization, we can conjecture that the mortgage origination in counties with climate change risks may be less affected by the deposit reduction of the banks with a poor reputation for environmental issues.

[Insert Table 6 about here]

To test this prediction, we decompose mortgages into two types—retained mortgages and sold mortgages—and compare the effects on banks' mortgage origination in the areas with severe climate change risks between these two subcategories (Gilje et al., 2016). The regression results reported in Table 7 confirm that the interaction terms, *EnvRepRisk* × *SevereClimateRisk*, are negative and significant only for retained mortgages (Panel A). The coefficients are insignificant for sold mortgages (Panel B). In other words, banks with higher reputational risks tend to reduce their lending in areas with severe climate change risks, particularly if these loans are expected to be retained in the banks and thus are more sensitive to local deposit reduction than potential securitized loans. The contrasting results between the effects on retained mortgages and those on sold mortgages will serve as key evidence against the alternative possibility that a bank's poor reputation for environmental issues negatively influences loan applications and thus reduces the size of the mortgage origination. If the mortgage applicants are the underlying driver for the reduced mortgage origination from the banks with poor environmental reputation, there should be no significant difference in regression results between the effect on the retained mortgages and those on the sold mortgages. [36]

Economic significance is also sizable for the retained mortgages (Panel B). The coefficients of the interaction term range from –0.015 to –0.038, which means a one index point increase of a bank's environmental reputational risk (*EnvRepRisk*) is associated with a 1.5 to 3.8 percent reduction of local retained mortgage origination in counties exposed to severe climate change risks in the subsequent year.

[Insert Table 7 about here]

4.4. Reputational risk for environmental issues and bank liquidity creation

We then consider how a bank's reputational risk for environmental issues affects its liquidity creation if the bank has high exposure to the counties with severe climate change risks.

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[36] In untabulated results, we cannot find a significant reduction of the number of mortgage loan applications for the banks with high environmental reputational risks in the regions exposed to severe climate change risks.

Because a bank's liquidity creation is available at a bank-quarter level, we need to adjust the regression specifications as follows:

$$\begin{aligned} LiquidityCreation_{i,q} &= \beta_0 + \beta_1\, EnvRepRiskQ_{i,q-1} + \beta_2\, ClimateRiskExposureQ_{i,q-1} \\ &+ \beta_3\, EnvRepRiskQ_{i,q-1} \times ClimateRiskExposureQ_{i,q-1} + \Gamma X_{i,q-1} \\ &+ \delta_i + \delta_q + \epsilon_{i,q} \end{aligned} \quad (3)$$

The subscripts *i* and *q* refer to the bank and quarter, respectively. *LiquidityCreation* is the size of the bank's liquidity creation, scaled by its total assets as of the quarter-end. *EnvRepRiskQ* is the mean value of the bank's monthly reputational risk indices for the environmental issues during the previous quarter. *ClimateRiskExposureQ* is the share of a bank's deposits in the area exposed to severe climate change risks among the bank's total deposits as of June 30 prior to the current quarter-end. Because we use bank-quarter level panel data instead of bank-year-county or branch-year panels for this test, we need to convert the county-level dummy variable of *SevereClimateRisk* into the bank-level continuous variable of *ClimateRiskExposureQ* by using the bank's deposit shares in each county as a weight. This regression includes the bank-level control variables listed in Table 2 at the previous quarter-end. We include bank and quarter fixed effects.

Table 8 presents the regression results. In this table, we report four different types of banks' liquidity creation. In Column 1, we report the banks' total liquidity creation that covers their asset-side, liability-side, and off-balance-sheet-side liquidity creation. In Columns 2 to 4, we report the liquidity creation for each of asset-side, liability-side, and off-balance-sheet-side, respectively. The results show that a bank with high exposure to the regions with severe climate change risks in terms of its deposits is more likely to reduce its liquidity creation if its reputational risk is high for environmental issues. This result is driven mainly by the bank's off-balance-sheet items, as presented in Column 4. In contrast, the liability-side liquidity creation is less affected by the bank's environmental reputational risk. We can conclude that the local deposit reduction induced by the bank's high reputational risks for environmental issues has a negative spillover effect on the bank's overall liquidity provision.

[Insert Table 8 about here]

4.5. Bank management of their exposure to climate change risks

In previous sections, we find that banks with a high reputational risk for environmental issues are more likely to experience a reduction in their local branch deposits in the counties exposed to severe climate change risks. Further, those banks with high reputational risk reduce mortgage originations in the regions with severe climate risks. Ultimately, the banks with such reputational risk create less liquidity if they have more deposit shares in the regions with severe climate change risks.

From those results, we can conclude that more deposit shares in the regions with severe climate change risks will be a potential threat to the banks' deposit funding, which may ultimately worsen the bank's lending activities and liquidity creation. Thus, we anticipate that the banks with high deposit shares in the regions with severe climate risks will reduce the branch shares in such regions to hedge the risk. To test this prediction, we relate a bank's deposit shares in high climate risk areas to the bank's annual change of branch distribution across counties as follows:

$$\begin{aligned} \mathit{\Delta BranchFrac}_{i,c,y} &= \beta_0 + \beta_1\, \mathit{ClimateRiskExposure}_{i,y-1} + \beta_2\, \mathit{SevereClimateRisk}_c \\ &+ \beta_3\, \mathit{ClimateRiskExposure}_{i,y-1} \times \mathit{SevereClimateRisk}_c + \Gamma X_{i,c,y-1} \\ &+ \delta_{i,c} + \delta_{i,s,y} + \epsilon_{i,c,y} \end{aligned} \quad (4)$$

ΔBranchFrac is the annual change of the fraction of the number of a bank's branches in a county among total number of the bank's whole branches in the United States as of June 30 in the current year. *ClimateRiskExposure* is a share of a bank's deposits in the area exposed to severe climate change risks among the bank's total deposits as of June 30 in the previous year. The interaction of *ClimateRiskExposure* × *SevereClimateRisk* is the main coefficient of our interest in this model. Notably, as additional control variables, we add *EnvRepRisk* and the interaction of *EnvRepRisk* × *SevereClimateRisk* in the model to control for the effect of banks' environmental reputation on their branch shares in the regions exposed to severe climate change. The same set of control variables used in Equation (1) are included in this model. Table 9 provides the results. Regardless of the sample coverage, *ClimateRiskExposure* × *SevereClimateRisk* is negative and statistically significant, indicating that banks with high deposit shares in the counties with high climate risks are more likely to reduce the fraction of branch numbers in such counties.

[Insert Table 9 about here]

Another conclusion from our findings in previous sections is that a bank's reputational risk for environmental issues is a potential threat to a bank's deposit funding, which spills over to its lending activities and liquidity provision. Thus, we can predict that the banks with high deposit shares in the counties with severe climate change risks will manage their reputational risk for environmental issues more strictly than the banks with lower deposit shares in such counties. To test this prediction, we relate a bank's exposure to severe climate risk areas in terms of its deposits and the bank's reputational risk for environmental issues in the subsequent year. The regression model is as follows:

$$EnvRepRiskCurrent_{i,y} = \beta_0 + \beta_1\ ClimateRiskExposure_{i,y-1} + \Gamma X_{i,y-1} + \delta_i + \delta_y + \epsilon_{i,y} \quad (5)$$

EnvRepRiskCurrent is the mean value of the bank's monthly reputational risk indices for environmental issues in the current year. Table 10 presents the regression results. The estimated value for the *ClimateRiskExposure* is negative and statistically significant. This result suggests that banks with high deposit shares in the counties with severe climate risks are more likely to alleviate their reputational risks for environmental issues in the subsequent year.

[Insert Table 10 about here]

5. Conclusion

Our study shows that banks with a poor reputation on environmental issues are more likely to experience declined local deposits in the regions exposed to severe climate change risks. Those banks with a poor reputation on environmental issues reduced their mortgage origination in the regions with severe climate change risks. Further, the banks with high environmental reputational risks tend to diminish their overall liquidity creation if those banks have greater exposure to the regions with severe climate risks in terms of their deposit shares in the regions. Consequently, banks with high deposit shares in the regions exposed to severe climate change risks strengthen their management of local deposit drawdown by relocating their branches out of the regions with severe climate change risks or managing the banks' environmental reputational risk. From those results, we can conclude that a bank's reputational risk for environmental issues is one of the key factors that are highly related to a drawdown of local deposits, which have negative effects on their local credit provision in their area.

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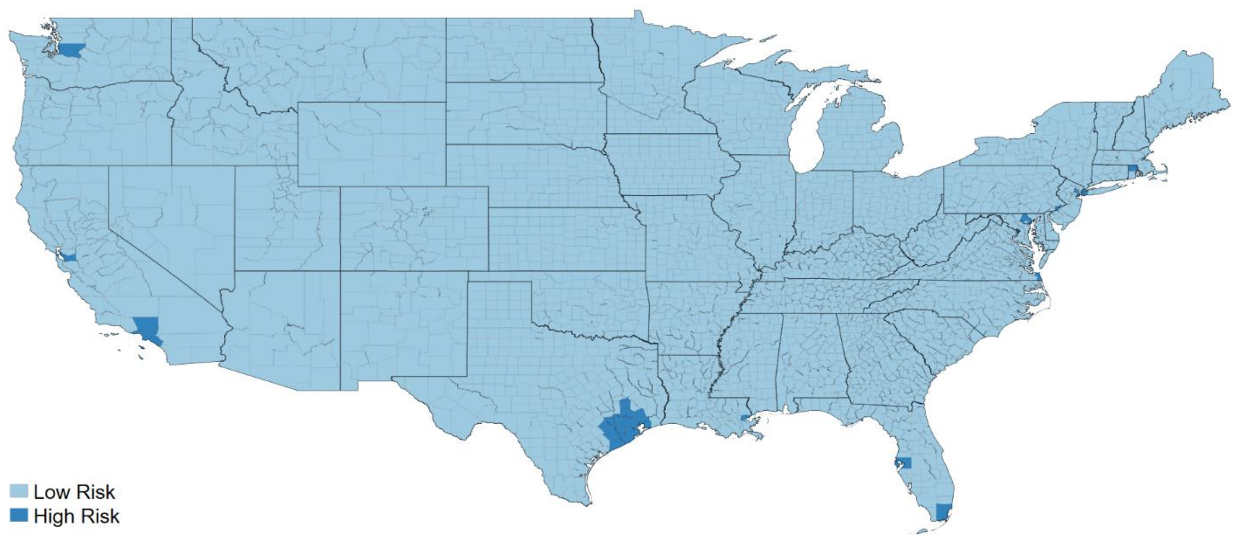
Figure 1: Map of the counties with high climate change risks

This figure maps the US counties exposed to high climate change risks. If a county is overlapped with cities exposed to high climate change risks, then the county is also assumed to be exposed to high climate change risks in this study. A city's exposure to high climate change risks means its expected mean annual loss from a 40-cm rise of sea level, scaled by the city's GDP (Painter, 2020) is higher than 0.01%. In the figure, the dark shaded areas are the counties exposed to high climate change risks and the light shaded areas are the counties not exposed to high climate change risks. In the first figure (1a), we cover entire counties in the United States. In the second figure (1b), we limit samples to counties in states exposed to severe climate risk. In the third figure (1c), we limit samples to counties in MSAs exposed to severe climate risk.

a. All counties in the United States



b. Within states with at least one county with high climate change risk

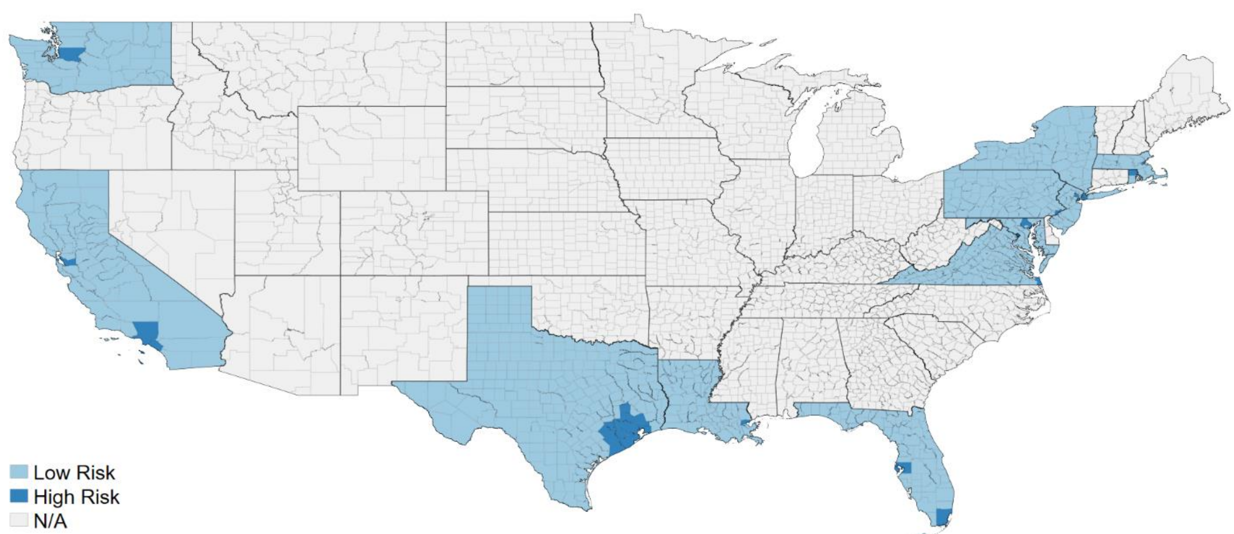


Figure 1: continued

c. Within MSAs with at least one county with high climate change risk

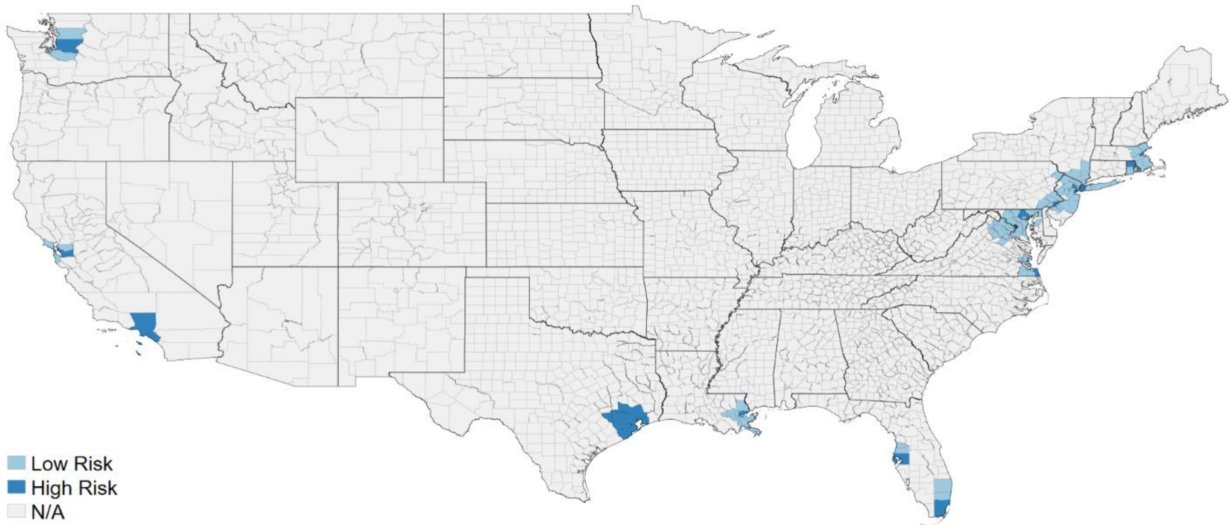


Table 1: List of US counties exposed to high climate change risks

This table presents a list of the US counties exposed to high climate change risks. If a county is overlapped with cities exposed to high climate change risks, then the county is also assumed to be exposed to high climate change risks in this study. A city's exposure to high climate change risks means that climate risk is higher than 0.01%. A city's climate change risk is measured by the expected mean annual loss from a 40-cm rise of sea level, scaled by the city's GDP, following the method of Painter (2020).

City (State)	County	Climate risk
New Orleans (LA)	Orleans Parish	1.479
Miami (FL)	Miami-Dade	0.42
Tampa, St. Petersburg (FL)	Hillsborough, Pinellas	0.324
Virginia Beach (VA)	Virginia Beach	0.173
Boston (MA)	Suffolk	0.149
Baltimore (MD)	Baltimore	0.104
LA, Long Beach, Santa Ana (CA)	Los Angeles, Orange	0.097
New York (NY), Newark (NJ)	Bronx, Kings, New York, Queens, Richmond, Essex	0.089
Providence (RI)	Providence	0.083
Philadelphia (PA)	Philadelphia	0.044
San Francisco, Oakland (CA)	San Francisco, Alameda	0.042
Houston (TX)	Walker, Montgomery, Liberty, Waller, Austin, Harris, Chambers, Colorado, Wharton, Fort Bend, Galveston, Brazoria, Matagorda	0.038
Seattle (WA)	King	0.023
Washington, D.C.	Washington	0.016

Table 2: Summary Statistics

This table presents the summary statistics for the key regression variables. The sample period runs from 2008 to 2015. Appendix A provides a description of each variable.

				Percentile Distribution		
	N	Mean	S.D.	25th	Median	75th
Ln(BranchDeposits)	228998	10.261	2.183	9.966	10.623	11.208
Ln(Mortgage)	32458	9.171	2.084	7.937	9.195	10.474
Ln(Retain)	32458	7.844	2.338	6.692	7.987	9.284
Ln(Sold)	32458	7.912	3.433	7.004	8.627	10.045
LiquidityCreation (total)	2132	0.556	0.466	0.388	0.505	0.630
LiquidityCreation (asset-side)	2132	0.130	0.164	0.031	0.153	0.250
LiquidityCreation (liability-side)	2132	0.198	0.091	0.150	0.204	0.259
LiquidityCreation (OBS-side)	2132	0.228	0.463	0.073	0.117	0.188
ΔbranchFrac	39517	-0.000	0.010	-0.000	-0.000	0.000
EnvRepRisk	228998	4.621	5.846	0.000	2.785	8.258
SevereClimateRisk	228998	0.140	0.347	0.000	0.000	0.000
PostCrisis	228998	0.748	0.434	0.000	1.000	1.000
DisasterNearby	228998	0.273	0.445	0.000	0.000	1.000
NumBank	228965	2.487	1.125	1.000	2.000	3.000
SocCap	228998	2.417	1.107	1.000	2.000	3.000
YoungPop	228965	2.422	1.110	1.000	2.000	3.000
ClimateRiskExposure	39517	0.178	0.170	0.068	0.114	0.267
RepRiskIndex	228998	27.148	19.152	11.143	24.500	44.286
Ln(Assets)	228998	19.659	1.596	18.736	19.703	21.101
CaptialRatio	228998	0.131	0.030	0.119	0.130	0.141
LeverageRatio	228998	0.077	0.017	0.061	0.078	0.085
C&IloanRatio	228998	0.219	0.065	0.181	0.203	0.249
EstateLoanRatio	228998	0.559	0.102	0.480	0.561	0.623
NPLRatio	228998	0.042	0.023	0.023	0.039	0.059
Small	228998	0.004	0.065	0.000	0.000	0.000
Local	228998	0.015	0.121	0.000	0.000	0.000
LoanDeposit	228998	2.866	293.709	0.711	0.849	0.912
DepositLiab	228998	0.804	0.085	0.725	0.826	0.872
CountyMktShare	228998	0.153	0.119	0.063	0.130	0.216
HHI	228998	0.177	0.105	0.116	0.147	0.198
Ln(Population)	228998	13.067	1.452	12.118	13.219	14.009
Ln(Income)	228998	16.809	1.580	15.765	17.005	17.928
UnemploymentRate	228998	7.871	2.592	6.000	7.700	9.600

Table 3: Banks' environmental reputational risks and deposits

This table presents the results for the relationship between a bank's environmental reputational risk and its branch-level deposits in counties with severe climate change risks from 2008 to 2015. *Ln(BranchDeposits)* is the natural log of a bank branch's deposits as of June 30 in the year. *EnvRepRisk* is the mean value of the bank's environmental reputation risk indices during the previous calendar year. *SevereClimateRisk* is a dummy variable that identifies the county exposed to severe climate change risk. In Column 1, we cover entire counties in the United States. In Column 2, we limit samples to counties in states exposed to severe climate risk. In Column 3, we limit samples to counties in MSAs exposed to severe climate risk. This regression includes bank-level *(RepRiskIndex, Ln(Assets), CaptialRatio, LeverageRatio, C&IloanRatio, EstateLoanRatio, NPLRatio, Small, Local, LoanDeposit*, and *DepositLiab*), bank-county level (*CountyMktShare*), and county-level (*HHI, Ln(Population), Ln(Income),* and *UnemploymentRate*) control variables at the previous year-end. For brevity, those control variables are not reported. The estimation results for those control variables are reported in Table B.5 in the Online Appendix. Appendix A provides a description of each variable. Standard errors are clustered at the bank level; *t*-statistics are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

	Ln(BranchDeposits)		
	Full counties	States with climate risk	MSAs with climate risk
	(1)	(2)	(3)
SevereClimateRisk	-0.136**	-0.124*	-0.086
	(-2.32)	(-1.73)	(-1.68)
EnvRepRisk × SevereClimateRisk	-0.004***	-0.004***	-0.006***
	(-3.07)	(-3.21)	(-5.09)
Observations	228998	113573	60313
Adjusted R^2	0.954	0.954	0.932
Branch FE	Yes	Yes	Yes
Bank-State-Year FE	Yes	Yes	Yes

Table 4: Banks' environmental reputational risks and deposits (environmentally sensitive periods)

This table presents the results for the relationship between a bank's environmental reputational risk and its branch-level deposits in counties with severe climate change risks by decomposing samples into the periods with relatively high and low sensitivity to environmental issues. In Column 1, we define the period after the 2007-2009 financial crisis as the period with a relatively high sensitivity to environmental issues. *PostCrisis* is a dummy variable that identifies the post-crisis period (2010 to 2015). In Column 2, we define the year when at least one natural disaster hits the rural areas in the same state as the period with a relatively high sensitivity to environmental issues. *DisasterNearby* is a dummy variable that takes a value of one if there is at least one natural disaster in the same state other than the MSAs during the year and zero otherwise. In both Columns 1 and 2, we limit samples to counties in MSAs exposed to severe climate risk. This regression includes bank-level, bank-county level, and county-level control variables listed in Table 3 at the previous year-end. For brevity, those control variables are not reported. All other regression specifications are the same as in Table 3. Standard errors are clustered at the bank level; *t*-statistics are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

	Ln(BranchDeposits)	
	(1)	(2)
Sensitive periods	Post Financial Crisis	Natural Disasters Nearby
SevereClimateRisk	0.697***	-0.115***
	(2.89)	(-5.50)
EnvRepRisk × SevereClimateRisk	-0.000	-0.001
	(-0.05)	(-0.32)
PostCrisis × SevereClimateRisk	-0.749***	
	(-2.76)	
PostCrisis × EnvRepRisk × SevereClimateRisk	-0.010***	
	(-4.38)	
DisasterNearby × SevereClimateRisk		0.065
		(0.35)
DisasterNearby × EnvRepRisk × SevereClimateRisk		-0.005**
		(-2.22)
Observations	60313	60313
Adjusted R^2	0.962	0.947
Branch-PostCrisis FE	Yes	No
Bank-State-Year-PostCrisis FE	Yes	No
Branch-DisasterNearby FE	No	Yes
Bank-State-Year- DisasterNearby FE	No	Yes

Table 5: Banks' environmental reputational risks and deposits (environmentally sensitive areas)

This table presents the results for the relationship between a bank's environmental reputational risk and its branch-level deposits in counties with severe climate change risks, by decomposing samples into the areas with a relatively high and low sensitivity to environmental issues. In Column 1, we define the counties with more numbers of bank brands as the area with a relatively high sensitivity to environmental issues. *NumBank* is a quartile variable for the number of banks in a county scaled by the county's population. In Column 2, we define the states with higher social capitals as the area with a relatively high sensitivity to environmental issues. *SocCap* is a quartile variable for the state-level social capital. In Column 3, we define the states with higher fractions of young populations as the area with a relatively high sensitivity to environmental issues. *YoungPop* is a quartile variable for the state-level fraction of young population (age > 40) among total population in the state. In all three columns, we limit samples to counties in MSAs exposed to severe climate risk. This regression includes bank-level, bank-county level, and county-level control variables listed in Table 3 at the previous year-end. For brevity, those control variables are not reported. All other regression specifications are the same as in Table 3. Standard errors are clustered at the bank level; *t*-statistics are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

	Ln(BranchDeposits)		
	(1)	(2)	(3)
Sensitive areas	More banks	High social capital	High young population
SevereClimateRisk	-0.030	-0.060	-0.022
	(-0.78)	(-0.94)	(-0.22)
EnvRepRisk × SevereClimateRisk	0.001	-0.001	-0.003*
	(0.28)	(-0.71)	(-1.91)
NumBank	-0.007		
	(-0.45)		
NumBank × EnvRepRisk	-0.000		
	(-0.05)		
NumBank × SevereClimateRisk	-0.019		
	(-0.77)		
NumBank × EnvRepRisk × SevereClimateRisk	-0.004***		
	(-3.36)		
SocCap × SevereClimateRisk		-0.006	
		(-0.25)	
SocCap × EnvRepRisk × SevereClimateRisk		-0.002**	
		(-2.28)	
YoungPoP × SevereClimateRisk			-0.036
			(-1.10)
YoungPoP × EnvRepRisk × SevereClimateRisk			-0.002**
			(-2.07)
Observations	60313	60313	60313
Adjusted R^2	0.932	0.932	0.932
Branch FE	Yes	Yes	Yes
Bank-State-Year FE	Yes	Yes	Yes

Table 6: Banks' environmental reputational risks and mortgages

This table presents the results for the relationship between a bank's environmental reputational risk and its county-aggregate mortgage origination in counties with severe climate change risks from 2008 to 2015. *Ln(Mortgage)* is the natural log of a bank's aggregated mortgage origination in the county during the year. In Column 1, we cover entire counties in the United States. In Column 2, we limit samples to counties in states exposed to severe climate risk. In Column 3, we limit samples to counties in MSAs exposed to severe climate risk. This regression includes bank-level, bank-county level, and county-level control variables listed in Table 3 at the previous year-end. For brevity, those control variables are not reported. All other regression specifications are the same as in Table 3. Standard errors are clustered at the bank level; *t*-statistics are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

	Ln(Mortgage)		
	Full counties	States with climate risk	MSAs with climate risk
	(1)	(2)	(3)
EnvRepRisk × SevereClimateRisk	-0.016***	-0.016***	-0.012**
	(-4.52)	(-4.08)	(-2.48)
Observations	32458	9752	2676
Adjusted R^2	0.939	0.942	0.944
Bank-County FE	Yes	Yes	Yes
Bank-State-Year FE	Yes	Yes	Yes

Table 7: Banks' environmental reputational risks and mortgages (retained vs. sold)

This table presents the results for the relationship between a bank's environmental reputational risk and its county-aggregate mortgage origination in counties with severe climate change risks from 2008 to 2015 by decomposing mortgages into retained and sold mortgages. In Panel A, *Ln(Retain)* is the natural log of a bank's aggregated origination of retained mortgages in the county during the year. In Panel B, *Ln(Sold)* is the natural log of a bank's aggregated origination of sold mortgages in the county during the year. In Column 1, we cover entire counties in the United States. In Column 2, we limit samples to counties in states exposed to severe climate risk. In Column 3, we limit samples to counties in MSAs exposed to severe climate risk. This regression includes bank-level, bank-county level, and county-level control variables listed in Table 3 at the previous year-end. For brevity, those control variables are not reported. All other regression specifications are the same as in Table 6. Standard errors are clustered at the bank level; *t*-statistics are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Panel A	Ln(Retain)		
	Full counties	States with climate risk	MSAs with climate risk
	(1)	(2)	(3)
EnvRepRisk × SevereClimateRisk	-0.038***	-0.035***	-0.015**
	(-10.07)	(-11.01)	(-2.38)
Observations	32458	9752	2676
Adjusted R^2	0.833	0.857	0.890
Bank-County FE	Yes	Yes	Yes
Bank-State-Year FE	Yes	Yes	Yes

Panel B	Ln(Sold)		
	Full counties	States with climate risk	MSAs with climate risk
	(1)	(2)	(3)
EnvRepRisk × SevereClimateRisk	-0.000	-0.001	-0.005
	(-0.02)	(-0.17)	(-0.45)
Observations	32458	9752	2676
Adjusted R^2	0.963	0.961	0.973
Bank-County FE	Yes	Yes	Yes
Bank-State-Year FE	Yes	Yes	Yes

Table 8: Banks' environmental reputational risks and liquidity creation

This table presents the results for the relationship between a bank's environmental reputational risk and its liquidity creation from 2008 to 2015 depending on the bank's relative exposure to severe climate risks. *LiquidityCreation* is Berger and Bouwman's (2009) liquidity creation measure for each bank at each quarter-end (total, asset-side, liability-side, or off-balance sheet side from Columns 1 to 4, respectively). *EnvRepRiskQ* is the mean value of a bank's environmental reputation risk indices during the previous quarter. *ClimateRiskExposureQ* is a share of a bank's deposits in the area exposed to severe climate change risks among the bank's total deposits as of June 30 prior to the current quarter-end. This regression includes bank-level control variables *(RepRiskIndex, Ln(Assets), CaptialRatio, LeverageRatio, C&IloanRatio, EstateLoanRatio, NPLRatio, Small, Local, LoanDeposit*, and *DepositLiab)* at the previous quarter-end. For brevity, those control variables are not reported. Standard errors are clustered at the bank level; *t*-statistics are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

	LiquidityCreation			
	Total	Asset-side	Liability-side	OBS-side
EnvRepRiskQ	0.049***	0.003**	0.000	0.046***
	(3.29)	(2.11)	(0.50)	(3.07)
ClimateRiskExposureQ	0.358***	0.052	0.112***	0.193
	(2.69)	(1.60)	(3.88)	(1.58)
EnvRepRiskQ × ClimateRiskExposureQ	-0.069***	-0.007***	0.000	-0.062***
	(-3.08)	(-3.13)	(0.18)	(-2.82)
Observations	2132	2132	2132	2132
Adjusted R^2	0.909	0.928	0.851	0.924
Bank FE	Yes	Yes	Yes	Yes
Quarter FE	Yes	Yes	Yes	Yes

Table 9: Banks' exposure to climate risks and branch distribution changes

This table presents the results for the relationship between a bank's relative exposure to severe climate risks and the annual change of the bank's fraction of the number of branches in counties with severe climate change risks from 2008 to 2015. *ΔBranchFrac* is an annual change in the fraction of the number of branches in the county among the total number of bank branches as of June 30 of that year. *ClimateRiskExposure* is a share of a bank's deposits in the area exposed to severe climate change risks among the bank's total deposits of June 30 in the previous year. In Column 1, we cover entire counties in the United States. In Column 2, we limit samples to counties in states exposed to severe climate risk. In Column 3, we limit samples to counties in MSAs exposed to severe climate risk. This regression includes bank-level, bank-county level, and county-level control variables listed in Table 3 at the previous year-end. For brevity, those control variables are not reported. Standard errors are clustered at the bank-county level; *t*-statistics are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

	ΔBranchFrac		
	Full counties	States with climate risk	MSAs with climate risk
	(1)	(2)	(3)
ClimateRiskExposure × SevereClimateRisk	-0.105**	-0.104**	-0.139**
	(-2.10)	(-2.32)	(-2.62)
Observations	35215	15826	3385
Adjusted R^2	0.699	0.857	0.340
Bank-County FE	Yes	Yes	Yes
Bank-State-Year FE	Yes	Yes	Yes

Table 10: Banks' exposure to climate risks and environmental reputational risks

This table presents the results for the relationship between a bank's relative exposure to severe climate risks and the bank's environmental reputation risk from 2008 to 2015. *EnvRepRisCurrent* is the mean value of a bank's environmental reputation risk indices during the current year. *ClimateRiskExposure* is a share of a bank's deposits in the area exposed to severe climate change risks among the bank's total deposits as of June 30 in the previous year. This regression includes bank-level control variables listed in Table 8 at the previous year-end, except *RepRiskIndex*, which is replaced with *RepRiskIndexCurrent*. For brevity, those control variables are not reported. Appendix A provides a description of each variable. Standard errors are clustered at the bank level; *t*-statistics are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

	EnvRepRiskCurrent
ClimateRiskExposure	-2.593**
	(-2.07)
Observations	615
Adjusted R^2	0.731
Bank FE	Yes
Year FE	Yes

Appendix A. Definition of Variables

Variable	Definition	Level
Ln(BranchDeposits)	Logarithm of a bank branch's deposits as of June 30 in the year.	Year-Branch
Ln(Mortgage)	Logarithm of a bank's aggregated amount (thousands USD) of mortgage origination in the county during the year.	Year-Bank-County
Ln(Retain)	Logarithm of a bank's aggregated mortgage origination for retained mortgage in the county during the year.	Year-Bank-County
Ln(Sold)	Logarithm of a bank's aggregated mortgage origination for sold mortgage in the county during the year.	Year-Bank-County
LiquidityCreation	Berger and Bouwman's (2009) preferred liquidity creation measure relative to total assets. This "cat fat" measure classifies loans by category regardless of their maturity, whereas all other activities are classified based on both their category and their maturity. This measure includes off-balance-sheet activities.	Quarter-Bank
EnvRepRiskCurrent	Mean value of a bank's monthly Environmental *RepRiskIndex* during the current year. Environmental *RepRiskIndex* is calculated by the bank's percentage of environmental links in proportion to the total number of links in the news (risk incidents) that comprises the *RepRiskIndex* during the current year multiplied by *RepRiskIndex* in the year.	Year-Bank
ΔBranchFrac	Annual change in the fraction of the number of branches in the county among total number of bank branches as of June 30 in the year.	Year-Bank-County
EnvRepRisk	Mean values of a bank's monthly Environmental *RepRiskIndex* during the previous year. Environmental *RepRiskIndex* is calculated by the bank's percentage of environmental links in proportion to the total number of links in the news (risk incidents) comprising *RepRiskIndex* during the previous year multiplied by *RepRiskIndex* in the previous year.	Year-Bank
SevereClimateRisk	Dummy variable that identifies the county exposed to high climate change risks. If a county is overlapped with cities exposed to high climate change risks, then the county is assumed to be exposed to high climate change risks as well in this study. A city's exposure to high climate change risks means the situation where the city's expected mean annual loss from a 40-cm rise of sea level, scaled by the city's GDP (Painter, 2020), is higher than 0.01%.	County
PostCrisis	Dummy that identifies the post-crisis period (2010 to 2015).	Year
DisasterNearby	Dummy that takes a value of one if there is at least one natural disaster in the same state other than the MSAs during the year and zero otherwise.	Year-State
NumBank	Quartile variable for the number of banks in a county scaled by the county's population.	Year-County
SocCap	Quartile variable for the state-level social capital.	Year-State
YoungPop	Quartile variable for the state-level fraction of young population among total population in the state.	Year-State
ClimateRiskExposure	A share of a bank's deposits in the area exposed to severe climate change risks among its total deposits as of June 30 in the previous year.	Year-Bank
RepRiskIndex	Mean value of a bank's monthly *RepRiskIndex.* The index is	Year-Bank

Variable	Definition	Level
	constructed based on the bank's media and stakeholder coverage related to ESG issues. The *RepRiskIndex* ranges from zero (lowest) to 100 (highest). The higher the value, the higher the risk exposure.	
Ln(Assets)	Logarithm of a bank's total assets (thousands USD).	Year-Bank
CapitalRatio	Ratio of a bank's regulatory capital (the sum of Tier 1 and Tier 2 capital) over its total risk-weighted assets.	Year-Bank
LeverageRatio	Ratio of a bank's Tier 1 capital over its total assets.	Year-Bank
C&ILoanRatio	Ratio of a bank's commercial and industrial loans over its total loans.	Year-Bank
EstateLoanRatio	Ratio of a bank's real estate loans over its total loans.	Year-Bank
NPLRatio	Ratio of a bank's non-performing loans over its total loans.	Year-Bank
Small	Dummy that identifies small banks (total assets < 2 billion USD).	Year-Bank
Local	Dummy that identifies local banks. A local bank is one that collects more than 65% of its deposits from a single county (Cortés, 2014).	Year-Bank
LoanDeposit	Ratio of a bank's total loans over total deposits.	Year-Bank
DepositLiab	Ratio of a bank's total deposits over total liabilities.	Year-Bank
CountyMktShare	A bank's deposit market share in a county.	Year-Bank-County
HHI	Herfindahl-Hirschman Index for a county-level deposit market.	Year-County
Ln(Population)	Logarithm of a county's aggregated population.	Year-County
Ln(Income)	Logarithm of a county's aggregated personal income.	Year-County
UnemploymentRate	A county's unemployment rate.	Year-County

Online Appendix for

"Environmental Reputation and Bank Liquidity under Climate Change Risk"

Table B.1: Banks' environmental reputational risks and their loan origination to the firms with severe environmental reputational events

This table presents how a bank's environmental reputational risk is related to the bank's loan origination to a firm with a severe environmental reputational event in the same year from 2008 to 2015. *EnvRepRisCurrent* is the mean value of a bank's environmental reputation risk indices during the current year. *LendingHighEnvRiskFirm* is a dummy variable that takes a value of one if the bank originates at least one loan to the firm with a severe environmental reputational event in the current year and zero otherwise. In Column 1, the sample includes all banks covered by *RepRisk*. In Column 2, we limit samples to the banks that originate at least one loan, covered by the *Dealscan* in the current year. This regression includes bank-level control variables listed in Table 10 at the previous year-end. For brevity, those control variables are not reported. The Appendix provides a description of each variable. Standard errors are clustered at the bank level; *t*-statistics are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

	EnvRepRiskCurrent	
	(1)	(2)
LendingHighEnvRiskFirm	4.408***	3.885***
	(3.26)	(3.65)
Observations	615	134
Adjusted R^2	0.750	0.714
Bank FE	Yes	Yes
Year FE	Yes	Yes

Table B.2: Banks' environmental reputational risks and deposits

This table presents the results for the relationship between a bank's loan origination to a firm with a severe environmental reputational event and its branch-level deposits in counties with severe climate change risks from 2008 to 2015. *LendingHighEnvRiskFirm* is a dummy variable that takes a value of one if the bank originates at least one loan to the firm with a severe environmental reputational event in the previous year and zero otherwise. All other regression specifications are the same as in Table 3. Standard errors are clustered at the bank level; *t*-statistics are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

	Ln(BranchDeposits)		
	Full counties	States with climate risk	MSAs with climate risk
	(1)	(2)	(3)
SevereClimateRisk	-0.135**	-0.120	-0.103
	(-2.01)	(-1.32)	(-1.56)
LendingHighEnvRiskFirm × SevereClimateRisk	-0.034***	-0.033***	-0.069***
	(-7.18)	(-6.97)	(-6.58)
Observations	255586	125369	66459
Adjusted R^2	0.949	0.950	0.929
Branch FE	Yes	Yes	Yes
Bank-State-Year FE	Yes	Yes	Yes

Table B.3: Banks' environmental reputational risks and deposits (Expand the coverage of the regions with severe climate change risks)

This table presents the results for the relationship between a bank's environmental reputational risk and its branch-level deposits in counties with severe climate change risks from 2008 to 2015. In this table, we define all cities (and their corresponding counties) with non-zero expected mean annual losses from a 40-cm rise in the sea level, scaled by their annual GDPs, as the regions with severe climate change risks. All other regression specifications are the same as in Table 3. Standard errors are clustered at the bank level; *t*-statistics are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

	Ln(BranchDeposits)		
	Full counties	States with climate risk	MSAs with climate risk
	(1)	(2)	(3)
SevereClimateRisk	0.062	0.081	-0.048*
	(0.57)	(0.80)	(-1.97)
EnvRepRisk × SevereClimateRisk	-0.003***	-0.003***	-0.006***
	(-2.96)	(-3.01)	(-6.63)
Observations	228998	118164	67039
Adjusted R^2	0.954	0.952	0.930
Branch FE	Yes	Yes	Yes
Bank-State-Year FE	Yes	Yes	Yes

Table B.4: Banks' environmental reputational risks and deposits (Limit sample to counties with moderate climate risk)

This table presents the results for the relationship between a bank's environmental reputational risk and its branch-level deposits in counties with severe climate change risks from 2008 to 2015. In this table, we limit samples to counties with moderate climate risk by dropping Orleans, Miami-Dade, Hillsborough, and Pinellas from samples, which are the top 10 percent counties in terms of the climate risk index (the expected mean annual loss from a 40-cm rise of sea level is above 0.3 % of the city's GDP). All other regression specifications are the same as in Table 3. Standard errors are clustered at the bank level; *t*-statistics are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

	Ln(BranchDeposits)		
	Full counties	States with climate risk	MSAs with climate risk
	(1)	(2)	(3)
SevereClimateRisk	-0.134**	-0.123	-0.078
	(-2.28)	(-1.56)	(-1.30)
EnvRepRisk × SevereClimateRisk	-0.003***	-0.003***	-0.006***
	(-2.64)	(-2.70)	(-3.55)
Observations	224274	91481	50930
Adjusted R^2	0.955	0.955	0.932
Branch FE	Yes	Yes	Yes
Bank-State-Year FE	Yes	Yes	Yes

Table B.5: Banks' environmental reputational risks and deposits
(Report all control variables)

This table presents the results for the relationship between a bank's environmental reputational risk and its branch-level deposits in counties with severe climate change risks from 2008 to 2015. In this table, we report the estimation results for all control variables. All other bank-level control variables are absorbed by Bank-State-Year fixed effect. All regression specifications are same as in Table 3. Standard errors are clustered at the bank level; *t*-statistics are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

	Ln(BranchDeposits)		
	Full counties	States with climate risk	MSAs with climate risk
	(1)	(2)	(3)
SevereClimateRisk	-0.136**	-0.124*	-0.086
	(-2.32)	(-1.73)	(-1.68)
EnvRepRisk × SevereClimateRisk	-0.004***	-0.004***	-0.006***
	(-3.07)	(-3.21)	(-5.09)
CountyMktShare	0.608***	0.528***	0.630***
	(4.74)	(3.84)	(4.35)
HHI	-0.019	-0.043	0.092
	(-0.19)	(-0.28)	(0.58)
Ln(Population)	0.461***	0.320**	0.221
	(4.86)	(2.30)	(1.25)
Ln(Income)	-0.341***	-0.223*	-0.174
	(-4.82)	(-1.92)	(-1.26)
UnemploymentRate	-0.015***	-0.019***	-0.015
	(-3.99)	(-3.24)	(-1.30)
Observations	228998	113573	60313
Adjusted R^2	0.954	0.954	0.932
Branch FE	Yes	Yes	Yes
Bank-State-Year FE	Yes	Yes	Yes

Table B.6: Banks' environmental reputational risks and deposits
(Limit sample to branches with no location change across counties)

This table presents the results for the relationship between a bank's environmental reputational risk and its branch-level deposits in counties with severe climate change risks from 2008 to 2015. In this table, we limit samples to bank branches, which does not change their location across counties during the sample period. All other regression specifications are the same as in Table 3. Standard errors are clustered at the bank level; *t*-statistics are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

	Ln(BranchDeposits)		
	Full counties	States with climate risk	MSAs with climate risk
	(1)	(2)	(3)
EnvRepRisk × SevereClimateRisk	-0.003^{*}	-0.003^{*}	-0.005^{***}
	(-1.74)	(-1.84)	(-3.18)
Observations	227390	112677	59869
Adjusted R^2	0.954	0.954	0.932
Branch FE	Yes	Yes	Yes
Bank-State-Year FE	Yes	Yes	Yes

Table B.7: Banks' environmental reputational risks and deposits (Add lagged variables for banks' environmental reputation indices)

This table presents the results for the relationship between a bank's environmental reputational risk and its branch-level deposits in counties with severe climate change risks from 2008 to 2015. In this table, we include lagged variables for a bank's environmental reputation indices as of two- or three-years prior to the current year, which are *EnvRepRisk (t-2)* and *EnvRepRisk (t-3)*, respectively, and their interaction terms with *SevereClimateRisk* in the regression in addition to existing *EnvRepRisk* and the interaction of *EnvRepRisk* × *SevereClimateRisk*. All other regression specifications are the same as in Table 3. Standard errors are clustered at the bank level; *t*-statistics are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

	Ln(BranchDeposits)		
	Full counties	States with climate risk	MSAs with climate risk
	(1)	(2)	(3)
SevereClimateRisk	-0.092**	-0.091*	-0.071
	(-2.15)	(-1.92)	(-1.14)
EnvRepRisk × SevereClimateRisk	-0.003*	-0.003**	-0.005**
	(-1.69)	(-2.07)	(-2.69)
EnvRepRisk (t-2) × SevereClimateRisk	-0.001	-0.001	-0.002
	(-0.82)	(-0.78)	(-1.08)
EnvRepRisk (t-3) × SevereClimateRisk	-0.001	-0.001	-0.001
	(-1.42)	(-1.39)	(-0.86)
Observations	156827	77459	41299
Adjusted R^2	0.975	0.980	0.972
Branch FE	Yes	Yes	Yes
Bank-State-Year FE	Yes	Yes	Yes

Table B.8: Banks' environmental reputational risks and deposits (Use nearest neighbor matching)

This table presents the results for the relationship between a bank's environmental reputational risk and its branch-level deposits in counties with severe climate change risks from 2008 to 2015. In this table, we match counties with high climate change risk with counties with low climate change risk within the same state and the same year in terms of lagged income and population using nearest neighbor matching. In Column 4, we replace Bank-State-Year fixed effect with Bank-MSA-Year fixed effect for the sample used in Column 3. All other regression specifications are the same as in Table 3. Standard errors are clustered at the bank level; *t*-statistics are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

	Ln(BranchDeposits)			
	Full counties	States with climate risk	MSAs with climate risk	MSAs with climate risk
	(1)	(2)	(3)	(4)
SevereClimateRisk	0.004	0.004	0.010**	0.008*
	(1.41)	(1.41)	(2.26)	(1.91)
EnvRepRisk × SevereClimateRisk	-0.001**	-0.001**	-0.002***	-0.001***
	(-2.11)	(-2.11)	(-3.61)	(-2.79)
Observations	76215	76215	47009	47009
Adjusted R^2	0.955	0.955	0.939	0.939
Branch FE	Yes	Yes	Yes	Yes
Bank-State-Year FE	Yes	Yes	Yes	No
Bank-MSA-Year FE	No	No	No	Yes

Table B.9: Banks' environmental reputational risks and deposit interest rates

This table presents the results for the relationship between a bank's environmental reputational risk and its branch-level deposit interest rates in counties with severe climate change risks from 2008 to 2015. *DepositRate* is an annual average interest rate of each type of deposit for each bank branch. In Panels A to C, we use deposit interest rates for the certificate of deposit (CD, with an account size of $10,000) with maturities of 6, 12, and 24 months, respectively. In Panel D, we use deposit interest rates for the money market account (MM) with an account size of $10,000. In Column 1, we cover entire counties in the US. In Column 2, we limit samples to counties in states exposed to severe climate risk. In Column 3, we limit samples to counties in MSAs exposed to severe climate risk. This regression includes bank-level, bank-county level, and county-level control variables listed in Table 3 at the previous year-end. For brevity, those control variables are not reported. All other regression specifications are the same as in Table 3. Standard errors are clustered at the bank level; *t*-statistics are in parentheses. Statistical significance at the 10%, 5%, and 1% levels is denoted by *, **, and ***, respectively.

Panel A: 6-months CD ($10,000)	DepositRate		
	Full counties	States with climate risk	MSAs with climate risk
	(1)	(2)	(3)
EnvRepRisk × SevereClimateRisk	0.005	0.006	0.000*
	(1.11)	(1.43)	(1.77)
Observations	5684	1574	606
Adjusted R^2	0.990	0.990	1.023
Branch FE	Yes	Yes	Yes
Year-State-Bank FE	Yes	Yes	Yes

Panel B: 12-months CD ($10,000)	DepositRate		
	Full counties	States with climate risk	MSAs with climate risk
	(1)	(2)	(3)
EnvRepRisk × SevereClimateRisk	0.005	0.007	0.000
	(1.11)	(1.59)	(0.55)
Observations	5685	1575	606
Adjusted R^2	0.991	0.991	1.017
Branch FE	Yes	Yes	Yes
Year-State-Bank FE	Yes	Yes	Yes

Panel C: 24-months CD ($10,000)	DepositRate		
	Full counties	States with climate risk	MSAs with climate risk
	(1)	(2)	(3)
EnvRepRisk × SevereClimateRisk	0.005	0.006	0.000
	(1.03)	(1.29)	(0.69)
Observations	5673	1563	597
Adjusted R^2	0.991	0.993	1.023
Branch FE	Yes	Yes	Yes
Year-State-Bank FE	Yes	Yes	Yes

Panel D: MM ($10,000)	DepositRate		
	Full counties	States with climate risk	MSAs with climate risk
	(1)	(2)	(3)
EnvRepRisk × SevereClimateRisk	-0.003	-0.004	0.000
	(-1.22)	(-1.56)	(0.05)
Observations	5508	1527	578
Adjusted R^2	0.965	0.977	1.032
Branch FE	Yes	Yes	Yes
Year-State-Bank FE	Yes	Yes	Yes