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# The interaction of climate risk and bank liquidity: An emerging market perspective for transitions to low carbon energy

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ABSTRACT

Climate change leads to many financial risks, including exerting pressure on banking liquidity. The issue is plausibly more severe for emerging markets that suffer from financial frictions. Therefore, an assessment of the liquidity profile of banks in emerging markets is necessary to understand the devastating impact of climate risk to devise optimal financial strategies to support low-carbon transitions. Using a comprehensive sample of banks from twenty-three emerging markets and assessing data for over a decade, we report that climate risk is negatively associated with liquidity. This means that banks that are domiciled in countries with a higher level of climate risk are likely to experience more liquidity pressures. The finding remained robust for various definitions of liquidity and after controlling for a series of exogenous variables. We argue that such pressures emanate from both physical and transitional risks and therefore it is in the interest of financial intermediaries to devise sustainable financial strategies to support sustainable development goals and limit ecological degradation.

## 1. Introduction

Climate change and resulting ecological degradation are the pressing issues of recent times that warrant immediate action. The Paris agreement of 2015 and COP26 are notable global initiatives aimed at reducing greenhouse emissions, financing low-carbon transitions, and regulating carbon markets. Consequently, the focus was to facilitate circular economies and sustainable business models through conducive financing and investments (Guo et al., 2022; Liang et al., 2022; Shan et al., 2022). A key consideration of COP26 is to support emerging markets and help them in the proactive management of carbon emissions (Su et al., 2022b).

In emerging markets, financial intermediaries notably the banking sector play a critical role in channeling the funds between deficit and surplus units (Ji et al., 2021b; Umar et al., 2021c). Multiple studies like (Umar et al., 2021a), (Rizvi et al., 2021), and (Ji et al., 2021a) have documented that there are inherent benefits for stakeholders engaging in green financial practices. These pieces of evidence suggest that curtailing climate risk through sustainable investment styles incentivizes financial intermediaries (Gozgor, 2018; Lu et al., 2020; Shang et al., 2022). While a plethora of studies evaluates the performance benefits for financial institutions, very few have assessed if climate degradation has any impact on the risk and more specifically the liquidity profile.

There are many reasons why climate risk may impair the liquidity of the financial sector. If the physical risk is triggered (for example wildfire, floods, etc) it may spark the withdrawal of deposits resulting in more than anticipated outflows. Such risks may also crystalize the off-balance sheet commitments requiring immediate financing. In case of transition risks, the prudential regulations may get stringent limiting the available market-based funding or external recourse (for example if credit exposure is skewed towards high-emission firms). As climate change is non-linear, a sudden degradation may exert more regulatory pressures resulting in a hard landing for the banking sector.

Climate risk can also impact bank liquidity through the direct effects on their loan portfolios. Banks that have invested in sectors that are vulnerable to the impacts of climate change, such as agriculture, tourism, and energy, can face increased defaults and losses due to climate-related events like droughts, hurricanes, and sea level rise. This

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reduction in assets can result in a decrease in the bank's liquidity, making it more difficult for the bank to meet its short-term obligations (Su et al., 2022a). Similarly, there can be a broader economic impact. Climate-related events can result in supply chain disruptions, increased costs for businesses, and decreased consumer spending, all of which can lead to a decrease in economic activity and lower profits for businesses (Yu et al., 2022). As a result, the bank's loan portfolio may become less valuable, leading to a decrease in its liquidity (Mirza et al., 2023).

As mentioned before, the increasing regulatory focus on climate risk is also having an impact on bank liquidity. Regulators are becoming more stringent in their requirements for banks to assess and disclose their exposure to climate risk, and to implement strategies to manage this risk (Umar et al., 2022). This increased regulatory scrutiny can lead to increased costs for banks, including the cost of obtaining necessary information and implementing risk management strategies, which can further impact their liquidity (Li et al., 2020). Therefore, it is clear that climate risk is having a significant impact on bank liquidity, and that banks must take this issue seriously. This means taking steps to understand and manage their exposure to climate risk, and to implement strategies that will help to mitigate the impacts of this risk on their liquidity. By taking these steps, banks can ensure that they remain resilient in the face of the increasing challenges posed by climate change.

The role of banking in addressing climate risk is crucial in emerging markets. These markets are often more susceptible to the impacts of climate change due to factors such as poverty, limited infrastructure, and weak governance. The effects of a major climate-related crisis on financial stability in these regions could result in reduced access to credit and increased loan defaults, leading to a liquidity crisis for banks operating there. This could have serious consequences for the broader economy. Additionally, emerging markets have a critical role to play in global efforts to address climate change as many of these countries are significant emitters of greenhouse gases and also face significant climate impacts. Banks in these markets can finance the transition to low-carbon and climate-resilient development, reducing the vulnerability of these countries to the impacts of climate change. By taking a proactive approach to managing climate risk, banks in emerging markets can help ensure the long-term financial stability and sustainability of these regions and support global efforts to mitigate and adapt to the effects of climate change.

Based on this discussion, a valid research gap is to evaluate the impact of climate change on the liquidity profile of the banking sector in emerging markets. This paper assesses this impact on liquidity creation by employing various definitions of liquidity. Overall, our results show that climate risk is negatively associated with the liquidity profile and this key finding remained robust even after sorting the sample based on bank size or geographic location. The channel for this relationship is plausible. For example, if a borrower is heavily invested in industries that are vulnerable to the effects of climate change, such as fossil fuels or real estate in flood-prone areas, then a shift in regulations or consumer sentiment away from these industries. This could lead to a decrease in their value, potentially impacting the bank's liquidity. Additionally, the cost of addressing climate change, such as building sea walls or transitioning to renewable energy, could increase the expenses for borrowers, leading to a higher likelihood of default and decreased liquidity for the bank. The findings have important implications for the role of financial intermediaries to support structural changes and transitions to low-carbon energy consumption.

The rest of the paper is organized as follows. Section 2 outlines our empirical strategy and data. Section 3 presents the findings of this research and Section 4 concludes.

## 2. Empirical strategy and data

As mentioned earlier, liquidity plays a critical role in the financial resilience of financial institutions, notably banks (Hasnaoui and Hasnaoui, 2022). The importance of liquidity increases manifold during periods of turbulence and geopolitical crisis (Yarovaya and Mirza, 2022). Therefore, it is critical to evaluate how bank liquidity evolves in the context of climate risk. To assess this, we adopt the following empirical strategy.

We constitute our sample from emerging markets using the classification of MSCI.[1] The classification includes twenty-three countries from the Americas, Europe, the Middle East, Africa, and Asia. Further, we consider all locally incorporated banks in these locations that have disseminated liquidity and other fundamental data from January 2011 to June 2022. The choice of sample period is motivated by the arguments of (Alam et al., 2021), (Naqvi et al., 2021), and (Chen et al., 2022) to ensure that there are no spillovers from the global financial crisis. Table 1 presents our sample distribution across countries.

There are three constructs for liquidity that are employed in this paper. These include Loan to Deposits (Afzal and Firdousi, 2022; Fallanca et al., 2020; Mili et al., 2019), liquidity coverage ratio (Gómez-Ortega et al., 2022; Nguyen and Nguyen, 2022), and market funds to tangible banking assets (Abdelsalam et al., 2022; Chipalkatti et al., 2020; Khemakhem and Boujelbene, 2018). These variables of liquidity help us extend the study of (Lee et al., 2022) to present a more holistic view of bank liquidity. The loan to deposits (LTD) compares the funding pledged in long-term avenues. Given that the loan commitments are long-term while the average maturity of deposits is shorter, the ratio is meant to capture the liquidity (or illiquidity) available.

The liquidity coverage ratio (LCR) is a supervisory instrument introduced by Basel III, and it reflects the availability of highly liquid assets with a bank. It is considered superior to other ratios because the estimation is forward-looking and sometimes considered a generic stress test. The LCR is estimated as follows

$$LCR_{it} = \frac{LA_{it}}{NCOF_{it}}, \tag{1}$$

where LA is high-quality liquid assets that can be easily converted into

**Table 1**
Sample description.

| | Countries | No of Banks | CRI Score 2021 |
|---|---|---|---|
| Americas | Brazil | 12 | 33.67 |
| | Chile | 9 | 33 |
| | Colombia | 8 | 36.33 |
| | Mexico | 9 | 59.5 |
| | Peru | 5 | 56.33 |
| Europe, Middle East, and Africa | Czech Republic | 13 | 92.83 |
| | Egypt | 7 | 102 |
| | Greece | 14 | 45 |
| | Hungary | 9 | 85.83 |
| | Kuwait | 6 | 118 |
| | Poland | 11 | 80 |
| | Qatar | 9 | 118 |
| | Saudi Arabia | 12 | 73 |
| | South Africa | 15 | 32.5 |
| | Turkey | 8 | 66 |
| | UAE | 9 | 118 |
| Asia | China | 35 | 42.83 |
| | India | 20 | 16.67 |
| | Indonesia | 12 | 24.83 |
| | Korea | 10 | 64 |
| | Malaysia | 9 | 87.33 |
| | Philippines | 6 | 26.67 |
| | Thailand | 5 | 43.17 |
| | Total | 253 | |

[1] The classification is available at https://www.msci.com/our-solutions/indexes/market-classification

cash via market sales or using collateralization (for example through *repos*) without incurring a significant loss of value. The NCO refers to the anticipated net cash outflow over a thirty-day horizon. It includes both on and off-balance sheet commitments. Finally, the ratio of market funds to tangible banking assets (MFTA) helps in measuring the liability side volatility and associated liquidity risk. The estimate has predictive precision during periods of credit bouts, especially for institutions with reliance on market funding to support liquidity needs.

To capture the relationship between climate change and bank liquidity, our independent variable is the climate risk index (CRI) of ResourceWatch. The index is aimed at identifying the adverse impact climate change had on different countries. These include meteorological events like storms, hydrological outbursts like floods, or climatological happenings like wildfires. A lower score on the index is an indication of high climate risk and vice versa.[2] We hypothesize that an increase in climate risk will relapse the liquidity creation of the banking sector and the banks in countries with higher climate risk will have lower liquidity (Hughes, 2022).

There are exogenous factors that may impact the liquidity of the banks and therefore we control for them in our panel setting. Some of the countries in our sample have a strong Islamic banking industry. (Reddy et al., 2017), (Mirza et al., 2022), (Louhichi et al., 2019), (Alizadeh et al., 2021), and (Tusiime and Wang, 2020) noted that faith-based financing exhibits unique characteristics that are different from their conventional counterparts. Hence, we control for this by introducing a dummy (IBD) that takes a value of 0 for Islamic banks and 1 otherwise. Along similar lines, we control for banking spread, the market value of equity, volatility of banking assets, credit quality, cost-to-income ratio, market concentration, growth in GDP, and money supply. For the three constructs of liquidity, we employ the following panel regressions with country and year-fixed effects.

$$LTD_{it} = \alpha_t + \beta_{1t} CRI_{it} + \beta_{2t} IBD_{it} + \beta_{3t} \pi_{it} + \beta_{4t} MVE_{it} + \beta_{5t} VA_{it} + \beta_{6t} CtI_{it} + \beta_{7t} HHI_{it} + \beta_{8t} gGDP_{it} + \beta_{9t} MS_{it} + \varepsilon_t \quad (2)$$

$$LCR_{it} = \alpha_t + \beta_{1t} CRI_{it} + \beta_{2t} IBD_{it} + \beta_{3t} \pi_{it} + \beta_{4t} MVE_{it} + \beta_{5t} VA_{it} + \beta_{6t} CtI_{it} + \beta_{7t} HHI_{it} + \beta_{8t} gGDP_{it} + \beta_{9t} MS_{it} + \varepsilon_t \quad (3)$$

$$MFTA_{it} = \alpha_t + \beta_{1t} CRI_{it} + \beta_{2t} IBD_{it} + \beta_{3t} \pi_{it} + \beta_{4t} MVE_{it} + \beta_{5t} VA_{it} + \beta_{6t} CtI_{it} + \beta_{7t} HHI_{it} + \beta_{8t} gGDP_{it} + \beta_{9t} MS_{it} + \varepsilon_t \quad (4)$$

## 3. Results and discussion

The descriptive statistics of selected variables are presented in Table 2, while the correlation matrix of variables is shown in Table 3. The pairwise correlation across all variables is low suggesting the absence of multicollinearity.

The results of fixed effect panel regression of the complete sample for Eqs. (2) to (4) are presented in Table 4. Our results show that liquidity is negatively associated with climate change. This is true for the three definitions of liquidity with loans to deposits significant at 5 %, while LCR and market funds to tangible assets are significant at 1 %. This is plausible as climate change can limit the ability of financial institutions to raise additional funds or liquidate assets to support liquidity. Alternatively, the climate risk (for example natural disasters) can trigger deposit outflow due to unprecedented withdrawals. Similarly, due to physical risks, some unfunded exposure (for example guarantees) may become due and exert pressure on the banking liquidity. This is in line with the earlier findings of (Brei et al., 2019) which suggested that physical risks tend to impair banking fundamentals including liquidity risk.

These results have important implications for the banking sector. Earlier evidence by (Chen et al., 2022; Umar et al., 2021b) documented that banking profitability benefits from green credit strategies. Our findings complement this notion by identifying that climate degradation exerts liquidity pressures and therefore banks must proactively finance sustainable initiatives to limit climate change. For control variables, we could not deduce any significance for the Islamic banking dummy and therefore can conclude that faith-based banking does not influence liquidity creation. This is similar to the findings of (Mirza et al., 2015) who argued that there are no fundamental differences in the business model of conventional and Islamic banking.

We found banking spread to be positively associated with liquidity and this was consistent for the three constructs. This is plausible because the spread represents core intermediation earning and a higher spread will support liquidity via persistent cash flows and deposit volume. The market concentration is also significant and contributes to the liquidity profile. It is also understandable because, in emerging markets where few banks tend to dominate the market share, liquidity is also concentrated. Finally, the GDP growth is also significant suggesting that business cycles shape banking liquidity.

The results for the size-sorted sample are presented in Table 5. The findings for climate risk are similar to those of the complete sample as the coefficient of CRI is significant and positively associated with all three variables of liquidity. Hence, we can argue that climate risk hinders bank liquidity regardless of the scale. Again, this is not surprising because climate risk is a macroeconomic sensitivity and therefore it has a similar impact on funding, financing, and market-based support. Since the consequences of climate risk for liquidity are scale neutral, both large and small banks should expedite their efforts to support sustainability goals.

The differences between big and small banks when it comes to combating climate change include resources, risk tolerance, market influence, regulation, and customer demand. Big banks typically have more resources, including financial, technological, and human resources, which enables them to develop and implement comprehensive and sophisticated strategies to manage climate risk. However, smaller banks may have a lower risk tolerance and limited resources to manage the risks posed by climate change, limiting their ability to invest in low-carbon and climate-resilient sectors and making it more challenging for them to adapt to the impacts of climate change. About market influence, big banks have a greater market influence and can play a key role in driving the transition to a low-carbon economy, while smaller banks may have less influence but still play an important role in financing local and regional initiatives to address climate change.

In terms of regulation, big banks are often subject to more stringent regulatory requirements and are more likely to have the resources to meet these requirements. On the other hand, smaller banks may face fewer regulatory requirements but may also have limited resources to comply with these regulations. In terms of customer demand, big banks may have a broader customer base, including institutional investors and large corporations, which may have greater demands for climate-friendly financial products and services. However, smaller banks may have fewer resources to meet these demands but may be better positioned to serve local communities and support local initiatives to address climate change.

Finally, Both big and small banks have a critical role to play in addressing climate change. By working together, they can leverage their strengths and address their weaknesses to support the transition to a low-carbon and climate-resilient economy.

There are some interesting observations concerning the control variables for the size-sorted sample. The dummy for Islamic banking remains insignificant regardless of the size. For the bigger banks, the variables related to size are significant. This includes the market value of equity and the HHI measure of concentration. The spread was not significant for the larger banks while it was for small banks. This reveals that larger banks in emerging markets largely benefit from the scale

[2] The detailed methodology of Climate Risk Index is available at https://resourcewatch.org/

**Table 2**
Descriptive Statistics of Selected Variables (Weighted Average for the Sample Period).

| | Loans to Deposits | LCR | Market Funds to Tangible Banking Assets | Spread | Volatility of Assets | Asset Quality | Cost to Income |
|---|---|---|---|---|---|---|---|
| Brazil | 0.8339 | 0.1606 | 0.3293 | 0.0970 | 0.0399 | 0.1972 | 0.4887 |
| Chile | 0.8551 | 0.1568 | 0.2905 | 0.0984 | 0.0378 | 0.1866 | 0.4622 |
| Colombia | 0.7806 | 0.1786 | 0.3501 | 0.0402 | 0.0453 | 0.1002 | 0.4233 |
| Mexico | 0.8195 | 0.2267 | 0.3280 | 0.0167 | 0.0405 | 0.0745 | 0.5062 |
| Peru | 0.9475 | 0.1390 | 0.4283 | 0.0613 | 0.0435 | 0.0931 | 0.4676 |
| Czech Republic | 0.8106 | 0.1702 | 0.3210 | 0.0373 | 0.0446 | 0.1150 | 0.4109 |
| Egypt | 0.9119 | 0.1670 | 0.3700 | 0.0926 | 0.0370 | 0.1330 | 0.5210 |
| Greece | 0.8805 | 0.1485 | 0.2798 | 0.0868 | 0.0365 | 0.0141 | 0.4841 |
| Hungary | 0.8737 | 0.1400 | 0.3777 | 0.0929 | 0.0360 | 0.1981 | 0.4959 |
| Kuwait | 0.9137 | 0.1567 | 0.3711 | 0.0879 | 0.0425 | 0.0981 | 0.5550 |
| Poland | 0.7860 | 0.1845 | 0.2791 | 0.0316 | 0.0411 | 0.0690 | 0.5412 |
| Qatar | 0.8807 | 0.2389 | 0.3356 | 0.0556 | 0.0376 | 0.1229 | 0.4804 |
| Saudi Arabia | 0.8669 | 0.1501 | 0.4500 | 0.0612 | 0.0428 | 0.1845 | 0.4596 |
| South Africa | 0.8406 | 0.1608 | 0.4259 | 0.0327 | 0.0393 | 0.0875 | 0.4469 |
| Turkey | 0.8526 | 0.1235 | 0.3937 | 0.0501 | 0.0442 | 0.0982 | 0.4407 |
| UAE | 0.8845 | 0.1641 | 0.3976 | 0.0386 | 0.0396 | 0.1064 | 0.4525 |
| China | 0.9261 | 0.1733 | 0.3556 | 0.0288 | 0.0426 | 0.1443 | 0.5330 |
| India | 0.8911 | 0.1639 | 0.2971 | 0.0153 | 0.0336 | 0.1002 | 0.5240 |
| Indonesia | 0.9075 | 0.1931 | 0.3851 | 0.0554 | 0.0382 | 0.0802 | 0.5033 |
| Korea | 0.8475 | 0.1812 | 0.4238 | 0.0892 | 0.0414 | 0.1547 | 0.5207 |
| Malaysia | 0.9463 | 0.1579 | 0.3610 | 0.0849 | 0.0346 | 0.1148 | 0.5453 |
| Philippines | 0.8891 | 0.1887 | 0.3885 | 0.0959 | 0.0487 | 0.0786 | 0.6253 |
| Thailand | 0.8206 | 0.1667 | 0.2921 | 0.0217 | 0.0385 | 0.1583 | 0.6945 |

while the smaller banks have to rely on the core earnings for supporting their liquidity. For smaller banks both the volatility in assets and assets quality are relevant revealing that asset variation and quality are important determinants of liquidity. Finally, the business cycles significantly influence smaller banks with GDP growth associated positively with liquidity. However, for bigger banks, there is no impact on GDP growth.

Given that our sample stems from very diversified geographic regions, we also present the results for Eqs. (2) to (4) after sorting the sample banks into three regions. These include the Americas, Europe Middle East, Africa, and Asia. It is important to consider climate risk across various locations because the impacts of climate change can vary widely depending on geography. Different regions may experience different levels of vulnerability to extreme weather events, sea level rise, and other effects of a changing climate. For example, coastal areas may be more susceptible to flooding and storm surges, while regions with water scarcity may face increased competition for resources. In addition, the local infrastructure, economies, and social systems can also play a role in shaping a region's vulnerability to climate change. For example, an area with a strong tourism industry may be more economically vulnerable to the effects of rising temperatures or changes in weather patterns that affect the tourism season.

By considering climate risk across various locations, organizations, including banks, can better understand the potential impacts on their operations and investments and take steps to manage those risks. This can help to ensure the long-term financial stability and sustainability of the organization, as well as support efforts to mitigate and adapt to the effects of climate change. The results are presented in Table 6. Similar to our earlier findings, climate risk proves to be an important determinant of liquidity across all regions and there is a negative relation between the two. This is plausible because climate degradation is a global phenomenon and our results show that across all regions the banking liquidity is sensitive to the CRI. Hence, while many financial policies are domestic, combatting climate change is something that requires a global pursuit.

In the case of control variables, there are some regional discrepancies. For banks located in the Americas, the volatility of assets and business cycles is equally important. The banks in Europe, the Middle East, and Africa, size, asset quality, and market concentration also play a significant role in determining liquidity. Finally, in Asia, banking liquidity benefits from the intermediation spread, asset quality, market concentration as well as business cycles. The findings on these control variables can help the stakeholder reconcile the factors that influence bank liquidity in addition to the climate risk.

Financial institutions can take several measures to manage the liquidity problems posed by climate change. They can conduct a thorough assessment of the potential impacts of climate change on their operations and investments, which helps to identify the areas of greatest risk and prioritize efforts to manage those risks. Portfolio management is another key strategy, where financial institutions can consider reducing exposure to high-risk industries, such as fossil fuels, and increasing investments in low-carbon and climate-resilient sectors, such as renewable energy and sustainable agriculture. Stress testing is a useful tool, as it allows financial institutions to evaluate the resilience of their balance sheets and identify areas where additional capital may be needed to withstand potential losses. Financial institutions can also develop and implement risk management strategies, such as insurance, to protect against the impacts of climate change and offer financial products that help clients adapt to and mitigate the effects of climate change. Improving transparency and disclosure of their exposure to climate risk and efforts to manage those risks can also build trust with stakeholders and increase the ability to attract investment. By taking these steps, financial institutions can better understand and manage the risks posed by climate change, reducing the potential for liquidity problems in the future.

## 4. Conclusion and policy implications

### 4.1. Conclusion

The financial risks emanating from climate change pose real challenges for the financial system. These risks come from both physical and transitional aspects of climate change. Among other fundamentals, the liquidity profile of financial institutions is also sensitive to ecological degradation. Liquidity is critical for banks because it is necessary to limit extreme events like bank runs and satiate the outflow demands of unsecured creditors. In this paper, we evaluate if climate risk affects the liquidity profile of banking firms in emerging markets.

Our results show that liquidity is sensitive to climate risk and banks in countries with greater climate risk experience more pressure on their liquidity compared to the banks that are domiciled in countries with relatively lower climate risk. The findings remained robust for various definitions of liquidity. We repeated our assessment after sorting the sample based on the firm size and climate risk continued to remain

**Table 3**
Correlation matrix of selected variables.

| | Loan to Desposits | LCR | MFTBA | CRI | IBD | Spread | MVE | V(A) | AQ | CtI | HHI | gGDP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Loan to Desposits | | | | | | | | | | | | |
| LCR | 0.19700907 | | | | | | | | | | | |
| MFTBA | −0.026463395 | 0.0547 | | | | | | | | | | |
| CRI | −0.071879612 | 0.1793 | −0.1305 | | | | | | | | | |
| IBD | 0.273921536 | −0.149 | 0.05725 | 0.271617 | | | | | | | | |
| Spread | 0.104484401 | 0.2936 | 0.16579 | −0.19602 | 0.009279 | | | | | | | |
| MVE | 0.041268258 | 0.1478 | 0.22236 | −0.07203 | −0.11242 | −0.0328 | | | | | | |
| V(A) | 0.233485859 | 0.2883 | 0.03339 | 0.163911 | 0.119738 | 0.018456 | 0.028887 | | | | | |
| AQ | 0.039766042 | 0.0686 | 0.14764 | −0.02239 | −0.04556 | 0.25245 | 0.095384 | 0.186885 | | | | |
| CtI | −0.124014924 | 0.1739 | 0.15893 | 0.145637 | 0.068286 | 0.183239 | −0.13009 | −0.15343 | 0.032565 | | | |
| HHI | 0.121854174 | 0.007 | 0.04958 | 0.310375 | 0.136058 | 0.122641 | 0.239237 | 0.078087 | −0.16901 | 0.293059 | | |
| gGDP | 0.093938073 | 0.0269 | −0.094 | 0.10512 | 0.237254 | 0.063102 | 0.21649 | 0.259523 | 0.136406 | 0.108425 | 0.284748 | |
| MS | −0.073655413 | 0.0161 | 0.04284 | 0.300613 | 0.36293 | 0.006145 | −0.01769 | 0.009991 | 0.136569 | 0.20475 | 0.070807 | 0.184062 |

MFTBA = Market Funds to Tangible Banking Assets.

**Table 4**
Panel regression results for complete sample.

| | Loan to Deposits | | LCR | | Market Funds to Tangible Banking Assets | |
|---|---|---|---|---|---|---|
| Constant | 0.0180 | | 0.5376 | | 0.5436 | |
| t stats | 0.4198 | | 0.9914 | | 0.6121 | |
| CRI | 0.0538 | ** | −0.0991 | *** | −0.0408 | *** |
| t stats | 1.9926 | | −3.0150 | | −3.1706 | |
| IBD | 0.9497 | | 0.7942 | | 0.2113 | |
| t stats | 1.3879 | | 0.1724 | | 0.7131 | |
| Spread | −0.0375 | ** | 0.0418 | ** | 0.0573 | ** |
| t stats | −2.0244 | | 1.9914 | | 2.1891 | |
| MVE | 0.1556 | | 0.2245 | | 0.1802 | |
| t stats | 0.4184 | | 1.7653 | | 0.8618 | |
| V(A) | 0.0488 | | 0.0127 | | 0.0794 | |
| t stats | 0.9258 | | 1.4535 | | 0.6306 | |
| AQ | 0.0713 | | 0.0430 | | 0.0453 | |
| t stats | 0.8435 | | 0.9437 | | 1.0560 | |
| CtI | 0.0819 | | 0.0927 | | 0.0360 | |
| t stats | 0.4299 | | 0.9567 | | 0.3492 | |
| HHI | −0.0819 | *** | 0.0687 | *** | 0.0806 | *** |
| t stats | −2.5459 | | 3.5919 | | 2.8606 | |
| gGDP | 0.0211 | ** | 0.0618 | ** | 0.0180 | ** |
| t stats | 2.0390 | | 2.1618 | | 2.0775 | |
| MS | 0.8803 | | 0.2210 | | 0.5336 | |
| t stats | 0.6875 | | 0.4081 | | 0.8795 | |
| Country FE | YES | | | | | |
| Year FE | YES | | | | | |
| Adj R2 | 0.711389 | | 0.61198 | | 0.678269 | |

***represent significance at 1 %, ** at 5 % and * at 10 %.

significant. Finally, creating a subsample based on geographical locations yielded the same result. This, while confirming, a negative relationship between climate risk and liquidity, also indicates that liquidity-related concerns will be there for all banks regardless of the size or their location. Since there is no escape for any firm, we conclude that a comprehensive and globally coordinated financial strategy is warranted to mitigate the climate risk.

### *4.2. Policy implications*

Banks can play a crucial role in achieving the targets of COP26 by supporting and financing low-carbon and sustainable projects and initiatives. This can include financing renewable energy projects, supporting energy-efficient buildings, and investing in sustainable agriculture and transportation. Banks can also encourage their customers to adopt sustainable practices by offering green financial products and promoting environmentally-friendly behavior. Additionally, banks can work towards reducing their carbon footprint and becoming more environmentally conscious in their internal operations.

Furthermore, by implementing guidelines and regulations, authorities may push banks to manage the risks associated with climate change in their operations and urge banks to assess the threats posed by climate change. Policymakers may support low-carbon financing by incentivizing banks to finance projects by introducing tax incentives or establishing financing streams dedicated to low-carbon activity. Improving data collection and analysis is possible so policymakers understand the risks associated with climate change. This information may formulate effective policies and laws promoting the transition to a low-carbon economy. In order to facilitate the transition to a low-carbon economy, policymakers can promote collaboration across several stakeholders. This might entail collaborating with banks, governments, and other stakeholders to develop solutions for mitigating climate change risks and supporting low-carbon activities. Access to capital is something that policymakers may facilitate for small and medium-sized enterprises (SMEs) that are transitioning to a low-carbon economy. Policymakers can enhance regulatory frameworks to support the transition to a low-carbon economy. This may entail establishing criteria for measuring carbon emissions, establishing goals for reducing emissions,

**Table 5**
Panel regression results for size sorted sample.

| | Loan to Deposits | | LCR | | Market Funds to Tangible Banking Assets | |
|---|---|---|---|---|---|---|
| Big Banks | | | | | | |
| Constant | 0.0118 | | 0.3529 | | 0.3569 | |
| t stats | 0.2756 | | 0.6509 | | 0.4018 | |
| CRI | 0.0353 | ** | −0.0651 | *** | −0.0268 | *** |
| t stats | 1.9631 | | −2.9793 | | −4.0815 | |
| IBD | 0.6235 | | 0.5214 | | 0.1387 | |
| t stats | 0.9111 | | 0.1132 | | 0.4682 | |
| Spread | −0.0246 | | 0.0275 | | 0.0376 | |
| t stats | −1.3290 | | 1.3074 | | 1.4371 | |
| MVE | 0.1022 | ** | 0.1474 | *** | 0.1183 | *** |
| t stats | 2.1275 | | 3.1589 | | 2.5657 | |
| V(A) | 0.0320 | | 0.0084 | | 0.0521 | |
| t stats | 0.6078 | | 0.9542 | | 0.4140 | |
| AQ | 0.0468 | | 0.0282 | | 0.0298 | |
| t stats | 0.5538 | | 0.6195 | | 0.6933 | |
| CtI | 0.0537 | | 0.0609 | | 0.0236 | |
| t stats | 0.2822 | | 0.6281 | | 0.2293 | |
| HHI | −0.0537 | ** | 0.0451 | ** | 0.0529 | ** |
| t stats | −1.9671 | | 2.1358 | | 1.9878 | |
| gGDP | 0.0139 | | 0.0406 | | 0.0118 | |
| t stats | 1.3386 | | 1.4192 | | 1.3639 | |
| MS | 0.5779 | | 0.1451 | | 0.3503 | |
| t stats | 0.4513 | | 0.2679 | | 0.5774 | |
| Country FE | YES | | | | | |
| Year FE | YES | | | | | |
| Adj R2 | 0.68175 | | 0.7408 | | 0.71795 | |
| | | | | | | |
| Small Banks | | | | | | |
| Constant | 0.0160 | | 0.4774 | | 0.4828 | |
| t stats | 0.3728 | | 0.8805 | | 0.5436 | |
| CRI | −0.0477 | ** | −0.0880 | *** | −0.0362 | *** |
| t stats | −1.7697 | | −2.6776 | | −3.8159 | |
| IBD | 0.8434 | | 0.7053 | | 0.1876 | |
| t stats | 1.2326 | | 0.1531 | | 0.6333 | |
| Spread | −0.0333 | *** | 0.0372 | *** | 0.0509 | *** |
| t stats | 2.7979 | | 3.7686 | | 3.9441 | |
| MVE | 0.1382 | | 0.1994 | | 0.1600 | |
| t stats | 0.3716 | | 1.5678 | | 0.7653 | |
| V(A) | 0.0433 | ** | 0.0113 | ** | 0.0705 | ** |
| t stats | 1.9822 | | 2.0291 | | 2.1560 | |
| AQ | 0.0633 | ** | 0.0382 | *** | 0.0403 | ** |
| t stats | 2.0749 | | 0.8381 | | 2.2938 | |
| CtI | 0.0727 | | 0.0824 | | 0.0320 | |
| t stats | 0.3818 | | 0.8496 | | 0.3101 | |
| HHI | −0.0727 | | 0.0611 | | 0.0716 | |
| t stats | −1.2610 | | 0.1900 | | 0.5405 | |
| gGDP | 0.0188 | ** | 0.0549 | ** | 0.0160 | ** |
| t stats | 1.9581 | | 1.9990 | | 1.9845 | |
| MS | 0.7818 | | 0.1963 | | 0.4739 | |
| t stats | 0.6105 | | 0.3624 | | 0.7810 | |
| Country FE | YES | | | | | |
| Year FE | YES | | | | | |
| Adj R2 | 0.79014 | | 0.68527 | | 0.60312 | |

***represent significance at 1 %, ** at 5 % and * at 10 %.

and promoting sustainable financial techniques. By taking these steps, banks can help to achieve COP26 goals and contribute to the transition towards a low-carbon, sustainable future.

## CRediT authorship contribution statement

**Qiaoqi Lang:** Conceptualization, Investigation, Writing – review & editing. **Feng Ma:** Conceptualization, Supervision, Validation, Project administration, Writing – review & editing. **Nawazish Mirza:** Data curation, Software, Validation, Project administration, Writing – original draft. **Muhammad Umar:** Conceptualization, Methodology, Visualization, Writing – original draft.

**Table 6**
Panel regression results for geographic sample.

| | Loan to Desposits | | LCR | | Market Funds to Tangible Banking Assets | |
|---|---|---|---|---|---|---|
| Americas | | | | | | |
| Constant | 0.014205 | | 0.424736 | | 0.429503 | |
| t stats | 0.331643 | | 0.783292 | | 0.483616 | |
| CRI | 0.042474 | ** | −0.07833 | *** | −0.03224 | *** |
| t stats | 2.036253 | | −3.58556 | | −4.01202 | |
| IBD | 0.750341 | | 0.627469 | | 0.166912 | |
| t stats | 1.096536 | | 0.136205 | | 0.563424 | |
| Spread | 0.029595 | | 0.033061 | | 0.04529 | |
| t stats | 1.599472 | | 1.573387 | | 1.072955 | |
| MVE | 0.122968 | | 0.177373 | | 0.142346 | |
| t stats | 1.560369 | | 3.801718 | | 1.087827 | |
| V(A) | 0.038559 | ** | 0.010059 | ** | 0.062747 | *** |
| t stats | 1.973145 | | 1.148348 | | 3.498247 | |
| AQ | 0.056342 | | 0.033965 | | 0.035827 | |
| t stats | 0.666462 | | 0.745579 | | 0.834346 | |
| CtI | 0.064674 | | 0.073266 | | 0.028438 | |
| t stats | 0.33965 | | 0.755862 | | 0.275902 | |
| HHI | 0.064674 | | 0.054315 | | 0.063669 | |
| t stats | 0.36741 | | 2.570403 | | 0.392274 | |
| gGDP | 0.016691 | ** | 0.048815 | ** | 0.014235 | ** |
| t stats | 1.961096 | | 1.707988 | | 1.996414 | |
| MS | 0.695546 | | 0.174617 | | 0.421617 | |
| t stats | 0.543147 | | 0.322399 | | 0.69484 | |
| Country FE | YES | | | | | |
| Year FE | YES | | | | | |
| Adj R2 | 0.71091 | | 0.6251 | | 0.70139 | |
| | | | | | | |
| Europe Middle East and Africa | | | | | | |
| Constant | 0.024329 | | 0.727464 | | 0.735628 | |
| t stats | 0.56802 | | 1.341578 | | 0.82831 | |
| CRI | −0.07275 | *** | −0.13416 | *** | −0.05522 | *** |
| t stats | −2.69642 | | −3.07989 | | −5.81422 | |
| IBD | 1.285141 | | 0.746933 | | 0.285878 | |
| t stats | 1.878085 | | 0.233283 | | 0.965 | |
| Spread | 0.050689 | | 0.056625 | | 0.07757 | |
| t stats | 1.263183 | | 1.742204 | | 0.966668 | |
| MVE | 0.210612 | ** | 0.303794 | *** | 0.243802 | *** |
| t stats | 2.056625 | | 2.388861 | | 3.16615 | |
| V(A) | 0.066041 | | 0.017229 | | 0.107469 | |
| t stats | 0.203062 | | 0.917096 | | 0.285104 | |
| AQ | 0.0965 | *** | 0.058173 | *** | 0.061362 | *** |
| t stats | 3.161545 | | 3.276984 | | 3.495039 | |
| CtI | 0.110771 | | 0.125485 | | 0.048707 | |
| t stats | 0.581732 | | 1.294597 | | 0.472549 | |
| HHI | −0.11077 | ** | 0.093027 | ** | 0.109048 | ** |
| t stats | −1.99141 | | 2.028952 | | 1.982357 | |
| gGDP | 0.028588 | | 0.083607 | | 0.02438 | |
| t stats | 0.983567 | | 0.458205 | | 0.237821 | |
| MS | 1.191291 | | 0.299074 | | 0.722121 | |
| t stats | 0.930271 | | 0.552187 | | 1.190083 | |
| Country FE | YES | | | | | |
| Year FE | YES | | | | | |
| Adj R2 | 0.642729 | | 0.720854 | | 0.681491 | |
| | | | | | | |
| Asia | | | | | | |
| Constant | 0.016566 | | 0.495352 | | 0.500911 | |
| t stats | 0.386782 | | 0.913521 | | 0.564021 | |
| CRI | −0.04954 | ** | −0.09135 | *** | −0.0376 | *** |
| t stats | −1.98361 | | −3.09719 | | −3.95907 | |
| IBD | 0.875091 | | 0.508609 | | 0.194663 | |
| t stats | 1.278844 | | 0.15885 | | 0.657097 | |
| Spread | 0.034516 | ** | 0.038557 | ** | 0.05282 | ** |
| t stats | 2.086014 | | 2.186319 | | 2.065823 | |
| MVE | 0.143412 | | 0.206863 | | 0.166012 | |
| t stats | 1.400417 | | 1.626647 | | 1.155926 | |
| V(A) | 0.044969 | | 0.011732 | | 0.073179 | |
| t stats | 0.138271 | | 0.624478 | | 0.194136 | |
| AQ | 0.06571 | ** | 0.039612 | *** | 0.041783 | *** |
| t stats | 2.015279 | | 2.531397 | | 2.798767 | |
| CtI | 0.075427 | | 0.085447 | | 0.033166 | |
| t stats | 0.396119 | | 0.88153 | | 0.321773 | |
| HHI | −0.07543 | *** | 0.063345 | *** | 0.074254 | *** |

(*continued on next page*)

**Table 6** (*continued*)

| | Loan to Desposits | | LCR | | Market Funds to Tangible Banking Assets | |
|---|---|---|---|---|---|---|
| t stats | −3.35601 | | 3.381574 | | 2.934985 | |
| gGDP | 0.019466 | ** | 0.05693 | ** | 0.016601 | *** |
| t stats | 1.966974 | | 1.99312 | | 2.816194 | |
| MS | 0.811186 | | 0.203648 | | 0.491714 | |
| t stats | 0.633449 | | 0.376 | | 0.810363 | |
| Country FE | YES | | | | | |
| Year FE | YES | | | | | |
| Adj R2 | 0.731101 | | 0.72093 | | 0.641347 | |

***represent significance at 1 %, ** at 5 % and * at 10 %.

## Data availability

Data will be made available on request.

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