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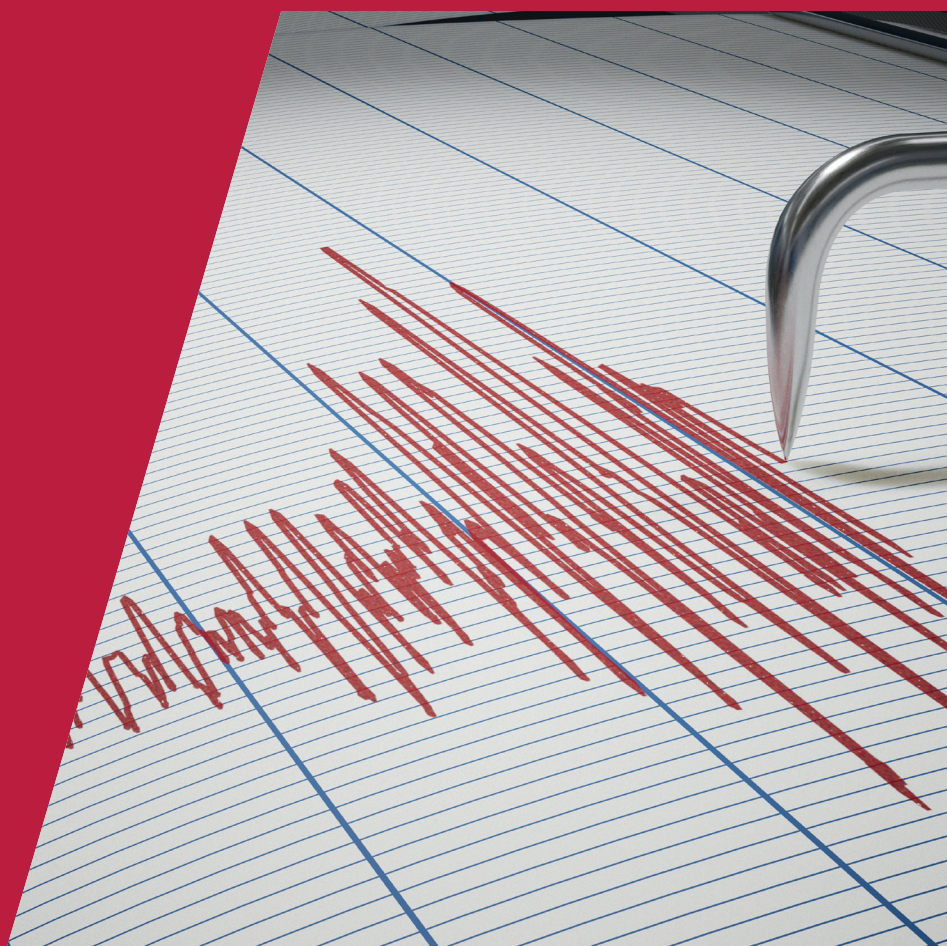
Disasters and (Bank) Financing

Mikhail Mamonov, Steven Ongena and Anna Pestova

LTI Report III



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LTI@UniTO
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DISASTERS AND (BANK) FINANCING

LTI Report 3

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LTI Report 3

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Pietro Garibaldi is the Director of LTI@UniTO.

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Mikhail Mamonov is an Assistant Professor of Finance (tenure track) at Toulouse Business School. In October 2023, Mikhail received a PhD in Economics from CERGE-EI (a joint workplace of Charles University and the Czech Academy of Sciences). During 2021-2023, Mikhail was a visiting PhD student in the Department of Banking and Finance at the University of Zurich, the Department of Accounting, Finance, and Insurance at KU Leuven, and the Department of Economics at Princeton University. Mikhail is an applied economist focusing on how political distortions affect banks and their corporate borrowers. His specific interest is in how banks and firms adapt to these distortions once they become more frequent and thus anticipated.

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Anna Pestova is a Post-Doctoral Researcher at Toulouse Business School. She obtained a PhD in Economics at CERGE-EI in January 2024. In 2022-2023, she visited the Economics Department and Julis-Rabinowitz Center for Public Policy and Finance at Princeton University. In 2021-2022, she visited the University of Zurich. In June 2022 and June 2023, she visited KU Leuven. Anna is an applied economist. Her research interests lie at the intersection of economics and finance. She aims to understand how financial shocks shape macroeconomic outcomes and how credit conditions affect household balance sheets, credit access, and inequality.

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We thank Alberto Eichholzer, Matteo Bordone Molini, Pietro Garibaldi, Gregorio De Felice, Giuseppe Grande, Elisa Luciano (discussant), Fabio Trojani (discussant), Luca Regis, and the participants at the 3rd LTI@UniTO Report Presentation Conference "Disasters and (bank) financing" for their comments.

Contents

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Foreword

This is the third LTI Report, an initiative of the Long-Term Investors (LTI@UniTO) think tank launched by the University of Torino and hosted by Collegio Carlo Alberto since 2017. LTI@UniTO is supported by key financial institutions in Northern Italy, such as Compagnia di San Paolo, Equiter, Ersel, Fondaco, Intesa SanPaolo, Reale Mutua Assicurazione, and Banor.

The goal of the LTI Report series is to engage leading scholars to address key research topics around the area of long-term investment, in order to make their research results accessible to broader audiences. This third LTI report, authored by Mikhail Mamonov (TBS Business School), Steven Ongena (University of Zurich and CEPR) and Anna Pestova (TBS Business School), focuses on the short- and medium-term effects of 'disasters' in the banking system. While some sort of disaster affecting the economy seems to be a 'new normal', the report focuses specifically on armed conflicts, pandemics, and climate change. Armed conflict affects bank loans not only during the war itself, but also through a lengthy aftermath via market concentration in the banking system. Economic sanctions appear less effective than they are ex-ante envisaged through a variety of evading mechanisms. The effects of pandemics on banks crucially depend on the geographical expansion of the underlying infection, and early policy intervention is equally crucial for defending the banking system. Natural disasters can have long-run effects on the supply of loans, since banks tend to concentrate their activity in unaffected areas.

This report was produced following the Third LTI Report Conference Presentation, held at Collegio Carlo Alberto on 21 November 2023, and includes the comments of two academic discussants and three panelists.

LTI@UniTO gratefully acknowledges support from its sponsors, as well from its distinguished Scientific Committee, chaired by Jean Charles Rochet. We also thank Gian Maria Ajani for chairing the Sponsor Committee, Deputy Director Luca Regis, Florence Plouchart-Cohn, and all the LTI@UniTO and Collegio Carlo Alberto staff for their excellent work in the preparation of both the conference and this report. Veronica Merlone provided the authors with high-level research assistance. CEPR thanks Anil Shamdasani for his skilled handling of its production

The views expressed in the report are those exclusively of its authors and do not represent those of CEPR, which takes no institutional positions on economic policy matters. CEPR and LTI@UniTO are delighted to provide a platform for an exchange of views on this important topic.

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March 2024

Executive summary

Disasters are, in general, unexpected. However, over the past several decades the world has witnessed a rising incidence of disasters of various types, including armed conflicts, infectious diseases, and nature loss, which overall makes disasters more predictable. In this report, we study how banks respond to unexpected disasters and how they adapt to predictable disasters. We distinguish between the direct and indirect effects of disasters on banks. The direct effects involve physical damage to buildings and personnel, while the indirect effects propagate through changes in the behaviour of the banks' borrowers, lenders, and the government. We review the nascent theoretical and empirical literature in this area, present some additional estimations, and distil several key lessons from banks' responses and adaptation to disasters.

In the introductory chapter, we document the rising incidence of disasters and the strengthening of government responses to these. We describe possible human causes of the different types of disasters and document disaster propagation channels through banks, their financiers and borrowers, and the government.

In Chapter 1, we begin by exploring how banks adapt to armed conflicts, ranging from civil unrest to full-scale wars, and international sanctions. We survey existing literature on finance and armed conflict and formulate several lessons. First, banks and their clients are affected by war and peace: war translates into higher loan rates, and when peace is restored, banks witness an increase in loan demand stemming from a higher willingness to invest. Second, civil unrest activates taste-based discrimination by loan officers, which results in price discrimination against loan applicants based on their non-economic (e.g., religious, national) characteristics. This implies that the emotional state of loan officers plays an important role in their credit decision-making. Third, banks are affected by international sanctions through the cutting off of opportunities to place new debts in the financial markets of sanction-imposing countries and the risk of their foreign assets being frozen. However, the severe effects of sanctions are usually mitigated through the following three channels: (i) financial support from the sanctioned government; (ii) evasion of the international restrictions with the help of banks from non-sanctioning countries (e.g., China) and sometimes banks from sanctioning countries as well (e.g., Germany); and (iii) staggered implementation of the global sanction policy. Under staggered implementation, the first sanction announcement has strong negative effects on the already-sanctioned banks but also has strong anticipatory effects on those not-yet-sanctioned banks, thus leaving some time for them to adapt both their international and domestic operations.

In our quantitative analysis, we focus on international financial sanctions imposed in response to the Russia–Ukraine war. In addition to the direct treatment effect of sanctions on local banks, we investigate spillovers of the sanction policy to formally non-targeted banks (i.e., subsidiaries of foreign financial institutions operating in the sanctioned country). These spillovers are likely to arise because of home-based

pressure on foreign banks (from both the regulatory and customer sides) and potentially deteriorating domestic macroeconomic conditions forcing the banks to exit. We study sanctions against Russia that were implemented in a staggered fashion between 2014 and 2019 to analyse the adaptation of both politically connected and foreign banks in Russia. We show that the first sanction announcement forced not only politically connected banks to adapt their international exposures, as has recently been established in the literature, but also subsidiaries of foreign banks. Using detailed bank balance sheets, we trace the evolution of the adaptation effects at a monthly frequency and show that major politically connected banks (Sberbank, VTB, Gazprombank, Russian Agricultural Bank) first increased their borrowings from abroad by 4% (within a year of the first announcement) but then reduced them by 7.4% (over a three-year horizon). These banks encountered 'sectoral sanctions' (based on the Sectoral Sanctions Identifications, or SSI, list) from the US Office of Foreign Asset Control targeting only the liability side of the banks' balance sheets. Other politically connected banks were targeted by 'fully-blocking sanctions' (based on the Specially Designated Nationals and Blocked Persons, or SDN, list), which forced banks to shrink their foreign borrowings by as much as 10.7% in a year and by 15.5% over three years. Sanctions spilled over to foreign banks in Russia, which reduced the inflow of funds from abroad by 6.6% in 2014 and by 15.9% during 2014–2016.

Our quantitative analysis further reveals substantial heterogeneity in the spillover effects of anti-Russian sanctions on foreign banks in Russia. First, in line with the findings from the previous literature that political partisanship matters for the cross-border flows of capital, our estimation demonstrates that foreign banks originating in the West (UniCredit, City, Société Générale, Raiffeisen, etc.) reduced their foreign liabilities in Russia – i.e., the inflow of funds to Russia from abroad – by 30% in the three years after the first sanctions. Conversely, subsidiaries of foreign banks from the East (mainly Turkey, India, and China) increased their foreign liabilities in Russia by 5.5% over the same period. We conclude that in the case of financial sanctions against Russia, spillovers are large and heterogeneous. Overall, the negative spillover effect of sanctions on foreign banks eventually exceeds the direct treatment effect on politically connected banks, but the effect is driven exclusively by Western foreign banks.

We then turn to a cross-country analysis and show that wars significantly harm banking, with decreased bank credit and deposits for several years following an armed conflict. However, our analysis also uncovers unexpected findings. First, we document that non-performing loans (NPLs) relative to total loans did not consistently rise across approximately 30 war-affected countries from 1989 to 2020. Second, the capital adequacy ratio (CAR) declines in the first one or two years after a war, suggesting that bank owners may withdraw or lose their funds. Yet, over time, the CAR tends to rebound, likely reflecting post-crisis economic recoveries. Third, wars reduce bank concentration within countries during conflicts. Fourth, foreign banks tend to increase their presence in war-affected regions as time passes, potentially capitalising on reduced concentration and post-war economic recovery. Fifth, the impact of wars on bank credit varies substantially

across countries. Tighter fiscal and especially monetary policy, along with excessively volatile stock markets, exacerbates the negative effects of wars on banking systems. However, a greater ability to attract foreign loans and rising world prices of the affected countries' exports substantially mitigate these adverse consequences of wars.

In Chapter 2, we study bank adaptation to infectious diseases, focusing primarily on the literature devoted to the COVID-19 pandemic. We survey existing research and document the effects of the pandemic on bank lending, profitability, and the structure of bank operations. Over the course of the pandemic, banks increased their markups yet faced a deterioration in their performance and shifted towards government-supported lending. The pandemic facilitated a major transformation of banking, accelerating the shift away from in-person interactions to online and mobile transactions, and provided an advantage to fintech lenders.

We then continue our cross-country regression analysis from Chapter 1 and show that infectious diseases exert a dampening effect on the demand for loans: both the volume of bank loans and the interest rates on loans tend to decrease as infectious diseases spread. This contrasts with the impact of wars, which primarily affect the supply of loans. Furthermore, our results demonstrate that infectious diseases may be associated with an increase in banks' capital adequacy ratios. This phenomenon is likely driven by banks reducing loans to riskier borrowers while maintaining their capital levels. As loans shrink, banks also tend to rely more on non-interest sources of income as a response to the spread of infectious diseases.

In addition, we observe a trend towards greater bank concentration, suggesting that larger banks could be more resilient to the effects of infectious diseases than their smaller counterparts. This resilience may stem from larger banks' capacity to reorient their operations from regions more heavily affected by disease to those less affected, either within a single country or across multiple countries.

In Chapter 3, we begin by reviewing the literature on how banks adapt to natural disasters. Bank performance is negatively impacted by natural disasters, though the effect is short-lived and far from catastrophic even in the case of most destructive disasters. Non-native banks are more likely to leave markets affected by natural disasters. There is an increased credit demand in areas affected by natural disasters, but banks redirect funds across geographies with multiple frictions. Bank-borrower relationships as well as geographically diversified connections help sustain access to finance, while low bank capitalisation amplifies local natural disaster shocks. Banks price anticipated disaster risk: they charge higher interest rates for mortgages on properties exposed to a greater risk of sea level rise. Mortgage lenders transfer climate-related default risk through securitisation in the aftermath of natural disasters, which eventually helps sustain credit supply in disaster zones.

Our cross-country analysis does not find significant negative effects of adverse environmental events on bank credit to the economy, which is consistent with short-lived losses and multiple frictions during the recovery previously found in the literature. Additionally, we conjecture that the lack of identified country-level effects of natural disasters on banking may stem from their predominantly local nature.

In Chapter 4, we summarise bank adaptation strategies to disasters. Chapter 5 concludes.

Introduction: Rising incidence of disasters and their propagation through banks

How are banks affected by unexpected disasters and how can banks prepare once their occurrence becomes more routine – due to geopolitical tensions, nature loss, or climate change, for example – and thereby more expected? In this report, we review the nascent theoretical and empirical literature in this area, present some additional estimations at micro- and cross-country levels, and distil several key lessons for three types of disasters: armed conflicts, infectious diseases, and natural disasters.

Disasters of all three types have been occurring more frequently recently and can be expected to do so even more in the future, due to political and/or demographic developments, nature loss, and/or climate change (Table 1). Policy responses may also have become more vigorous given rising expectations and enhanced policy tools.

TABLE 1 **POSSIBLE (HUMAN) CAUSES OF THE DIFFERENT TYPES OF DISASTERS**

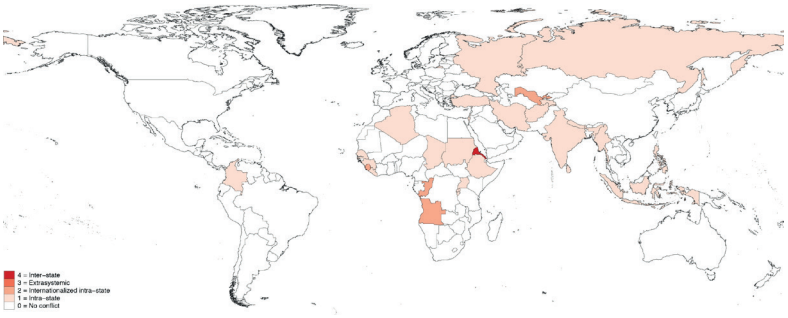
Human agency	*Possible causes of disasters*		*Type of disasters*	
High	**Political developments**	Failing states, Geo-political competition	**Armed conflicts**	Unrest, civil war War
Medium	**Demographic developments**	Ageing, Demographic imbalances	**Infectious diseases**	Epidemic Pandemic
Medium Low to None	**Nature loss, climate changes**	Sea level rise	**Natural disasters**	Floods, hurricanes, … Earthquakes, meteors, …

Source: Authors' compilation.

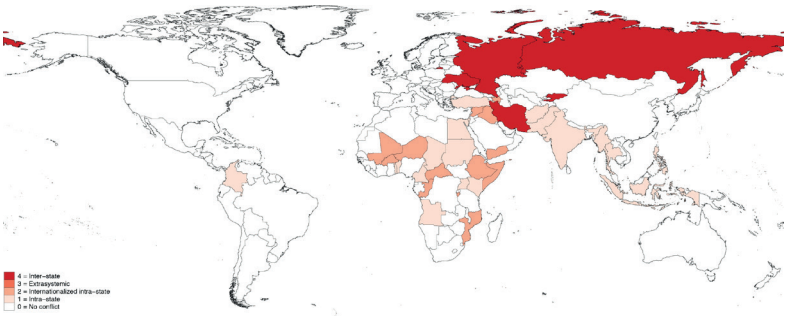
*Armed conflict*s, both domestic and international, may be ignited more often by failing states, demographic imbalances, and/or forced climate migration, and have become potentially more damaging due to technological developments in armaments as well as targeting and cyber capabilities. The maps presented in Figure 1 illustrate the rise in conflicts across the world and over time, especially in 2022 with the Russo–Ukrainian war and 2023 with the most recent Hamas–Israel war. And Figure 2 shows that countries launching wars are increasingly punished by economic sanctions imposed by the West (Felbermayr et al., 2020; Cipriani et al., 2023) and that they impose countersanctions in response to being sanctioned (Lastauskas et al., 2023).

FIGURE 1 **RISING ARMED CONFLICTS AROUND THE WORLD**

(a) 2000



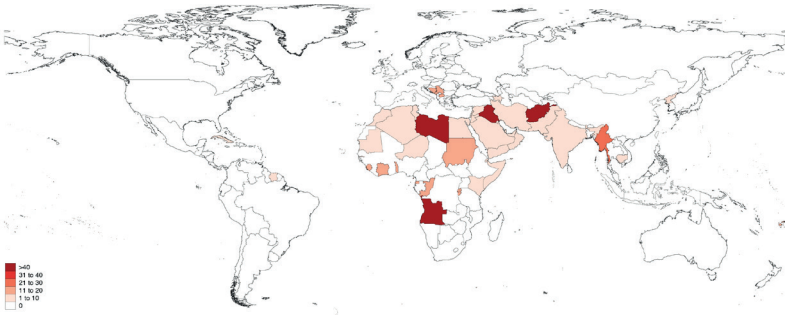
(b) 2022



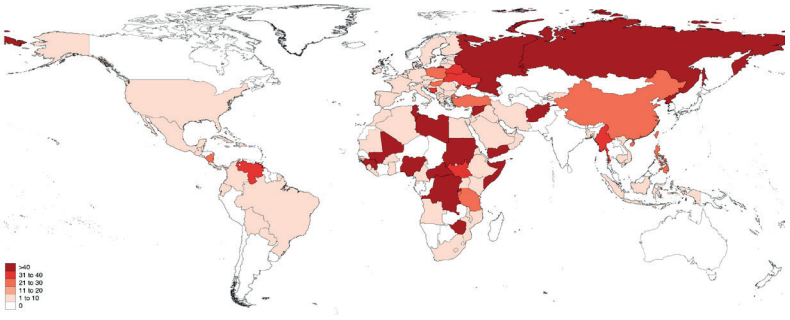
Source: Uppsala Conflict Data Program (UCDP), Department of Peace and Conflict Research, Uppsala Universitet.

FIGURE 2 **RESPONSE TO ARMED CONFLICTS: GROWING GEOGRAPHICAL SPREAD OF INTERNATIONAL SANCTIONS**

(a) 2000



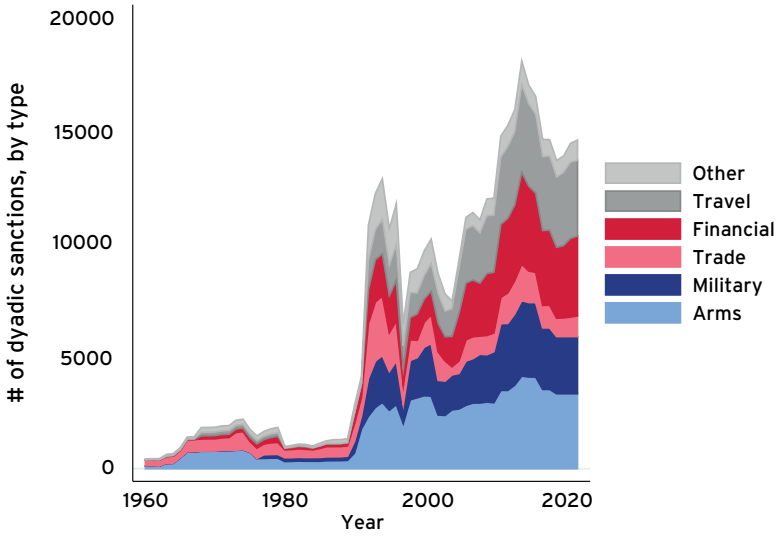
(b) 2022



Source: Global Sanction Database (Felbermayr et al., 2020).

Though countries have been applying economic sanctions to restrain unfavourable political regimes in other countries for centuries, the intensity of sanctions increased dramatically in the early 1990s and has been steadily rising since then. As Felbermayr et al. (2020) document, financial sanctions have become more and more popular among the different types of international restrictions (Figure 3).

FIGURE 3 **EVOLUTION OVER TIME OF DIFFERENT TYPES OF SANCTIONS, 1960-2022**



Source: Global Sanction Database (Felbermayr et al., 2020).

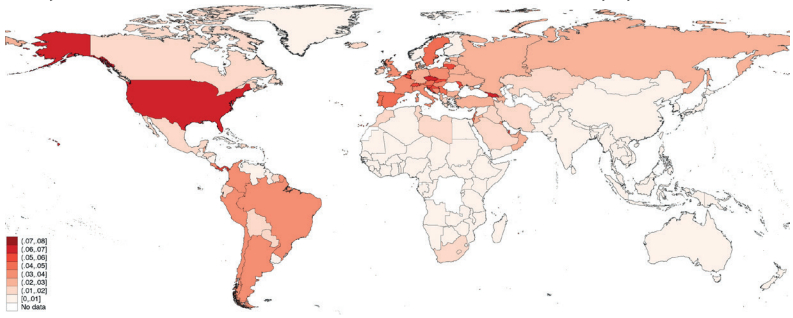
With cross-species viral transmission causing epidemics and pandemics, *infectious diseases* may increase, and become more lethal, due to weakening public health systems, ageing populations, and nature loss and/or climate change (e.g., Carlson et al., 2022). The recent COVID-19 pandemic, which affected countries across the world (Figure 4), has had dramatic effects on mental health and economic outcomes (Chetty et al., 2023). Rising risks of new epidemics and pandemics require governments throughout the world to develop pre-emptive policy measures to curb the spread of diseases and coordinate their policies to smooth the spillover effects.

Finally, *natural disasters*, such as floods and hurricanes (e.g., in the United States in 2022 and Tunisia 2023), droughts (the Brazilian Amazon in 2023), and even earthquakes (Morocco and Afghanistan in 2023) (e.g., Buis, 2019) may become more frequent due to climate change. They may also become more damaging due to lack of investment in public infrastructure and/or nature loss (e.g., Rizzi, 2023).

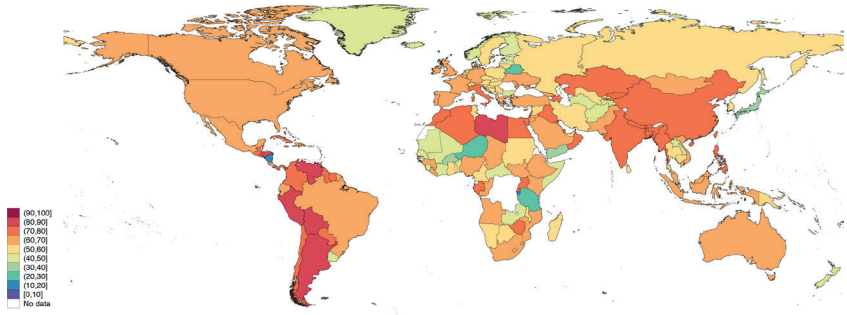
Figure 5 shows that while countries throughout the world encounter substantial damages caused by natural disasters, these tend to be greater in more developed countries (e.g., the US, Japan, Australia) and most of the BRICs. However, at the same time, it is barely the case that governments of those countries tend to improve their climate performance over time (except for the BRICs).

FIGURE 4 **THE COVID-19 PANDEMIC AROUND THE WORLD, 2020**

(a) COVID-19 spread: Number of confirmed cases in 2020, relative to population in 2019



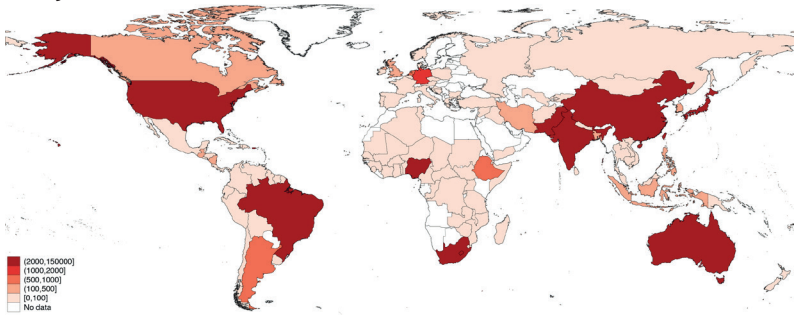
(b) Government responses to COVID-19*



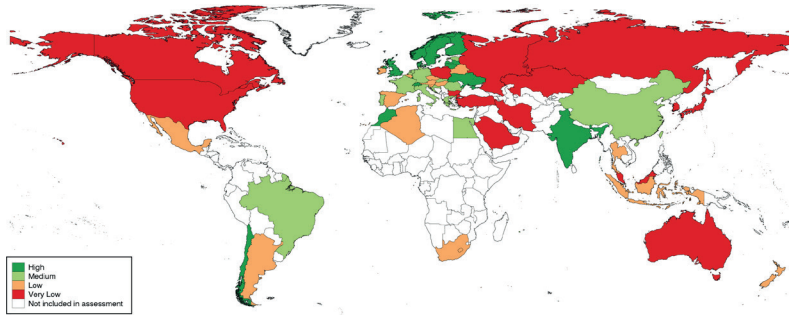
Source: Oxford COVID-19 Government Response Tracker
Note: * Composite Government Stringency Index based on nine indicators, including school closures, workplace closures, and travel bans (0 = lowest stringency; 100 = highest stringency).

FIGURE 5 **NATURAL DISASTERS AND CLIMATE PROTECTION MEASURES ACROSS THE WORLD**

(a) Total damages from natural disasters in 2022, in millions of 2021 US dollars



(b) Climate change performance index in 2020



Source: Panel (a): EM-DAT, the International Disasters Database; panel (b): Germanwatch Climate Change Performance Index (www.germanwatch.org/en/CCPI).

Bank adaptation to disasters

Banks will inevitably be 'in the middle of it all'. Banks can be negatively affected by conflict situations in a variety of ways. Domestic and/or cross-border bank operations can be curtailed or redirected by national policies and/or cross-border sanctions, while buildings may be destroyed or temporarily inaccessible and experienced personnel killed, hurt, and/or intimidated. Bank runs both by depositors and businesses with credit lines may occur simultaneously, and cash or electronic transfers may be jeopardised by the conflict situation involving damaged roads, cut cables, and/or jammed transmissions.

Banks can also be severely affected by diseases, the public health responses to them, as well as financial sector interventions (witness the recent COVID-19 pandemic), while personnel and clientele may face severe health challenges or may even die.

Finally, banks can face severe challenges linked to floods, fires, and biodiversity loss, the frequency and severity of which will only increase due to the impact of climate change on sea level rise, temperature rise and droughts, and corresponding changes in the natural environment.

In the foreseeable future, banks may have to respond more actively than ever to such disasters, given that political developments (e.g., geo-political ambitions by Russia; the rise of China; domestic conflicts in MENA countries), demographic developments (e.g., population growth in some parts of the world combined with population ageing in other parts; accelerating emigration from drought-struck areas), and natural loss and climate change may put them in 'triple jeopardy'.[1]

Banks' responses will likely consist of a combination of balance sheet strengthening, technological developments, and personnel skills and training. Being dependent on customers' needs and the strength of (global) regulatory supervision, these responses may either positive (e.g., facilitating the net-zero transition) or negative (e.g., evading sanctions) from a societal point of view.

The rest of the report proceeds as follows. Chapter 1 considers conflicts, Chapter 2 focuses on diseases, Chapter 3 proceeds to natural disasters, while Chapter 4 summarises bank adaptation to disaster risks. Chapter 5 concludes.

1 'Double jeopardy' refers to prosecuting a person more than once for the same offence. It is explicitly prohibited in some legal systems, for example by the Fifth Amendment to the United States Constitution. 'Multiple jeopardy' is "the theory that the various factors of one's identity that lead to discrimination or oppression, such as gender, class, or race, have a multiplicative effect on the discrimination that [a] person experiences" (source: Wikipedia).

CHAPTER 1

Bank adaptation to armed conflicts

1.1 SANCTIONS

1.1.1 Direct effects on banks

Sanctions on bank activities

Despite the long history and large scope of sanctions across the world (Felbermayr et al., 2020; Morgan et al., 2023), existing research on the direct effects of sanctions on banks is rather limited. Because banks may be globally interconnected, it is important to understand how sanctions impact not only the banks operating in sanctioned countries and banks targeted by the sanctions, but also the banks that are not targeted but that also operate within the sanctioned economies (e.g., subsidiaries of foreign banks). It is then crucial to understand how sanctions influence the cross-border operations of the banks operating in the sanctioning countries themselves. Global interconnectedness makes the effects of sanctions non-trivial due to the possibility of sanctions evasion and withdrawal of businesses by foreign banks from the sanctioned host countries.

Targeted banks in sanctioned countries. Mamonov et al. (2023) were among the first to focus on how targeted banks in sanctioned countries adapt their international and domestic operations in response to globally coordinated sanction policy. Their study exploits the episode of Western financial sanctions against Russia's financial sector dominated by politically connected banks in the wake of Crimea's annexation by Russia in 2014. This sanction policy was implemented in a staggered fashion: over the five years between 2014 and 2019, the West recognised 44 banks as being connected to the Kremlin and punished them sequentially in 12 US Office of Foreign Assets Control (OFAC)/ European Commission sanction packages. These 44 state-connected banks held roughly a 61% share of the banking system's total assets as of the end of 2013 (i.e., on the eve of sanctions) and can be broken down into the 'Big Five' banks – four commercial banks (Sberbank, VTB, Gazprombank, the Russian Agricultural Bank) and one development bank (VEB) – and others that were either subsidiaries of the Big Five or owned by rich oligarch families with close ties to President Putin.

Each targeted bank encountered either fully-blocking sanctions (based on the SDN list) or partly blocking sanctions (based on the SSI).[2] The SSI prohibited a targeted bank from only placing new debts (with maturity of more than 30 days) in Western financial markets, but did not threaten the bank's foreign asset holdings, whereas SDN froze any

2 SDN stands for specially designated nationals; SSI stands for sectoral sanctions identifications.

type of operations with the West. Typically, just being owned by the state was punished by the SSI-type sanctions (less restrictive; 20 targeted banks in Russia, including the Big Five). Conversely, being owned by the oligarchs that were helping dictators pursue their aggressive policies (annexations, election interventions, cyber-attacks, etc.) was severely punished by the SDN-type sanctions (the other 24 targeted banks in Russia).

As Mamonov et al. (2023) reveal, the staggered implementation of the sanction policy and the differential design of the sanctions (SSI versus SDN) are the two crucial ingredients for understanding how banks adapted to globally coordinated restrictions. First, the staggered design implies that some banks were sanctioned first, and others were sanctioned later during the subsequent five years. This, in turn, allowed potentially targeted (but not yet sanctioned) banks to adjust their international exposures (i.e., their foreign asset holdings and foreign debts placed in Western financial markets). Clearly, for the first bank that encountered sanctions, Rossiya Bank (ranked 20th in terms of asset size; SDN), the news of the already imposed sanctions in March 2014 was a shock, and the bank had to dramatically reduce its foreign assets (from 25% to just 8% of total assets) and foreign liabilities (from 5% to just 2%) within a few months. But, as Mamonov et al. (2023) find empirically, this was a strong signal to all the other politically connected banks to act.

Second, the fact that SSI sanctions affect only the liability side of targeted banks' balance sheets effectively allowed the SSI-sanctioned banks to continue holding, and even to expand, their foreign assets while reducing their foreign debts after being sanctioned. In this situation, SSI-sanctioned banks encounter a growing FX risk. It is thus natural, given the staggered policy design, that a not-yet-SSI-sanctioned bank may wish to expand, not reduce, its foreign debts before the sanctions close the opportunity window for new borrowings because only new – not already existing – foreign borrowing is forbidden. This would be a natural hedge against likely rising FX risk exposure in the future.

Indeed, running an event-study analysis at a monthly frequency around the first sanction announcement in March 2014, Mamonov et al. (2023) find that the first sanction announcement prompted not-yet-SSI-sanctioned banks to act in advance: before being sanctioned, they increased their foreign borrowings by 2.1 percentage points of their total liabilities during the subsequent two years, relative to a control group of never-sanctioned banks with no political connections. Raw data on Eurobond issues over these periods support this finding.[3] In turn, not-yet-SDN-sanctioned banks began to reduce their foreign borrowings over the same time interval, with the average reduction amounting to –2.4 percentage points relative to the respective control group. This differential adaptation pattern is a consequence of the design of SSI versus SDN sanctions.

3 As Mamonov et al. (2023) further show, foreign investors demanded the same 4.4% coupon rate on these new bonds issued by Russia's major politically connected banks as before the sanction regime in previous years. But the amount of funds the targeted banks raised after the first sanction announcement was at least twice as high as before.

Regarding foreign asset holdings, Mamonov et al. (2023) further establish that both not-yet-SSI-sanctioned and not-yet-SDN-sanctioned banks significantly reduced their exposures: by 2.3 and 2.4 percentage points of the respective banks' total assets over 2014–2015. Clearly, this is evidence suggestive of a fear of asset freezes because under the SSI design, foreign assets are not targeted.

Finally, Mamonov et al. reveal that domestic private depositors started to panic after the first sanction announcement and withdrew substantial funds from not-yet-SSI-sanctioned banks amounting to 2 percentage point of the banks' total liabilities during 2014–2015, equivalent to 1% of Russia's GDP. However, the Russian government stepped in and, as the authors' estimates suggest, directed financial support to those banks which largely exceeded the intended negative effects of the sanctions. As a result, the Russian banking system witnessed no bank failures. All else being equal, the sanctions did not affect the overall trends in the dynamics of credit (which were negative due to the oil price collapse). But the sanctions induced a credit reshuffling effect: not-yet-sanctioned banks reduced corporate credit by 4% of GDP during the five years after the first sanction announcement and raised household credit by virtually the same amount, thus offsetting the total loss at the aggregate level.

Non-targeted banks in sanctioned countries. This important area has not yet been covered by the literature, to the best of our knowledge, and is thus an avenue for future research. The exception is the abovementioned study by Mamonov et al. (2023), in which the authors investigate whether private banks in Russia also tended to reduce their international exposures after the first sanction announcement in March 2014 if they had visible political connections to the Kremlin. They find that such banks indeed acted as though they were anticipating certain types of sanctions, raising foreign borrowings as a share of total liabilities by 1.9 percentage points and shrinking their foreign assets as a share of total assets by 1.4 percentage points. Both effects are close to, though unsurprisingly lower than, the direct treatment effects on the banks recognised as state-controlled. This is important because it shows that sanctions have a broader impact beyond just the intended impact. Below, we expand this analysis by examining the patterns of adaptation to sanctions by the foreign banks in Russia. Foreign banks are clearly not targeted, but they have the option to leave a market once the economy falls under sanctions, which may be perceived as a spillover effect of sanctions.

Non-targeted banks in sanctioning countries. This area of research is also poorly investigated so far. The notable exception is the recent study by Efing et al. (2023), in which the authors attempt to answer the question of how banks operating in a sanctioning country adapt their exposures to the sanctioned countries. The authors exploit unique data on German banks which are obliged to report their international exposures to the Deutsche Bundesbank on the monthly basis (in External Position Reports). The data are part of the overall balance of payment statistics, but are not freely disclosed through the regulator's website. The authors identify those German banks that had connections to 11 different economies that encountered sanctions in 2002–2015 (Iran, Egypt, Syria, Russia, etc.). At first glance, the results appear as expected: German banks reduce the supply

of credit to the countries that encounter sanctions by on average 24%. However, banks may lend to the sanctioned countries both directly and also through their subsidiaries registered in those countries. The caveat that such subsidiaries are not obliged to report to the Deutsche Bundesbank is easily overcome by the fact that the German banks must report lending volumes to their subsidiaries. Efing et al. (2023) find that the banks located in Germany increased their intra-group advances and loans to their branches and subsidiaries in the countries that encountered sanctions by on average 31%. This number varies substantially depending on the institutional characteristics of the sanctioned country. If a sanctioned country is not a member of the Financial Action Task Force (FATF), the estimate is revised upwards to a 66% increase in the supply of funds by the banks located in Germany.

Overall, these important results vividly demonstrate that financial sanctions imposed by one government against other economies may be easily evaded with the help of the banks located in the sanctioning country. It is important to not only prevent sanction evasion by the entities operating in the sanctioned country, but also to create counter-incentives for entities in the sanctioning countries to not help entities in the sanctioned economies. Clearly, given the data at hand, a regulator may easily differentiate all local banks with respect to (i) the size of their exposures to the sanctioned countries, and (ii) the profitability of such exposures. If the exposures are large and profitable, a local bank may have strong incentives to continue and thus violate the sanction regime. The sanctioning government may thus identify all such banks and propose temporary reliefs for them in terms of (profit) taxes, capital adequacy, and so on, in exchange for breaking their connections to the sanctioned countries.

1.1.2 Quantitative exercise #1: Foreign and domestic bank adaptation to financial sanctions against Russia

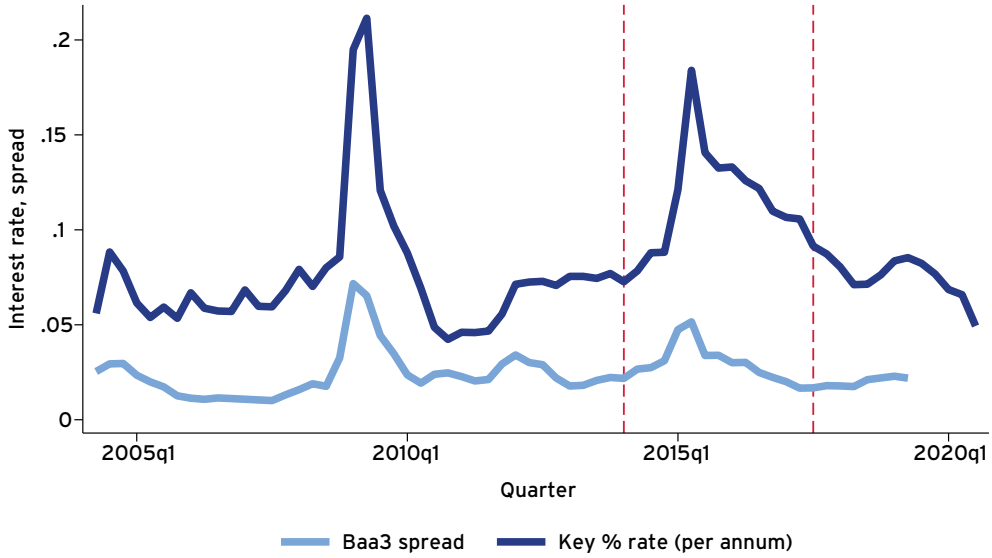
Institutional background

We exploit the case of the long-lasting Russo–Ukrainian conflict and the sanctions against the Russian economy implemented in a staggered fashion between 2014 and 2019 to analyse the adaptation of both state-controlled and foreign banks operating in Russia. Our analysis builds on the study by Mamonov et al. (2023) and extends it by focusing not only on the direct targets of the Western sanctions (i.e., the state-controlled banks) but more on the spillover effects on foreign banks (i.e., the non-targeted group). The adaptation by foreign banks is of great interest because these banks have the option to leave the host market once it falls under sanctions, and may do so due to either reputational concerns or home-country regulatory pressure.[4] However, the foreign banks may instead decide to stay and enjoy a growing competitive advantage over state-controlled banks, whose market power may deteriorate as a result of sanctions. We

4 A recent study by Kempf et al. (2023) establishes that financial intermediaries may act as political partisans: in determining the direction of cross-border flows of their capital, they take into consideration the degree of their partisanship with host-country governments.

conjecture that Western foreign banks tend to reduce their operations in the sanctioned country, if not fully leave, whereas Eastern foreign banks tend to increase their operations in the sanctioned country. The adaptation of foreign banks has been neglected in the academic literature so far, but has been widely discussed by policymakers and the world media covering, among other things, numerous scandals around foreign banks that were helping Russia evade sanctions.[5] Foreign banks in Russia hold a sizeable portion of the banking system's total assets: prior to the first sanction announcement in March 2014, their share was up to 10%.[6]

FIGURE 6 **INTERNAL AND EXTERNAL PRICES OF MONEY FOR THE RUSSIAN ECONOMY DURING THE GLOBAL FINANCIAL CRISIS AND THE WESTERN SANCTIONS**



Note: The chart shows the time evolution of the key regulated interest rate in Russia (the domestic price of money) and Baa3 spread (the external price of money) from 2014 to 2015, when the sanction shock and the collapse of world prices jointly affected the Russian economy.

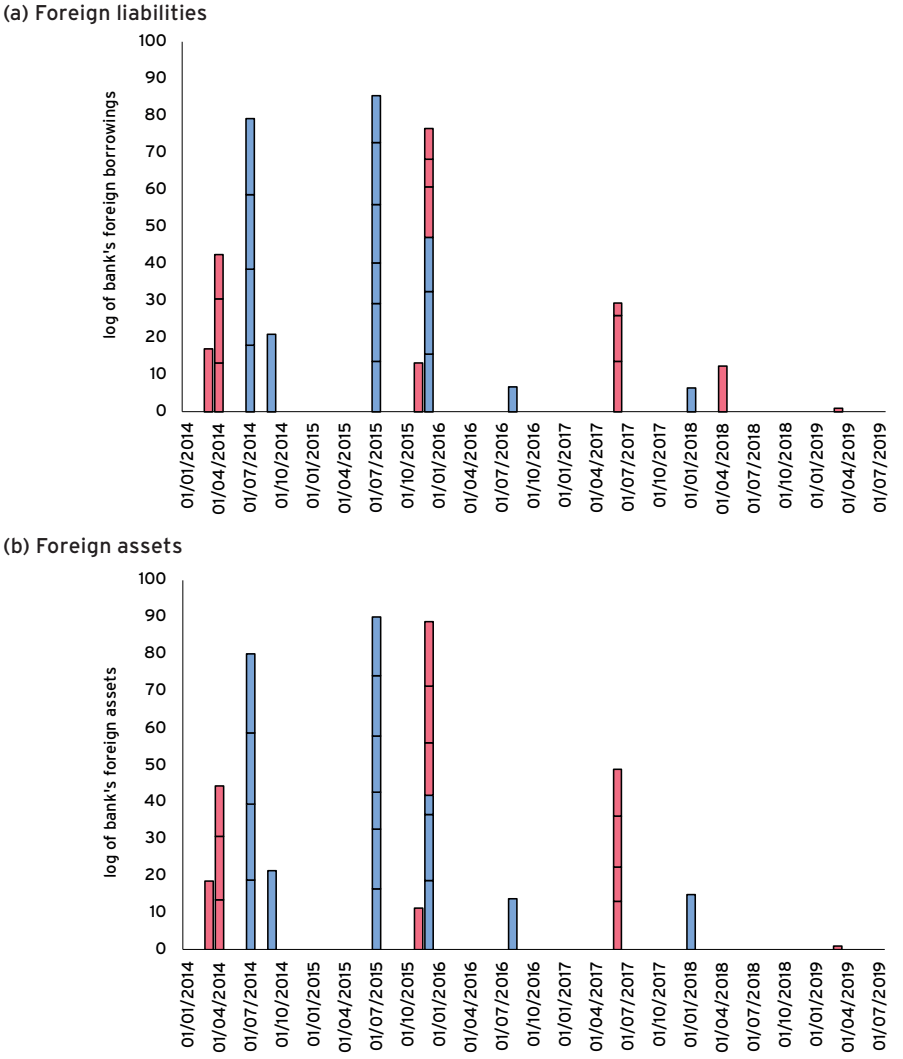
The major difficulty in capturing the effects of sanctions in 2014–2015 is that the sanction shock occurred at the same time as the collapse of world oil prices. This collapse caused major problems in the Russian economy. As the economy was heavily dependent on imports and given the schedule of upcoming repayments of Russian firms and banks on their international debts, the demand for foreign currency skyrocketed, inflation

5 OFAC settled a $3.5 million fine on Svedbank Latvia for violating the Crimea-related sanctions in 2015-2016 (https://ofac.treasury.gov/media/931911/download?inline). The United Kingdom's Office of Financial Sanctions Implementation (OFSI) imposed a £20.5 million fine on Standard Chartered Bank in 2020 for also violating sanctions against Russia (https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/banks-funds-on-alert-as-europe-s-enforcement-of-russia-sanctions-ramps-up-74265833). Globally, since 2007 OFAC and other governmental bodies across the Western world have imposed more than $95 billion in fines on different entities, including $15 billion on foreign banks, for violating sanctions against various dictatorship regimes (https://www.bbc.com/news/business-28021000). Concerning banks, historically the largest case pertains to BNP Paribas, which was fined $8.9 billion for violating sanctions against Cuba, Sudan, and Iran between 2002 and 2012 (https://www.reuters.com/article/us-bnp-paribas-settlement-sentencing-idUSKBN0NM41K20150501).

6 Of course, the state-controlled banks held a much larger share, amounting to 61%.

spiked immediately, and the Central Bank of Russia was forced to raise the key regulated interest rate from 5% to a peak of 17% on 'Black Monday' (15 December 2014), with an average rate of 15% over the first quarter of 2015 (Figure 6). Notably, this tightening of the monetary policy was even larger than that observed during the 2007–2009 global financial crisis in Russia. Clearly, in this environment, any attempts to capture the effects of sanctions on any domestic banks' operations, be they state-controlled or foreign, should take into account (i) depressed demand on credit from local borrowers, and (ii) differential exposure of the banks themselves to the FX risk associated with the oil price collapse.

FIGURE 7 **SANCTION ANNOUNCEMENT DATES AND THE SIZE OF THE FOREIGN OPERATIONS OF TARGETED RUSSIAN STATE-CONTROLLED BANKS**



Note: The charts illustrate the timing of the financial sanctions against Russia's state-controlled banks during 2014-2019, with light red reflecting SDN (blocking) sanctions and blue the SSI (sectoral) sanctions. Each sub-bar represents the log size of a sanctioned bank's foreign borrowings (a) or foreign asset holdings (b).

As Mamonov et al. (2023) point out, the West issued twelve sanction packages against Russia's state-controlled banks over 2014–2019, with the state-owned banks falling under sectoral restrictions (SSI) and politically connected banks financing the conflict in Ukraine under the blocking sanctions (SDN). The SSI sanctions targeted the banks' ability to borrow from abroad and the SDN sanctions effectively terminated both borrowing opportunities and foreign asset holdings. Seven sanction packages were introduced during 2014–2015, covering the banks with the greatest dependencies on foreign borrowings (Figure 7a) and with the largest holdings of foreign assets (Figure 7b). However, even two years may have been enough for not-yet-sanctioned banks to adapt both types of international operations in advance of being sanctioned. Therefore, in what follows we focus only on the very first sanction announcement in March 2014 and its treatment and spillover effects on international and domestic operations of the state-controlled banks and foreign banks.

Empirical design and data

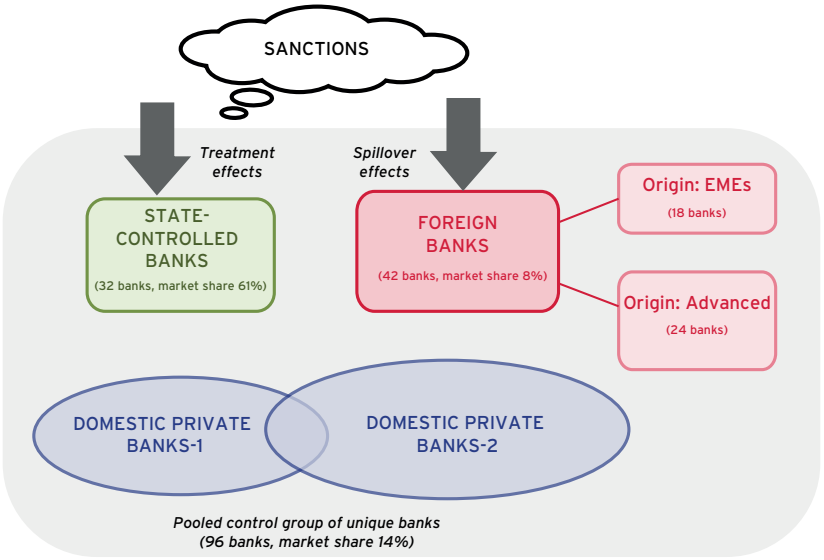
Having defined the timing of the treatment (i.e., before and after the first sanction announcement), we next need to shape the treatment groups and choose appropriate control groups. Because we aim to capture the spillover effects of sanctions on foreign banks (non-targeted by any sanction), we need a treatment group composed of foreign banks. Because the foreign banks – as with any other banks in the system – cannot avoid competition with the state-controlled banks, which dominate the market and are targeted by the sanctions, we also need a treatment group consisting of state-controlled banks.[7] For notational purposes, let us refer to the targeted state-controlled banks as the *treatment group* and to the foreign banks as the *spillover group* (Figure 8).

There are several approaches to constructing the control group of banks when one is focused on the spillover effects of treatment. First, we might identify two separate control groups: matches to the treatment group and matches to the spillover group (both among domestic private banks that are similar in observables). Second, we might identify a single control group consisting of only those domestic private banks that are matched to both the treatment and spillover groups. For the baseline analysis, we choose the first approach.[8]

7 Bircan and De Haas (2019) provide a historical retrospective into the origin of state-controlled banks' dominance in the Russian banking system.

8 It is clear that both approaches possess certain advantages and drawbacks. The first approach delivers more observations, and thus the variation in the matched dataset should be large enough to identify the effects of interest, but this comes at the cost of comparing the effects against two different reference groups instead of only one. The second approach removes the drawback of the first approach, but it assumes there are a sufficient number of domestic private banks that are simultaneously good matches for both the state-controlled and foreign banks. This assumption is quite strong, given the consensus in the banking literature that state-owned banks lack efficiency (La Porta el al., 2002; Sapienza, 2004) and foreign banks, by contrast, are the most efficient intermediaries because they are able to compete not only in their home markets but across the border in host countries (De Haas and Van Horen, 2013).

FIGURE 8 **COMPOSITION OF DIRECTED TREATMENT AND SPILLOVER TREATMENT EFFECTS OF SANCTIONS**



Notes: The figure illustrates the spread of sanctions across the Russian banking system, with a breakdown on directed treatment and spillover treatment effects. Directly treated are state-controlled banks. The spillover effect impacts the subsidiaries of foreign banks operating in Russia, because they may be forced to quit the system for various reasons (e.g., home-country pressure). The picture also shows the breakdown of the foreign banks operating in Russia on those originating from advanced economies and those from emerging market economies (EMEs). Finally, the picture highlights the construction of the matched sample of control banks that are not directly affected by sanctions and have no option to quit – domestic private banks. First, state-controlled banks are 1-to-4 matched with their controls. Second, foreign banks are 1-to-4 matched with their own controls. Third, the two control subgroups are pooled and the duplicate banks are dropped.

To perform our analysis, we use detailed bank balance sheet data at a monthly frequency retrieved from the Central Bank of Russia database from January 2004 to December 2019.[9] We focus on the subperiod of the three years before the first sanction announcement and the three years after it (i.e., March 2011 to February 2017). In this locus of the data, we have 32 out of the 44 state-connected banks that were sanctioned, including major banks such as Sberbank, with a pre-sanction market share of 61% of the banking system's total assets. We also have 42 foreign banks, originating from the West (UniCredit, Raiffeisen, Citibank, etc.) and the East (China Construction, Japi Credit, etc.), with a pre-sanction market share of 8%. Finally, we have 827 'other' banks as of January 2014, which were private domestic intermediaries. We then run the nearest-neighbourhood matching estimator of Abadie and Imbens (2011) to find the two control groups – one for the treatment group and the other for the spillover group. For this purpose, we use observables measured at the bank level during the last two pre-sanction years (2012 and 2013). Observables reflect the pre-sanction structure of assets and liabilities, and profitability, as in Gropp et al. (2019). And we also augment the set

9 One may wish to increase the time span of the sample period by including the post-2021 data covering the Russo-Ukrainian war to analyse the most recent sanctions against all major Russian banks, not only state-controlled, and the exodus of most of the Western foreign banks from Russia. This, though enormously relevant, is not possible: the Central Bank of Russia closed public access to its bank-level database, which had been opened since 2004, because of the war.

of matching observables by including net inter-bank positions in the domestic market, because net exposure in this market is a natural channel for the spillover of sanctions (though we stress that our data allow us to trace only overall, not bank-to-bank, exposure). We drop those private banks that appear twice in the control sample.

Having run two separate matching estimators following the rule of thumb suggested by Abadie and Imbens (2011) (one treated to four controls), we obtain a group of 82 domestic private banks that are controls for the treatment group and another 96 domestic private banks that are controls for the spillover group.[10] We further split the spillover group into two parts – one that corresponds to the foreign banks from advanced countries, another comprised of the foreign banks from emerging market economies (EMEs) – because, as we discuss above, we conjecture that the origin of a foreign bank matters for its adaptation to sanctions and likely affects its desire to stay or to leave.

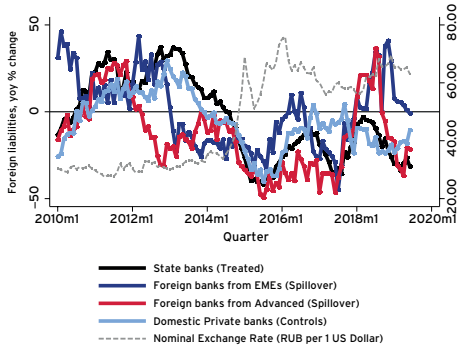
Descriptive analysis at the group level over time shows that all bank groups substantially slowed down their borrowings from abroad (*foreign liabilities*) one to two years prior to the first sanction announcement in 2014,[11] and that the adoption of the sanction regime by the West coupled with the collapse of world oil prices accelerated this process tremendously (Figure 9a). However, what is strikingly clear even from this raw data comparison is that the EME foreign banks operating in Russia began to revive their foreign borrowings at the end of 2015, and then both EME foreign banks and foreign banks originating from the West began to do so at the end of 2017. Very similar patterns apply to the annual dynamics of the *deposits attracted from domestic households* (Figure 9b), with a slowdown prior to the first sanction announcement and an accelerated decline after it. In this case, it is clear that the role of the oil price collapse is substantial: the 'W-shaped' decline of deposits fully mimics the 'M-shaped' depreciation of the ruble during the first two sanction years, which is true for each of the bank groups considered. And again, we observe a skyrocketing recovery of the private deposits attracted by especially the EME foreign banks in 2017.

As for *credit to domestic households and firms* (Figure 9c) and the corresponding *NPLs* (Figure 9d), we document similar trends before the first sanction announcement in March 2014, with smoother dynamics afterwards for the treatment group and more volatile dynamics for the other groups.[12] And again, we clearly observe a revival of credit by all the groups – especially by the EME foreign banks and the Western foreign banks starting from 2017, with only slightly rising NPLs, if any. This implies that borrowers' creditworthiness recovered after the joint oil/sanction crisis, and banks, including foreign ones, returned to expanding their loan portfolios despite the sanction regime.

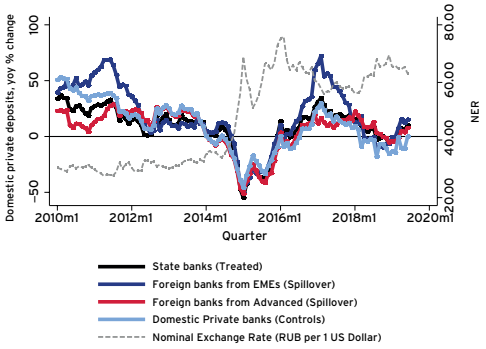
10 The matching procedure implies repetitions, which are dropped from the analysis.
11 This is likely because the Russian economy exhibited the first signs of entering a (local) recession, with the year-on-year growth rate of investment reaching the zero level by the end of 2013.
12 As we discuss above, the treatment group received direct financial support from the Russian government. Bertay et al. (2015) provide cross-country evidence that government-owned banks tend to smooth the amplitude of the credit cycle.

FIGURE 9 **KEY BANK VARIABLES ACROSS DIFFERENT BANK OWNERSHIP GROUPS IN RUSSIA IN THE MATCHED SAMPLE, MEANS ACROSS BANKS WITHIN EACH GROUP**

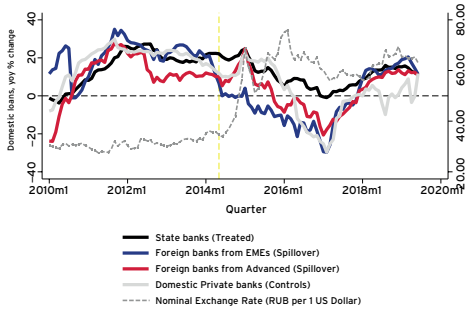
(a) Foreign liabilities (in USD equivalent)



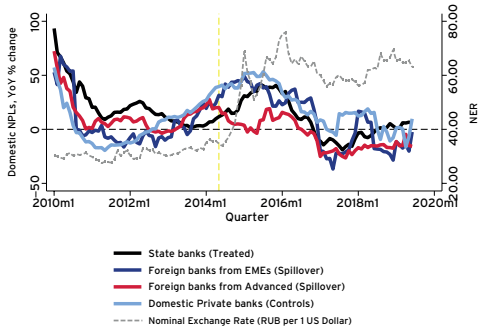
(b) Domestic private deposits (in USD equivalent)



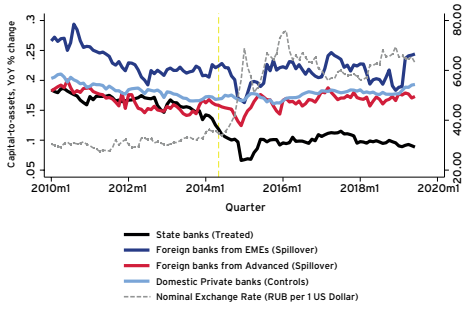
(c) Credit to domestic households and firms (in USD equivalent)



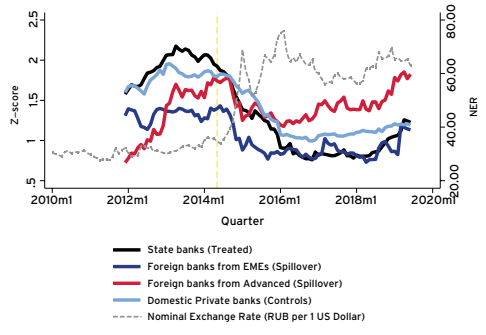
(d) NPLs to firms and households (in USD equivalent)



(e) Capital-to-assets ratio (%)



(f) Z-score of bank stability



Note: The figure reports the time evolution of key banking characteristics at the group level across time. We compute simple averages across the banks within each of the four groups.

Source: Monthly bank balance sheets from the Central Bank of Russia database.

Finally, moving to banking stability indicators, we document similar pre-trends across the four groups of banks in terms of *capital-to-assets ratios* (Figure 9e) and *Z-score*, a popular integral measure of bank soundness reflecting the 'distance to default' (Figure 9f).[13] We observe that EME foreign banks had possibly the largest capital buffers across all groups, which can explain why they recovered their credit faster than the others after the peak decline caused by the oil/sanction crisis. Interestingly, these largest capital-to-assets ratios did not imply the highest overall stability: the Z-score of EME foreign banks was the lowest, which may imply high volatility of their ROAs. Conversely, the Western foreign banks were the most stable group in the Russian economy – especially after the peak of the oil/sanction crisis. This fact may explain why they did not want to leave the market.

We run the following difference-in-differences regression to estimate the spillover effects of sanctions on the foreign banks operating in Russia:

$$\begin{aligned}\ln(1 + Y_{b,t}) = \alpha_b + \gamma_t &+ \beta_1 \cdot (SSI_b \cdot Post2014M3_t) \\ &+ \beta_1 \cdot (SDN_b \cdot Post2014M3_t) \\ &+ \boldsymbol{\beta_3} \cdot (EMEsFOREIGN_b \cdot Post2014M3_t) \\ &+ \boldsymbol{\beta_4} \cdot (AdvancedFOREIGN_b \cdot Post2014M3_t) \\ &+ X_{b,t^*}\psi' + \varepsilon_{b,t}\end{aligned} \quad (1)$$

where $Y_{b,t}$ is a variable of interest covering bank b's foreign and domestic operations and performance indicators in month t. Among foreign operations, we consider borrowings from abroad (the stock of foreign liabilities accumulated to month t) and foreign asset holdings (the stock of foreign assets accumulated to month t). Among domestic operations, we analyse the attraction of private deposits, lending to firms and households, NPLs, personnel expenses, and ROAs. Variables α_b and γ_t are, respectively, bank and month fixed effects. The binary variables SSI_b and SDN_b are the SSI- and SDN-sanctioned banks, which jointly constitute the treatment group but are estimated separately because the designs of SSI and SDN sanctions differ substantially. $EMEsFOREIGN_b$ and $AdvancedFOREIGN_b$ are, respectively, the EME and the Western foreign banks operating in Russia, which jointly constitute the spillover group. $Post2014M3_t$ is a binary variable, which equals 1 for all months after the first sanction announcement. X_{b,t^*} are bank-level control variables used in the matching exercise above and fixed at the pre-sanction level ($t^* \leq Jan.2014$), which aims to capture any residual differences that may still exist between the banks from different groups. $\varepsilon_{b,t}$ is the regression error.

13 The Z-score answers the question of by how many standard deviations a bank's return on assets (ROA) would need to fall to fully deplete its capital (e.g., Beck et al., 2013).

Our null hypotheses are as follows:

H1: *Average decline*. On average, foreign banks reduced their operations in Russia after the first sanction announcement.

H2: *Size matters*. Large foreign banks tended to do so to a greater extent than small foreign banks due to their larger visibility and thus reputational concerns.

H3: *Substitution effects*. EME foreign banks tended to recover their exposures to Russia after the peak of the oil/sanction crisis of 2014–2015, and at a faster speed than the foreign banks from advanced countries.

Table 2 presents the estimation results for the foreign borrowings of Russian state-controlled and foreign banks. Recall that all estimates are in comparison with the control group of domestic private banks. Thus, if we say, for example, that, foreign banks reduced their operations in response to sanctions, it may still be the case that they increased those operations overall but to a lesser extent than the control group. The estimates of the adaptation effects at the monthly frequency show that major politically connected banks (Sberbank, VTB, Gazprombank, Russian Agricultural Bank) first increased their borrowings from abroad by 4% (within a year of the first announcement) but then reduced them by 7.4% (over a three-year horizon). These banks encountered the 'sectoral' (SSI) sanctions from the US Office of Foreign Asset Control targeting only the liability side of the banks' balance sheets. Another portion of (less large, but more responsible for financing the war) politically connected banks were targeted by the 'fully blocking' (SDN) sanctions, which forced these banks to dramatically shrink their stock of foreign borrowings by 10.7% within a year and 15.5% over three years. Our estimates of the spillover effects indicate that in this environment, foreign banks in Russia may have reduced the attraction of funds from abroad by 6.6% in 2014 and 15.9% during 2014–2016, which eventually exceeds the treatment effects on the state-controlled banks. In other words, spillovers matter and may be very large.

However, our analysis further reveals a substantial degree of heterogeneity in the spillover effects of sanctions. First, large subsidiaries of foreign banks reduced their foreign borrowings by more than their smaller peers: by 10% versus only 5% within a year of the first sanction announcement. Moreover, three years after the announcement, small foreign banks stopped reducing their foreign borrowings, whereas large foreign banks continued to do so, and at a fast pace. Second, the previous literature has shown that political partisanship matters for the direction of cross-border flows of capital (Kempf et al., 2023), and our regressions demonstrate that foreign banks originating from the West (e.g., UniCredit, City, Societe Generale, Raiffeisen) reduced their flows of funds to Russia by 30% in the three years after the first sanctions. Conversely, subsidiaries of foreign banks from the East (mainly, Turkey, India, and China) increased their foreign liabilities attracted to Russia by 5.5% over the same period.

TABLE 2 **TREATMENT AND SPILLOVER EFFECTS OF SANCTIONS ON FOREIGN LIABILITIES OF RUSSIAN BANKS**

	Short-run adaptation			Long-run adaptation		
	(1)	(2)	(3)	(4)	(5)	(6)
SSI × Post 2014	0.042**	0.041**	0.041**	−0.074*	−0.074*	−0.074*
	(0.019)	(0.019)	(0.019)	(0.039)	(0.039)	(0.039)
SDN × Post 2014	−0.108***	−0.108***	−0.107***	−0.155***	−0.153***	−0.157***
	(0.027)	(0.027)	(0.027)	(0.049)	(0.048)	(0.049)
All foreign × Post 2014	−0.066***			−0.159***		
	(0.017)			(0.027)		
Big foreign × Post 2014		−0.103***			−0.405***	
		(0.018)			(0.028)	
Small foreign × Post 2014		−0.053***			0.020	
		(0.018)			(0.029)	
Foreign (EMEs) × Post 2014			−0.025			0.055**
			(0.016)			(0.027)
Foreign (advanced) × Post 2014			−0.100***			−0.330***
			(0.021)			(0.028)
No. observations	5,701	5,701	5,701	16,058	16,058	16,058
No. banks	248	248	248	252	252	252
R^2 (within)	0.128	0.136	0.129	0.174	0.197	0.184

Notes: The table presents the difference-in-differences estimates of the effects of the first sanction announcement against Russian banks in March 2014 on the stock of foreign liabilities of state-connected (directly targeted) and foreign (spillover) banks over a short-run period (within 12 months, columns 1–3) and a longer-run period (up to 36 months, columns 4–6). ***, **, and * signify an estimate is significant at 1%, 5%, 10%, respectively. Standard errors are clustered at the SSI, SDN, and foreign bank levels and appear under the estimated coefficients.

We further discuss the treatment and spillover effects of sanctions on domestic (within-Russia) operations of state-controlled and foreign banks, respectively. The estimates appear in Table 3.

While not-yet-sanctioned (but targeted) banks faced withdrawals of private deposits under the threat of upcoming sanctions, our further estimates show that these sanction-induced outflows were fully offset by inflows to the Eastern-originating foreign banks in Russia, which enjoyed an increase in the intensity of private deposit attraction of 1.4 percentage points at a monthly frequency over the three-year horizon. Western-originating foreign banks experienced no such effects. This implies that on the liability side, a staggered sanction policy together with greater political partisanship might have helped increase the competitive advantages of the Eastern-originating foreign banks over other local banks, which could have been further used to extend more credit to specific sectors of the economy.

TABLE 3 **DIRECT AND SPILLOVER EFFECTS OF SANCTIONS ON OTHER VARIABLES OF RUSSIAN BANKS AT A LONGER HORIZON: SUMMARY FROM DIFFERENT REGRESSIONS**

	Directly targeted banks		Spillovers	
	SSI banks	SDN banks	Foreign banks (EMEs)	Foreign banks (advanced)
1. Domestic private deposits	-0.003 (0.004)	-0.009** (0.005)	0.014*** (0.004)	-0.003 (0.003)
2. Domestic lending to households	0.007*** (0.002)	0.010*** (0.004)	0.011*** (0.003)	0.002 (0.003)
3. Domestic lending to firms	0.006** (0.002)	0.002 (0.004)	0.000 (0.004)	0.008*** (0.002)
4. NPL (households)	-0.004 (0.007)	0.018*** (0.007)	-0.040*** (0.006)	-0.009 (0.008)
5. NPL (firms)	-0.004 (0.004)	-0.007 (0.004)	-0.041*** (0.004)	-0.002 (0.004)
4. Personnel expenses	-0.002 (0.002)	-0.001 (0.002)	0.001 (0.002)	0.005*** (0.002)
5. Return on assets (ROA)	-0.034*** (0.013)	-0.021 (0.020)	0.052*** (0.016)	0.044*** (0.015)

Notes: The table presents the difference-in-differences estimates of the effects of the first sanction announcement against Russian banks in March 2014 on various variables of state-connected (directly targeted) and foreign (spillover) banks over a longer-run period (up to 36 months). ***, **, and * indicate estimate is significant at the 1%, 5%, 10% level, respectively. Standard errors are clustered at the SSI, SDN and foreign bank level, and appear under the estimated coefficients.

Indeed, as our further regression results show, the Eastern-originating foreign banks were able to increase the monthly intensity of lending by 1.1 percentage points in the three years after the first sanction announcement. Interestingly, these additional loans were directed to households, which are less likely to face sanctions than firms whose political ties are less certain. Surprisingly, our results also indicate that the Western-originating foreign banks also raised the intensity of lending in the Russian economy after the first sanction announcement. However, differently from their market rivals originating from the East, they tended to speed up lending to non-financial firms by 0.8 percentage points at a monthly frequency over the three-year horizon. Although we also obtain that politically connected (but not-yet-sanctioned) banks in Russia were also able to accelerate credit to both households and firms (which became possible thanks to the privileged support from the Russian government), our results clearly indicate large differences in the quality of loan management. Foreign banks, especially those from the East, were able to combine rising lending intensities with declining NPL ratios, whereas politically connected banks encountered a significant increase in their NPLs over a longer period. Eventually, the sanction-induced downward shift of the annualised ROAs of the politically connected banks approached -0.41 percentage points (with the overall net-of-taxes and net-of-loan loss reserves ROA being just 0.5% in early 2014). Conversely, the sanction-induced upward shift in the ROAs of both the Eastern- and Western-originating foreign banks in Russia is estimated at +0.6 percentage points (the respective overall ROAs were 1.2% for both types of foreign banks in 2014).

These results, in addition, speak to a misallocation of the sanction-induced government support directed towards politically connected banks, and suggest that foreign banks were likely to extract more profits from this situation. The fundamental difference between the Eastern- and Western-originating banks in this sense is only in whose money was used to finance the additional growth of lending to the sanctioned economy. The Eastern banks attracted new funds both domestically and from abroad, whereas the Western banks relied on existing funds and may have substituted between different types of current assets.

Summarising our findings, we cannot fully accept the **H1** (*average decline*) hypothesis for foreign banks: they did shrink their foreign borrowings (except for EME foreign banks), but they raised the intensity of domestic borrowings within Russia and further increased lending. This implies a substitution of foreign for domestic borrowing by the foreign banks that desire to stay in the sanctioned country. We can then accept the **H2** (*size matters*) hypothesis, as larger subsidiaries of foreign banks in Russia reduced their foreign borrowings faster than their smaller peers. And finally, we can partly accept the **H3** (*substitution effects*) hypothesis, because our estimates suggest that EME foreign banks turned to increasing their foreign borrowings to Russia after the peak of the oil/sanction crisis of 2014–2015, whereas the foreign banks from advanced countries tended to reduce those steadily over time. But at the same time, even the latter group tended not to leave Russia and turned to expanding domestic lending within Russia using the funds of local households.

Overall, in a single regression model, we show that the first sanction announcement against Russia in March 2014 forced not only its state-controlled banks to adapt their international exposures in advance, as has recently been established in the literature, but also subsidiaries of foreign banks operating in the sanctioned Russia. The patterns of foreign banks' adaptation are not trivial: sanctions against state-controlled banks did not force them to leave the Russian banking system but, by contrast, to expand their lending operations once the peak of the oil/sanction crisis of 2014–2015 had passed. Foreign banks from advanced countries turned to increasing corporate lending and foreign banks from EMEs to household lending, compared to the control group of non-targeted domestic banks. This points to the market competition mechanism. Indeed, as a result of this type of adaptation, foreign banks significantly improved their ROAs, whereas sanctioned banks experienced a decline in ROAs. This, in turn, rationalises why, in the current situation of the war against Ukraine and the substantially deteriorated reputation of the Russian government, some foreign banks from advanced countries still prefer to stay in Russia rather than leave.

The presented estimates of the treatment and spillover effects of sanctions can be further used in a calibration exercise aimed at evaluating the affected banks' discounted expected losses (DELs) and probabilities of default (PDs). Applying Merton's structural model of a bank, one can show that our estimates imply low DELs and PDs for SSI-sanctioned banks, consistent with what we observed in the 2010s. For SDN-sanctioned banks, the calibrated DELs are large but the PDs are low, which is also supported by the real data.[14]

1.1.3 Indirect effects on banks through their borrowers

Impact on firms

International sanctions not only affect banks directly, but also indirectly through their impact on firms, households, and the economy at large. Sanctions interfere with both sides of the balance sheets of firms and other agents in the economy, shifting their income and costs. These shifts are caused by the following three intended mechanisms of sanctions: (i) breaking of established international trade flows, (ii) breaking of existing international bank-firm relationships, and (iii) freezing of global inter-bank operations (Figure 10). However, the negative effects caused by the intended mechanisms also provoke both affected firms and banks across the board to develop countermeasures aimed at (partial) evasion of the sanctions by relaunching their prior operations through (a set of) unaffected firms and unaffected banks from the *sanctioned* economies.[15] The overall indirect effects of sanctions on banks depend on the interplay between these negative intended effects and positive unintended effects. But clearly, from the banking perspective, the indirect effects of sanctions manifest in unexpected and ex-ante unpredictable changes in the customers' ability to (i) repay existing loans and demand new loans, and (ii) continue depositing existing and place new savings in banks.

Let us consider these intended and unintended mechanisms in greater detail. In what follows, consider two economies: a sanctioned economy (the one that commits a crime) and the sanctioning economy (the one that punishes the crime by imposing sanctions).[16] Both countries possess banking systems and real sectors of the economy, which are closely interconnected at the pre-sanction stage. With the help of international payment systems (e.g., SWIFT),[17] the connections flourish through *cross-border trade* (i.e., the

14 We thank our discussant Elisa Luciano for providing us with the results on this calibration exercise.

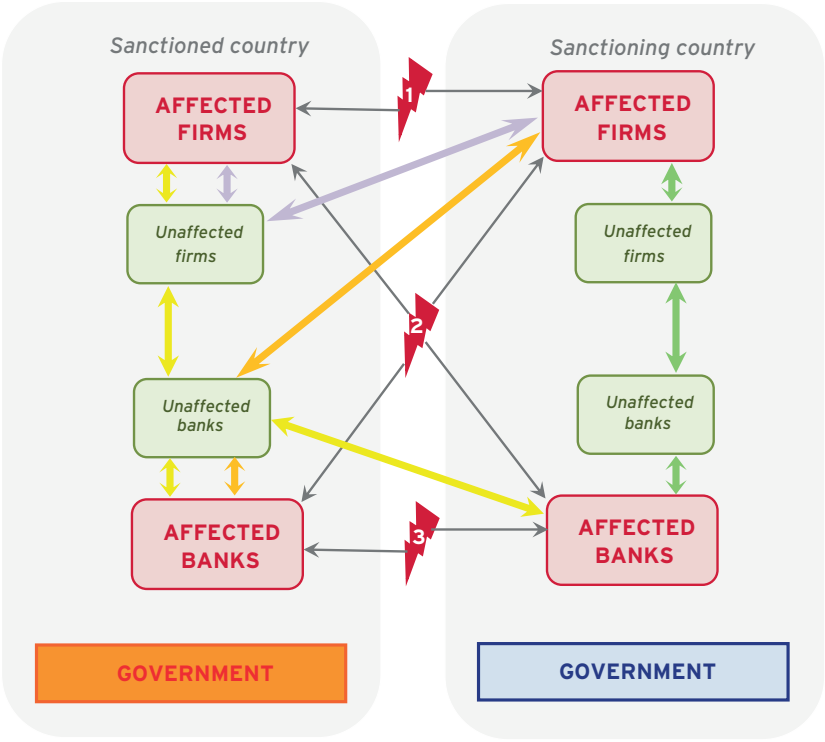
15 This is straightforward under a 'smart sanction' regime (Ahn and Ludema, 2020), but is much less possible under full-blockade regimes adopted by a large set of allies against of a particular country (territory), as it is the case, for example, with Iran (Laudati and Pesaran, 2023) or Gaza (Etkes and Zimring, 2015). However, even in these cases, the blocked countries may partly substitute the lost relationships with non-allied countries. Regarding the latter, this is what we clearly observe in the case of Russia: despite the full-scale war against Ukraine and 11 packages of the Western sanctions in response, different sectors of the Russian economy (e.g., agriculture, fertilizers, pharmaceuticals) still continue trading with the West, though less than before, and substitute for the lost trade flows with the East (as of mid-2023, Russia had fully recovered its imports to the pre-war level). Clearly, this creates an opportunity for Russian banks to survive and even expand.

16 Of course, in reality there are also third parties – the countries that keep neutrality in particular international conflicts (e.g., China, India, Turkey and others in the current Russia-versus-the-West conflict). But, for simplicity, let us omit those and assume, without loss of generality, that those sanction evasion schemes considered here may be just enlarged with the help of the neutral countries.

17 Cipriani et al. (2023) deliver a comprehensive survey on the role of SWIFT in implementing international sanctions and reenforcing their intended negative effects through the history of sanctions over the last seven decades.

exchange of real assets and services) and *cross-border financial flows* (i.e., placing bonds, obtaining syndicated loans, and developing inter-bank operations). Once the government of one country commits a crime and the government of the other imposes sanctions, these economic connections are distorted in the following ways (Figure 10).

FIGURE 10 **WHAT IS BROKEN BY SANCTIONS, AND HOW THOSE BREAKS CAN BE RESTORED:**
The effects of international sanctions on banks through firms



Note: The figure illustrates that sanctions may involve a triple negative cross-border effect for both sanctioned and sanctioning countries: (i) breaking of international trade flows between affected firms, (ii) breaking of existing international bank-firm relationships, and (iii) breaking of existing international inter-bank operations. The figure also summarises sanction evasion schemes: broken trade flows may be (partly) recovered using unaffected firms in the sanctioned country; broken cross-border lending relationships can be (partly) restored by unaffected banks in the sanctioned country. Finally, the figure also demonstrates that broken relationships between the sanctioned and sanctioning countries may lead to within-country substitution effects via the establishment of new bank-firm relationships within the sanctioning country (or across sanctioning countries).

Breaking of international trade flows. Firms that have political ties to the government of the sanctioned country are the first targets of sanctions. Once sanctioned, they must either completely shut down their trading operations with the firms from the sanctioning country (i.e., armaments, under the SDN regime) or at least reduce some of them alongside specific categories (i.e., double-use technologies, under the SSI regime). These full or partial bans on cross-border trade flows immediately lead to a slump in income on the balance sheets of both types of affected firms – in the sanctioned and the sanctioning countries (and more so if the political distortions are truly exogenous

and thus unexpected by the affected firms).[18] Importantly, from the banking perspective, these sanction-induced slumps in trading firms' income may entail far-reaching consequences not only for the banking system of the sanctioned country, but also for that of the sanctioning country:

- *Affected firms in the sanctioned country* may have been large enough to borrow from both domestic and global banks.[19] After the sanction-induced slump in income, these firms are likely to experience difficulties in repaying those loans. As a result, the banks involved – both domestic (affected banks in the sanctioned country) and global (affected banks in the sanctioning country) – are likely to encounter a spiral of negative effects: rising NPLs and, depending on the size of the sanction shock, shrinking ROAs and even declining CARs. Binding CAR constraints may further entail negative feedback loops in both sanctioned and sanctioning economies, as the affected banks may be forced to slow down lending to unaffected firms.[20]
- *Affected firms in the sanctioning country,* having encountered the slump in their income, may produce additional negative feedback effects on both their domestic and foreign (i.e., sanctioned) banking systems. The same logic with binding CAR constraint applies. Clearly, the negative feedback effects in the sanctioned country are intended, but they are inseparable from the same effects in the sanctioning country, which are unintended but unavoidable due to the pre-sanction interconnectedness of the two economies.

The negative feedback effects of sanctions may be substantially mitigated by the governments of each of the two countries – by tax cuts, additional subsidies, and injecting cheap long-term funds – if the governments and their central banks have enough reserves. However, even in the absence of such government support, affected firms

18 The literature on sanctions provides rich empirical evidence on the absence of differential trends in the time evolution of variables under interest (e.g., the absence of pre-trends) between treated (i.e., affected) and control (i.e., similar but unaffected) firms and banks (e.g., Keerati, 2023; Mamonov et al, 2023; Nigmatulina, 2023).

19 As an example, one of the largest Russian oil companies, Rosneft, was sanctioned right after Crimea's annexation in 2014, but it had a five-year syndicated loan of $21.7 billion issued by a number of banks, including foreign ones (including Barclays Bank PLC, The Bank of Tokyo-Mitsubishi UFJ, Ltd., BNP Paribas, UniCredit Group, Morgan Stanley, and others).

20 Generally, as Gropp et al. (2019) show in the setting of the European Banking Authority's intervention in banks experiencing a lack of capital, the affected banks are more likely to squeeze risk-weighted assets (i.e., lending to the economy) than inject new funds into the banks' capital.

may appeal to various sanction evasion schemes, which effectively relaunch the direct trade connections broken by the sanctions with the help of intermediaries. Among such intermediaries, one can find examples of exploiting unaffected firms in the sanctioned country or in neutral countries.[21]

However, no sanction evasion scheme comes without a cost. Resettling trading operations through an intermediary may involve additional costs due to the increasing complexity of logistics, accounting, management and so on, as well as markups required by the chosen intermediary. Both types of evasion-induced costs are likely to reduce the performance of the affected firms in the sanctioned country and adversely impact their ability to repay loans received from both domestic (sanctioned) and foreign (sanctioning) countries.

Breaking of international bank-firm relationships. In addition to distorted trade flows, (financial) sanctions hit (i) the ability of firms in the sanctioned country to continue borrowing from abroad (i.e., from the banks in the sanctioning country); and (ii) the willingness of banks in the sanctioned country to lend to firms in the sanctioning country. Even under a milder SSI regime, an affected firm in the sanctioned country is no longer able to borrow from abroad. If, in turn, a bank falls under the SSI sanctions, it is still able to continue lending to the firms in the sanctioning country (and also buying other assets),[22] but its willingness to do so may fall considerably due to the growing fear of asset freezes abroad. These fears are likely to be fuelled by the uncertainty regarding the sanction policy: the government of the sanctioning country may decide to reinforce the sanctions by substituting the SSI for the SDN regime against the bank(s) to further increase the pressure on the unfavourable political regime in the sanctioned country.[23] Under the fully blocking SDN regime, all lender-borrower operations are shuttered, as we discussed above (Section 1.1.1).

Clearly, it does not make sense for the government of the sanctioning country to impose restrictions on purely local firms (even if connected to the criminal government) – that is, firms that operate only in domestic markets and do not export their products to the sanctioning country. Therefore, sanctions are most harmful when they affect exporting

21 A vivid example of this 'triangular' sanction evasion scheme comes from Russia's adaptation to the 10th package of sanctions introducing the $60 price cap on the price of crude oil exported from Russian ports from 5 December 2023. Media reports by Investigate Europe and Reporters United dated 27 January 2023 showed that soon after the enactment of the price cap, Russia sold some of its tankers for oil transportation to Sun Ship Management, a firm registered in the United Arabian Emirates, and simultaneously introduced four persons from the largest state-holding company Sovkomflot (under the SDN sanctions) to the board of directors of Sun Ship Management. Formally, the tankers are no longer Russian and thus may be insured. During the two months after the price cap introduction, these tankers delivered Russian oil to Belgium, Greece, Spain, and Poland. See also Hilgenstock et al. (2023), who detail daily data on the trade flows from all Russian ports since the Russo-Ukrainian war in 2022, and a more recent media report by Bloomberg ("Russia Still Relies on Europe to Ship its Oil Despite Price Cap Breach", 27 September 2023).

22 Recall that only the liability side of affected agent's balance sheet is restricted under the SSI.

23 As an example, the largest Russian bank, Sberbank, fell under the SSI sanctions in 2014 after Crimea's annexation, but it then encountered the SDN sanctions in 2022 after the Kremlin launched a full-scale war against Ukraine. The latter effectively blocked the bank's ability bot only to borrow in Western countries but also to hold all types of assets there. Even between 2014 and 2022, when Sberbank was allowed to lend to Western companies, the bank's foreign operations were primarily focused on syndicated lending to firms in non-Western countries, including former USSR republics Kazakhstan ($300 million to the Aktobe Copper Company in October 2020), Belarus (€550 million to Belaruskali, a potash fertilizer company, in July 2015), and others.

firms. Being usually among the most competitive in the domestic economy, and probably in the global economy, exporting firms are likely to enjoy the highest credit ratings. This allows banks – both domestic (sanctioned country) and foreign (sanctioning country) – to set lower interest rates and create lower loan loss provisions (LLPs) when lending to exporting firms at the pre-sanction stage. Once sanctions fall from the sky (from the lenders' perspective), exporting firms suffer from reduced trade flows and income cash flows (see above), and eventually their credit ratings deteriorate. This creates negative feedback effects for the lenders in both countries. For example, banks from the sanctioning country now have a choice: either accelerate the loan (i.e., force a sanctioned firm to amortise the loan in advance) or continue holding the loan until it is matured, but with a necessity to raise LLPs because of deteriorated credit rating of the sanctioned firm. The foreign banks thus have large incentives to choose the first option. The supply of direct lending ceases, and this likely creates certain obstacles for the affected firms in redirecting their exporting activities towards neutral countries.[24]

But the cease of direct lending does not necessarily imply that the banks from the sanctioning country will fully suspend credit inflows to the sanctioned country. First, they may lend to unaffected banks in the sanctioned country, and these unaffected banks, in turn, may direct the flow of funds to the affected firms (a typical triangular sanction evasion scheme).[25] Among the unaffected banks, there may be subsidiaries of the banks from the sanctioning countries (Efing et al., 2023), which further simplifies the cross-border transactions, as we discussed above (Section 1.1.1). Second, the banks from the sanctioning country may also increase lending to unaffected firms in the sanctioned country. Once sanctions arrive, the unaffected firms may obtain a competitive advantage over their sanctioned peers in the domestic market. This competitive advantage may bring additional revenues for the unaffected firms, which may then beckon the banks from the sanctioning countries.[26]

24 More generally, using the setting of Global Financial Crisis of 2007–2009 and the credit register from Peru, Paravisini et al. (2015) establish that a 10% reduction in the supply of credit leads to a 1.8% contraction of the export intensity (highly significant) and only a 0.3 percentage point decrease in the likelihood of entering new export markets (insignificant). This occurs through an increase in the variable cost of production. We can thus infer that in the case of sanctioned firms, export intensity will not collapse: the firms will find new lenders and reorient their exporting flows towards neutral countries.

25 DealScan data on syndicated loans across the world show that two large Russian banks that were free of a sanction burden, Sovkombank and Moscow Credit Bank, attracted $590 and $300 million, respectively, in the second half of 2021 (i.e., on the eve of Russo-Ukrainian war). The syndicates of foreign lenders contained banks from not only Eastern countries but also major banks from Western countries (Citibank, Credit Suisse (Switzerland) Ltd, ING Groep, Credit Agricole, HSBC, Bank Intesa). Though we do not have access to the Russian credit register and thus are not able to trace how the two non-sanctioned Russian banks used these syndicated loans, in principle nothing prevented them from spreading those funds across the sanctioned firms within Russia.

26 Another portion of DealScan data reveals that syndicated lending from Western banks to Russian non-sanctioned companies shrank considerably during the first year of sanctions: over 2014, the total volume of syndicated loans attracted from abroad amounted to only $11.7 billion, compared with $48.4 billion attracted in 2013. However, the inflow of syndicated loans did not collapse to zero – at least until 2022, when the Russo-Ukrainian war began. For example, Russia's large fertilizers company EvroKhim attracted $1 billion from a syndicate of ten banks, including Citibank, Commerzbank Group, Credit Agricole CIB, Credit Suisse, ING Groep, Mizuho Bank Ltd and UniCredit. Aggregated data from DealScan for the pre-war year of 2021 demonstrate that Russia's non-sanctioned firms and banks attracted $16 billion, €10 billion, and CHF 0.6 billion, which together are equivalent to 1.6% of Russia's GDP in that year.

Finally, from the perspective of affected banks in the sanctioned country, lending to firms in the sanctioning country may also be restored, at least partly. To circumvent the fear of asset freeze when under the SSI sanctions, or to avoid international restrictions when under the fully blocking SDN sanctions, the banks from the sanctioned country may first lend to unaffected banks from the domestic market, which may then direct the lending flows to the sanctioning country (again, a triangular sanction evasion scheme). Of course, as we discussed above, including an intermediary in the existing international bank-firm relationships brings markups, which the unaffected banks are likely to require from the affected banks to cover reputational risks and the risk of secondary sanctions. These markups eventually raise the final interest rates for the borrowers from the sanctioning country. And if these final interest rates are higher than those the firms in the sanctioning country can obtain in the domestic banking market (or in neutral countries), the triangular sanction evasion scheme becomes senseless, and we may observe the creation of new bank-firm relationships within the sanctioning country to meet the released demand for credit.

Existing literature on economic sanctions, though rapidly growing over the last decade, does not cover all the generic cases of what is broken by sanctions and how it is restored (Figure 10), being mostly focused on trade sanctions and thus leaving a large avenue for future research. We provide a summary of the key findings from recent studies on the effects of trade sanctions on firms from both sanctioned and sanctioning countries in Table 4. We then discuss the implications of these findings for banks and their adaptation to sanction-induced changes in firm performance.

The study by Ahn and Ludema (2020) is a first comprehensive attempt to evaluate the effects of sanctions on the performance of targeted firms. They exploit the case of 'smart' sanctions imposed by the US and major European countries on Russia in 2014 after Crimea's annexation. The comprehensiveness of their approach rests on how they construct the sample of targeted firms (treatment group) and how they match them to non-targeted peers (control group). Using official sanction lists disclosed through the US OFAC's website, the authors identify 584 companies in Russia that encountered sanctions between 2014 and 2016. Further, using the corporate ownership (cross-country) database of the Bureau van Dijk (BvD) and the 50% rule, the authors identify 2,290 firms throughout the world that were subsidiaries of the 584 sanctioned companies in Russia. Consequently, the authors build the control group using the firms that: (i) were non-sanctioned, (ii) originated from the same home country, (iii) operated within the same sector of the economy,[27] and (iv) possessed similar fundamental observable characteristics (size of total assets, operating revenue, number of employees).[28]

27 Firm classification from the 4-digit NACE Rev. 2 code specification.

28 In this setting, the empirical analysis of sanctions captures the truly global effects of international restrictions. The authors are also able to control for country-sector-time fixed effects, which effectively remove any biases stemming from local business cycle conditions. This is especially important for Russia: in 2014, world oil prices collapsed and Russia's ruble lost roughly 90% of its value against the euro and the US dollar. Inflation soared, given the large share of imported goods and services, and the economy entered a local recession. One could argue that sanctions could have only a minor role in these circumstances, if any.

TABLE 4 IMPACT OF SANCTIONS ON NON-FINANCIAL FIRMS

Study	Country and sample	Period	Firms in sanctioned countries			Firms in sanctioning countries		
			Size	Empl.	Sales	# Exp firms	Empl.	Trade losses
Ahn and Ludema (2020)	Russia: 2,832 firms[a]	2014–2016	–50%	–34%	–26%			
	2,793 regular		*–54%*	*–38%*	*–29%*			
	39 strategic		*+21%*	*+17%*	*+15%*			
Nigmatulina (2023)	Russia: 932 firms	2014–2020	+37%	+12%	+23%			
Keerati (2023)	Russia: 650 firms	2011–2020	+33%		+61%			
Huynh, Hoang and Ongena (2022)	Russia: 788 firms	2000–2019			–17 pp			
Pestova and Mamonov (2023)	Russia: 7,460 firms[b]	2012–2020						
	Small & high TFP				0%			
	Small & low TFP				–1%			
	Large & high TFP				–2%			
	Large & low TFP				–4%			
Mamonov, Pestova and Ongena (2023)	Russia:[c]	2011–2017						
	(S)bank×(NS)firm		0	0	0			
	(NS)bank×(S)firm		+15%	+59%	–17%			
	(S)bank×(S)firm		–35%	–52%	–49%			
Crozet and Hinz (2020)	37 Western countries	2014–2015						–$42 bn (–0.3%)
	Russia	2014–2015			–$53 bn (–7.4%)			
Crozet, Hinz, Stammann and Wanner (2021)	France: ≥150,000 firms exporting to:							
	Russia					–23%		
	Iran					–39%		
Besedeš, Goldbach and Nitsch (2021)	Germany: ≥5,000 firms exporting to 23 sanctioned countries	1999–2014					–1.5%	–6.3%
Lastauskas, Proskute and Zaldokas (2023)	Lithuania: 25 firms exporting food to Russia	2011–2017					–67% to –6.8%	≤–38% to +16%

Note: The table compares the estimated effects of sanctions on firm performance in sanctioned countries (*Size* is the log of total assets, *Empl* is either the number of employees or the log of wage bills (Nigmatulina, 2023), *Sales* are either the log of total revenue or the growth rate of total revenue) and on firm performance in sanctioning countries (*# Exp firms* is the number of firms exporting to sanctioning countries, Empl is the number of employees, and *Trade losses* are losses on either domestic or external trade (Crozet et al., 2021). [a] Among the 2,832 sanctioned firms, 39 are strategic – they affect GDP formation, employment, and financial stability. [b] Differently from other studies, the sample includes not only sanctioned but also non-sanctioned firms. [c] The sample contains only the 59 largest Russian firms that were borrowing through the syndicated loan market within Russia. S and NS stand for sanctioned and non-sanctioned, respectively, and × denotes bank-firm lending relationship.

By employing a difference-in-differences estimator, Ahn and Ludema (2020) find that the targeted Russian firms and their subsidiaries abroad encountered substantial negative effects compared to their non-sanctioned peers: the size of total assets plummeted by 50%, employment collapsed by 34%, and total sales shrank by 26%. The subsequent estimates show that these average effects were primarily driven by declining Western private sector service inputs into the gross value added of the sector of the Russian economy in which a given sanctioned firm operated. The channel of non-service inputs from the West appears to be insignificant.

Prior to drawing conclusions for banks that could lend to such firms in different sanctioned countries, it is necessary to go through the next step of the authors' analysis. Their idea is that the Russian government could 'shield' sanctioned firms, but not all sanctioned firms are equally important to the government. The important ones are the strategic firms – those entities that (i) ensure country-wide military defence; (ii) are large enough to affect the volume of GDP, the employment rate, and social stability; and (iii) shape systemic financial stability. Using the official list disclosed by the Russian government, Ahn and Ludema (2020) reveal 374 strategic firms and find that only 40 of them fell under sanctions. Reproducing their difference-in-differences analysis by employing heterogeneous treatment effects, they achieve a very important result: sanctions led to a substantial improvement in the performance of strategic firms, while those dramatic negative effects discussed above pertain only to non-strategic sanctioned firms. Compared to respective control entities, 'strategic' sanctioned firms increased the size of their total assets by 21%, employment by 17%, and sales by 15% during the two years after 2014. Although the authors have no access to data on government contracts and subsidies, they refer to a large body of anecdotal evidence on government support of targeted, especially strategic, firms after the sanction regime had been adopted.[29]

Subsequent studies on the performance of Russian firms under sanctions obtained mixed, and somewhat conflicting, results. Nigmatulina (2023) and Keerati (2023) both conclude that even the overall average effects of sanctions were positive, not negative as in Ahn and Ludema (2020), due to the activated government support. Also employing also a difference-in-differences approach, in which a firm is treated if it falls under the US OFAC's and other Western sanctions, they estimate that the size of targeted firms' total assets increased by between 33% and 37% and their sales spiked by 23% (Nigmatulina, 2023) up to even 61% (Keerati, 2023), compared to control firms, over three to six years after the first sanction shock. Nigmatulina (2023), in addition, shows

29 Nigmatulina (2023) provides a formal proof of these results: employing the administrative data on government contracts, subsidies, and loans, she runs difference-in-differences regressions with heterogeneous treatment effects and demonstrates that subsidies to the main state-owned enterprises (SOEs) was the principal channel through which the Russian government shielded its economy from sanctions. After 2014, SOEs enjoyed an enormous 312% increase in the volume of subsidies, compared to control firms. Other instruments of government support were applied not just to SOEs but to any sanctioned entities: contracts spiked by 37% and credit cash-in grew by 32%, compared to control firms. Mamonov et al. (2023) provide further evidence of directed government support to the major Russian banks that fell under the SSI sanctions in 2014: compared to their control peers, the SSI-sanctioned banks enjoyed an inflow of municipal and federal governments' deposits of 0.5 percentage points of their total liabilities and another 2.0 percentage points of total liabilities in the form of loans from the Central Bank of Russia.

that sanctioned firms increased salaries by 12% in response to sanctions. It appears, however, that the empirical approaches employed in the three studies are not directly comparable. Nigmatulina (2023) and Keerati (2023) focus on the firms that operate only within Russia, i.e., they ignore the sanctioned firms' subsidiaries abroad. Nigmatulina (2023), despite starting with a number of sanctioned firms of 2,857, which is similar that in Ahn and Ludema (2020), ends up with only 921–932 sanctioned firms constituting the treatment group in her regressions. In addition, her sample of control firms includes 175,000–640,000 firms, which brings her overall number of observations to 0.6–3.3 million, whereas Ahn and Ludema (2020) have only 0.1–0.4 million observations.[30] Keerati (2023), in turn, has no more than 70,000 observations, with a treatment group featuring 650 sanctioned firms and a control group accommodating up to 8,000 firms. Finally, Nigmatulina (2023) and Keerati (2023) do not restrict their sample to 2016 but allow for a longer time period (up to 2020) because the unravelling of the government support may take a longer time.

Huynh et al. (2022), in turn, take a different approach to constructing the group of treated firms: using the Global Sanction Database of Felbermayr et al. (2020), they study the effects of sanction intensity – as measured by the number of sanctions imposed – on various characteristics of firm performance in Russia over a longer time span (from 2000 to 2019). They have 788 Russian firms in their treatment group, and employ propensity score matching to construct the control group of firms that are similar in terms of size, leverage, investment, cash holdings, and financial constraints. Overall, their sample contains up to 9,000 matched observations. The authors also apply the difference-in-differences approach, in which they consider several dependent variables at the firm-year level, including ROAs, capital expenditures, R&D intensity, cost of capital, firm-level political risk, and sales growth. They further differentiate sanction impact by firm ownership, by oligarchs, and by country of origin.

The only intersection between the results in Huynh et al. (2022) and in the three studies above is in sales growth. The authors find that sanctioned firms suffer a 17 percentage point reduction in the overall rates of sales growth, compared to matched non-sanctioned firms. Recall that Ahn and Ludema (2020) obtain negative effects only for non-strategic firms under sanctions, while strategic firms enjoyed rising revenues after being sanctioned. Recall also that Nigmatulina (2023) and Keerati (2023) deliver the opposite results.

Huynh et al. (2022) also study the heterogeneity of sanction effects, and they address this issue from a different angle. Given the predominant role of the energy sector in the Russian economy (that is, its strategic role), they divide their firms into energy and non-energy firms and find that global sanctions only undermined the performance of non-energy firms, while having an insignificant effect on energy firms in Russia. This result

30 This does not mean, of course, that the results in both studies are unreliable due to the size of the sample of control firms. Comparability of treated and control firms is achieved by saturating the regressions by country-sector-time fixed effects (Ahn and Ludema, 2020) and industry-year and size-year fixed effects (Nigmatulina, 2023).

is at least partly consistent with the narrative of the other three papers. Among the other characteristics, the authors reveal that an increase in the number of sanctions imposed by the West by 20 sanctions (i.e., one standard deviation of the sanction intensity measure) leads to a 4.4 percentage point decline in ROAs, which is equal to 40% of one standard deviation and is thus economically large. The same sanction shock also leads to a decline of capital expenditures by 2 percentage points and of R&D investments by 0.7 percentage points, while increasing the cost of capital (WACC) by 1.6 percentage points and leading to an overall rise in the firm-level political risk measure, recently introduced in Hassan et al. (2019), of 95 points (which is roughly 75% of one standard deviation of the risk measure).

In this regard, Mamonov et al. (2023) suggest a different angle to comparing sanctioned and non-sanctioned firms when it comes to evaluating the effects of sanctions on firm performance. They argue that it may be important to trace where the sanctioned firms were borrowing from before the sanction shock hit. Domestic banks that were lending to (not yet) sanctioned firms may also encounter sanctions in the future and thus suffer from a reduction of borrowed funds, which may then result in a credit supply shortage.[31] Put differently, firms can be sanctioned or not, and their lenders can also be sanctioned or not. The idea is thus to capture the differential real effects of sanctions within each of the four possible bank-firm relationship types. Because access to the credit register of the Central Bank of Russia is closed due to the Russo-Ukrainian war, the authors attempt to squeeze out some conclusions using the DealScan data on syndicated loans issued within Russia over 2011–2017 (i.e., with the centre in 2014, the first year of sanctions), restricting themselves to only those syndicates that contained at least one Russian bank. They come up with roughly 308 such loans, which is a low number but covers about 30% of the total volume of all corporate loans in Russia.

First, Mamonov et al. (2023) find that if a firm was not targeted by the sanctions, it did not matter whether the firm was borrowing from sanctioned or non-sanctioned banks – the real effects in terms of the firm's size, employment, investment, and market sales were close to zero and insignificant.

Second, if a firm was targeted by the sanctions, then it was important who the firm's lender was – a sanctioned or non-sanctioned bank. If the lender was a non-sanctioned bank, then the firm enjoyed increased size, employment, and investment – and the estimated magnitudes are large, ranging between 15% and 60% cumulatively over 2014–2017. This is the bridge to the findings of Ahn and Ludema (2020) regarding the strategic firms that fell under sanctions, and to Nigmatulina (2023) and Keerati (2023), who discovered that, unintentionally, the real effects of sanctions against firms turned out to be positive,

31 The idea stems from the widely explored area of credit supply shocks and their negative real effects (e.g., Chodorow-Reich, 2014; Paravisini et al., 2015; Mian et al., 2017; Jiménez et al., 2017; Amiti and Weinstein, 2018; Müller and Verner, 2023).

not negative. However, Mamonov et al. (2023) find that sales of the sanctioned firms borrowing from non-sanctioned banks did not rise; they shrank by 17%, which speaks to misallocation of the government support and is consistent with the findings of Huynh et al. (2022) (as one can see, not just qualitatively but even quantitatively).

Third, considering the bank-firm relationship in which both the firm and its lender were sanctioned, Mamonov et al. (2023) conclude that this is where the dramatic negative real effects materialise. As they reveal, the firm's size falls by 35%, its employment shrinks by 52%, and its sales drop by 49% cumulatively over 2014–2017. The negative real effects of sanctions persist and strengthen over time.

All the previous studies are focused on the average treatment effect on the treated, as intended effects of sanctions. However, it is clear – even from our quantitative exercise above, where we find significant spillover effects of sanctions from targeted (state-connected) to non-targeted (foreign) banks (Section 1.1.2) – that sanctions may affect a broader set of firms. Market interactions between sanctioned and non-sanctioned firms create a channel for spillover effects of sanctions on non-sanctioned firms' performance. Pestova and Mamonov (2023) approach this angle of sanction analysis by dividing all firms in their sample into four groups depending on whether the firms are: (i) large or small (in terms of total assets), and (ii) high- or low-productivity (in terms of total factor productivity, or TFP). The underlying idea is that the group of large and high-productivity firms likely contains exporting firms – the entities that, by design, are the main targets of sanctions – whereas small and low-productivity firms are more likely to be purely local firms oriented to the domestic market and at best relying on foreign inputs. Therefore, the overall effect of sanctions is expected to be larger for large and high-productivity firms than for small and low-productivity firms.

Pestova and Mamonov (2023) collate a balanced panel of 7,540 Russian firms which not only disclose all the necessary balance sheet information on assets, employment, investment, and others (as in Nigmatulina, 2023, and Keerati, 2023), but also survive till the end of the sample period to eliminate the survivorship bias. The authors suggest a high-frequency identification of the sanction shock – by isolating a part of the variation in the daily spreads of Russia's sovereign bonds, which is due to news on the upcoming sanction announcement by the US OFAC. Spreads presumably rise as a reflection of investors' expectations of the reduced ability of the Russian government to repay its debts after the enactment of another package of sanctions. Focusing on the period of 2014–2020, the authors argue there were 31 sanction announcements covering not just the financial sector but a broader set of sectors of the Russian economy. Further, using Jordà's (2005) local projection approach, they project their sanction news shock on the dynamics of various characteristics of firms up to four years ahead.

Using their HFI-Jordà approach, Pestova and Mamonov (2023) find that the effect of sanction shock on the total revenue of small and low-productivity firms is just -1% during the first year and then quickly dies out. The same effect on large and high-productivity firms reaches -2% during the first year, but it takes two years for this to attenuate back

to zero. Recall that both groups contain not only sanctioned but non-sanctioned firms as well, thus capturing both the intended and unintended effects of sanctions (in a general equilibrium sense). Notably, TFP plays a crucial role in adapting to the sanctions: the authors also show that large, low-productivity firms, as opposed to large, high-productivity firms, encounter a negative effect of the sanction shock on their sales that is twice as deep (down to -4%); the path to the trough lasts for two years, instead of one; and finally the negative effects persist through time at a level of -1%, not zero. High productivity absorbs sanction shocks and delivers certain competitive advantages over less-productive peers.

Another important aspect of sanction analysis that we have not discussed so far is how much harm the sanctions bring to the sanctioning countries themselves. Crozet and Hinz (2020) is among the first comprehensive studies that are aimed at addressing this question. Using monthly data on trade flows between Russia and 37 Western countries between 2014–2015 and applying them to a standard gravity model of international trade, the authors reveal that the difference between observed trade flows and their predictions based on pre-sanction period amounts to roughly $100 billion, of which the Western countries bear about 40%. The authors refer to this as the total 'lost trade' induced by the sanctions and stress that these losses ($42 billion) vastly exceed the losses from direct embargoes on certain categories of Western exports ($5 billion). The difference is thus attributed to an unintended decline in the exports of non-embargoed goods and services, which the authors refer to as '*friendly fire*'.[32]

Exploring the channels of 'friendly fire', Crozet and Hinz (2020) conclude that: (i) it has little to do with changes in Russian consumers' preferences towards Western (in this case, French) goods; and (ii) the bulk of the effect comes from declining trade financing, meaning that the Russian firms that were importing those non-embargoed goods also encountered serious difficulties in convincing global creditors to continue their credit lines. This is a very instructive finding in terms of our generic cases of international bank-firm adaptation to sanctions (Figure 10). However, one should also bear in mind that the relative trade losses estimated by Crozet and Hinz (2020) are not that large: for the Western countries, they amount to only -0.3% of their total exports; the figure for Russia is -7.4%, which is an order of magnitude larger but is still far from being destructive. This implies that there was a large body of adaptation to sanctions in terms of obtaining credit and continuing imports by (non-targeted) Russian firms.

32 In a subsequent study, Crozet et al. (2021) focus on France as one of the sanctioning countries and show that the imposition of sanctions against Russia led to an average decrease in the probability of continuing trade between French and Russian firms by 5.9%, or by 23% in terms of the number of French exporting firms. This is far from a collapse of trade. The authors also provide these estimates for the trade between French and Iranian firms, with Iran being another example of a sanctioned country (facing much stricter sanctions than Russia). In the case of Iran, the authors obtain a 39% decline in the number of French firms exporting to Iran after the sanctions were imposed. Notably, despite Iran facing much stricter sanctions, these estimates also do not suggest the full stop of trade.

Further exploring the area of research devoted to the effect of sanctions on the performance of firms from sanctioning countries, Besedeš et al. (2021) analyse more than 5,000 German non-financial firms that exported to a total of 23 countries that encountered sanctions over the period of 1999–2014.[33] First, using a difference-in-differences design, they find that the affected firms in Germany reduced employment by only 1.5% and faced a contraction of sales of only 6.3%, with both estimates being insignificant.[34] Second, once a country fell under sanctions, the intensity of financial activities between the German firms and the firms in this country was squeezed by 50%. Third, the affected German firms were disproportionately large and 19% more productive, and thus had enough business opportunities to substitute their trade losses. Along this direction, the authors come to an important finding for our narrative of sanction evasion: these affected German firms tended to redirect their trade flows to those non-sanctioned countries that are close trade partners with the sanctioned country. The estimated increase in the intensity of the affected German firms' trade with the third countries related to the sanctioned country ranges between 35% and 55%.

However, not all European firms are as large and adaptive as German or French firms tend to be. A recent study by Lastauskas et al. (2023) focuses on agricultural firms in Lithuania, a very small open economy in Eastern Europe bordering with Russia. Using a difference-in-differences approach, they show that the Russian counter-sanctions mattered a lot for the country. First, the affected Lithuanian firms encountered much larger trade losses – roughly 40% on average, which is dramatically larger than the equivalent effects in Germany or France. Second, given the enormous trade losses, the affected Lithuanian firms had to considerably reduce their employment after 2014 during the first year of sanctions. The firms started by firing part-time employees, reducing these by 67%, which also greatly exceeds any analogous estimates for the major European countries. Full-time employees were under much lower pressure, with their reduction amounting to only 7%. Clearly, the adaptation of small sanctioning countries to the sanctions they support is much more difficult compared to large sanctioning countries.

Lessons for banks

Taking the empirical findings on the effects of sanctions on firms in both sanctioned and sanctioning countries, we draw the following lessons for the banks operating there:

- **Lesson 1**: Firms do not necessarily collapse after they fall under sanctions. If they are strategic, they obtain preferential government support (subsidies, tax cuts, cash-in credit, etc.). In this case, they can maintain their interest payments on the funds borrowed from banks at least at shorter horizons (1–2 years). At longer horizons, however, it is likely that they will experience a decline in sales

33 The sanctioned countries considered by Besedeš et al. (2021) are mostly from Africa, North Korea and the Middle East.
34 Bachmann et al. (2022) deliver a similar conclusion for Germany in the context of the Russo-Ukrainian war: the estimated loss of GDP due to the *full* ban on Russian gas and oil barely exceeds 3%.

due to misallocation of government support. Banks may face squeezing interest payments on existing loans to these firms, which may lead to deteriorating credit rating scores, reclassification of the loans to lower categories, and additional loan loss provisions. Overall, profits may even rise in the short run, but then, as the government support is depleted, they may begin to shrink, with negative repercussions for capital adequacy ratios.

- **Lesson 2**: Even if the sanctioned firms are not strategic, they may still sustain their operations. This is likely to happen with firms that are large enough and, importantly, highly productive. These firms may suffer from shortages in sales, with negative consequences for their lenders, but these shortages are unlikely to last for more than a year after the shock. High-productivity firms may fully absorb the sanction shock, and even if the payments on loans decline during the first year, they may be restored. It is also important for the banks to assess their own capacities to absorb the negative short-run effects in terms of CARs and prudential regulation and decide whether to sustain existing bank-firm relationships ("a friend in need is a friend indeed") or break them and find new ones ("sorry, times have changed").

- **Lesson 3**: It may make sense for the banks that have relationships with sanctioned firms to (partly) re-orient their funds towards highly productive, non-sanctioned peers – not only because of rising political risk but also because of the competitive advantages those firms enjoy over their sanctioned peers.[35]

- **Lesson 4**: Banks in the sanctioning countries may be far from willing to end their relationships with firms in the sanctioned countries. If these are profitable, they may find ways to continue them – either through launching their own subsidiaries in the sanctioned countries or through lending to adjacent countries/countries that are not sanctioned but have close trade partnerships with the sanctioned countries. It must be that high profitability dominates increased political risks in this case.

- **Lesson 5**: Firms from more developed sanctioning countries (e.g., France, Germany) avoid any real implications of sanctions for their performance, whereas firms from less developed sanctioning countries (e.g., Lithuania) may encounter an abrupt decline in their employment and sales. Trade losses appear to be negligible for the former and dramatic for the latter. Therefore, banks lending to large firms in more developed countries that have exposure to the sanctioned countries may have no fear of negative feedback effects. But banks lending to the firms in less

35 In some cases, foreign banks originating from the sanctioning countries and operating in the sanctioned countries may also be willing to gain a competitive advantage over their peers in the market. A prominent example is the case of Raiffeisenbank and the conflict around it remaining in Russia after 2022. According to its annual report, Raiffeisenbank earned €3.8 billion net profit across the world, with €2.2 billion coming from Russia – a record-high level. One of the potential reasons is the lack of competitive environment: major foreign peers in Russia (Citi Group, Societe Generalle, etc.) had closed their branches voluntarily, leaving the markets a few months after the Kremlin began the war against Ukraine.

developed countries that also have exposure to sanctioned countries should either force those firms to partly redirect their export flows to the countries with lower levels of ex-ante political risks or be ready to attract additional funds from the owners to raise the capital.[36]

Impact on the economy

Our review of firm-level studies on sanctions has shown that the effects of international restrictions on firms – both in the sanctioned and sanctioning countries – are extremely heterogenous, ranging from highly negative (as intended) to highly positive (unintended). The large heterogeneity of the effects stems from either the government support channel or various sanction evasion channels. But is it possible for banks to draw any plausible conclusions regarding the overall perspectives of the countries after they encounter sanctions? Aside from the ethical issues, this would help in deciding whether they should end or continue their operations in the sanctioned countries from a purely economic standpoint.

To (partly) answer this question, we appeal to another layer of research on sanctions that focuses on the macro-financial aspects of the sanction regimes. A summary of the key existing studies is in Table 5. Although the studies all focus on rather different sets of macroeconomic aggregates, we attempt to find intersections – in terms of GDP growth, investment, employment, and nominal exchange rates (i.e., units of local currency per US dollar). The resulting list of studies contains both theoretical and empirical papers evaluating the effects of sanctions either in certain countries (Russia, Iran) or in a panel of countries that encounter international economic restrictions.

Theoretical studies on the aggregate effects of sanctions may be particularly instructive for banks in terms of their adaptation to the international restrictions because the underlying models typically consider general equilibria, which take into account adjustments in consumption and savings made by households and investment decisions made by firms (i.e., the two key types of bank borrowers). Along this direction, Itskhoki and Mukhin (2022) analyse static and dynamic general equilibria focusing on export and import operations and the dynamics of the nominal exchange rate under the sanction regime. Their main contribution is to prove that the exchange rate of local currency may not only depreciate once sanctions hit but also appreciate with respect to a global currency run by a sanctioning country. If the sanctions target the import operations of the sanctioned country and ignore exports, the local currency appreciates due to income stemming from exports and the inability to buy goods and services from abroad. If, instead, the sanctions restrict exports and ignore imports, the local currency depreciates because of the lack of foreign currency to pay for imported goods.

36 Caldara and Iacoviello (2022) provide a news-based geopolitical risk measure at country, industry, and firm levels showing that their measure predicts both economic downturns (declines in employment and investment) and disaster events.

TABLE 5 **MACROECONOMIC EFFECTS OF SANCTIONS ACROSS THE WORLD**

Study	Sanctioned country	Period	Macroeconomic variables in the sanctioned countries (%):			
			GDP	Consumption	Investment	Exchange rate to US dollar
Itskhoki and Mukhin (2022)	Russia	2022	-5	-10		Mar: +50 Jun: -100 Dec: +15
Ghironi, Kim and Ozhan (2023)	Russia	2022-	-0.8	-1.4		
Pestova and Mamonov (2023)	Russia	2014 2022	[-0.8, -3.2] [-8, -12]	[-2, -5] [-8, -12]	[-3, -6] [-18, -25]	[7, 11] [38, 61]
Nigmatulina (2023)	Russia	2014-2020	≤-1.1			
Kholodilin and Netšunajev (2019)	Russia	2014-2015	~0			
International Monetary Fund (2015)	Russia	2014-2015	[-1.5, -1.0]			
Barseghyan (2019)	Russia	2014-2015	-1.5			
Laudati and Pesaran (2023)	Iran	1979-2019	[-2, -1]**			-3
Gutmann, Neuenkirch and Neumeier (2023)	92*** countries	1960-2016	-2.7	-2.0	-6.7	
Neuenkirch and Neumeier (2015)	67 countries	1976-2012	UN: -2 US: [-1, -0.75]			

Note: The table presents the estimates of the macroeconomic effects of sanctions obtained in both theoretical and empirical studies devoted to a wide range of sanctions imposed on different countries across the world over the last 60 years. * The presented figures are calibrations of the DSGE models from Itskhoki and Mukhin (2022) and Ghironi, Kim and Ozhan (2023), which depend crucially on the model's assumptions, and which are thus not directly comparable to empirical estimates in the rest of the table. ** Differently from the other estimates in the table, which represent the effect of sanctions within 1-3 years after the sanction shock, Laudati and Pesaran (2023) estimate the loss of GDP growth rates in Iran over the 40 years of sanctions. *** Majority of sanctioned countries across the world from the Global Sanctions Database of Felbermayr et al. (2020).

When calibrating their model to the Russian economy in 2022 after the Russo-Ukrainian war, Itskhoki and Mukhin (2022) are able to explain the 'puzzling' appreciation of the ruble during the first half of 2022. Their calibration shows that ruble first depreciated against the US dollar by 50%, which is very close to the actual data from February and March, because of the first sanction shock causing panics in financial markets. There is nothing surprising in this result, but what is surprising is that their calibration then shows a dramatic appreciation of the ruble, by roughly 100%, during the April to June period, which is again very close to the actual data. This is explained by import constraints imposed on Russian economic agents, coupled with the capital control measures by the Central Bank of Russia. And finally, as the West began to restrict Russian exports more and more in the second half of 2022, the model predicts a gradual depreciation of ruble of roughly 3% per month. Under these circumstances, the authors calibrate the GDP decline in 2022 to 5% and obtain, among other results, that real consumption of Russian households reduces by 10% at an annual frequency. In reality, Russia's GDP contracted by only 2% over the first year of the war, but consumption did indeed shrink by 10%, so the authors' model produced plausible results.

Ghironi et al. (2023), in turn, focus on the interplay between Russia as the sanctioned country in 2022, the West as the block of sanctioning countries, and the East as a set of neutral countries that may help Russia evade the sanctions. They build a DSGE model to trace the impact of the 2022 sanctions on each of the three groups of countries. The authors model the sanction shock as (i) an exclusion of the top 0.5% of most productive firms from exporting to Russia, (ii) a 90% reduction in the number of foreign households that are allowed to trade bonds with Russia, and (iii) a complete gas embargo. In their quantitative part, Ghironi et al. (2023) predict a moderate recession in Russia (GDP contracts by no more than 1%) and a very mild decline in consumption of 1.4%. Their prediction for GDP appears to be closer to reality than that of Itskhoki and Mukhin (2022), but they underestimate the slump in consumption. The value of their approach is that they explicitly model the sanctioned country's opportunity to evade sanctions through the neutral countries, which allows the country to partly substitute for lost Western inputs.

Empirical studies also deliver a wide range of estimates, which are consistent with the theory but quantitatively are not directly comparable. First, Pestova and Mamonov (2023) apply the HFI-Jordà approach (see details above) and predict the contribution of the 2022 sanctions to both Russia's GDP and private consumption to be in the range of -8% to -12%. Interestingly, the actual consumption patterns were in this range, whereas GDP, as we already discussed, contracted by only 2%. This may imply that this time, as opposed to the case of 2014 sanctions, the Russian government did not help households to mitigate the adverse effects of sanctions by providing any subsidies (i.e., no counter-measures) and was instead fully focused on re-orienting the economy towards the military sector.

Interestingly, looking to the case of Crimean sanctions in 2014, most of the studies predict a moderate effect on the Russian economy of no more than an 1.5% contraction of GDP (controlling for the adverse effect of the world oil price collapse that occurred in the same year) (Barseghyan, 2019; International Monetary Fund, 2015; Kholodilin and Netšunajev, 2019; Nigmatulina, 2023). However, Pestova and Mamonov (2023) argue that previous studies do not (intend to) fully capture the overall effect of sanctions, because they focus on either specific sanction episodes or certain types of sanctions rather than considering all of them. In their HFI approach, Pestova and Mamonov (2023) include all sanction announcements between 2014 and 2022 and come up with much larger estimates of the contribution of those pre-war sanctions: up to -3.2 percentage points of GDP, between 2 and 5 percentage points of private consumption, and between 3 and 6 percentage points of private investment. Notably, these numbers are very close to those obtained by Gutmann et al. (2023), who deliver a unique, if not the only, cross-country macro-financial exercise on the effects of sanctions on 92 sanctioned countries between the 1960s and the 2010s. Laudati and Pesaran (2023), in turn, focus on Iran over the last 40 years and construct a sanction news intensity index. Their estimates show that the contribution of sanctions to Iranian GDP is bounded between -1 and -2 percentage points.

Aggregating all the results from the macroeconomic studies, it also becomes clear that the initial power of sanctions may be rather large, but it is then mitigated by either internal mechanisms employed by the sanctioned governments (accumulated international reserves, if not frozen) or by the evasion of the sanctions through neutral countries. In this situation, domestic banks have two broad strategies of adaptation: to increase lending to militaries, or to reduce it. Clearly, apart from the ethical considerations, lending to militaries is likely to be profitable only in the medium run during the war, whereas increasing lending to non-militaries during the same period of war implies gaining future profits when the war stops, peace is restored, the military sector slows down and the non-military sector recovers.

1.2 WAR AND CIVIL UNREST

1.2.1 Effects of wars on banks and their borrowers

We now turn to reviewing the effects of wars and civil unrest on banks and their borrowers. Adaptation to wars and civil unrest may be different from adaptation to sanctions, because not all wars or especially episodes of civil unrest end up with sanctions, and not all sanctions are imposed in response to armed conflicts. A recent literature has started to discuss how banks and bankers may be affected by civil unrest. Fisman et al. (2020), for example, provide microeconomic evidence on ethnic frictions and market efficiency, using data from a large Indian bank. They find that branch managers in areas affected by riots tend to provide fewer loans to Muslim borrowers, despite these loans demonstrating a lower likelihood of default. These observations

indicate that riot exposure may amplify taste-based discrimination. Additionally, the study reveals that this bias persists throughout a bank officer's tenure, indicating that the economic repercussions of ethnic tensions endure over time, possibly extending across multiple generations.

Only a few studies focus on the impact of war on banks and/or (the emotional state of) bankers.[37] A recent example is a study by Ouedraogo et al. (2022), who deliver the first cross-country evidence on rising probabilities of systemic banking crises in developing countries following armed conflicts in those countries. The authors first show that the main channel is the fiscal deficit that occurs as a consequence of armed conflicts. Second, they document the negative spillover effects of wars on adjacent countries.

Another example is Mishra and Ongena (2022), who study the impact of armed conflict on the actual lending decisions of loan officers in India.[38] Loan rates set by loan officers increase rapidly and substantially following the first episode of local mortar shellings. Rates even surpass the levels seen in comparable locales in border areas where shelling has become routine. Eventually, the dispersion of loan rates across locales drops, suggesting a hardening of beliefs around the locale being shelled as the 'new normal'. Hence the real costs of armed conflict through credit markets are large and may involve substantial and potentially harmful renegotiations of credit contracts.

While taste-based discrimination is potentially exacerbated, the trauma from experiencing violence during riots (independently of who was responsible or driving them) could also result in 'avoidance behaviour', which could have similar lending volume and selection outcomes.

Morales Acevedo and Ongena (2020) analyse the loan conditions of loans granted immediately after a the robbery of a bank branch. They uncover notable differences in loan terms following a robbery compared to the changes observed simultaneously at branches untouched by such events. Loan officers exhibit avoidance behaviour. Consistent with post-traumatic stress literature, this avoidance behaviour decreases by half within two weeks after the robbery, though this varies depending on whether a firearm was used during the incident. While robberies may have only a temporary impact on most people, exposure to intense riots and (civil) war may generate trauma that lasts a lifetime (e.g., van der Kolk, 2015).

37 Most studies focus on the impact of war, in terms of military threat and/or acts, on bonds and/or equity of non-financial firms and their investors and/or managers (e.g., Verdickt, 2020; Federle et al., 2022).

38 Given the difficulty in obtaining data in conflict-ridden areas, many studies capture individual outcomes using survey data (e.g., Voors et al., 2012; Callen et al., 2014). Dwarkasing (2014) investigates the effect of war on lending outcomes, specifically the effect the American Civil War had on mortgage lending approval. Recent studies also explore the reverse, that is, how credit conditions can lead to social unrest (e.g., Braggion et al., 2020) or political radicalisation (e.g., Doerr et al., 2022).

In general, and relatedly, several recent studies empirically assess the impact of emotions on real-world decisions made by loan officers. For instance, Cortés et al. (2016) employ daily variations in local sunshine as a proxy for sentiment to examine its impact on credit approvals by lower-level financial officers. They discover that positive sentiment correlates with increased credit approvals, while negative sentiment yields the opposite effect and with a more pronounced magnitude. Agarwal et al. (2013) investigate the influence of nationwide events such as the Super Bowl, the American Idol contest, and days surrounding major holidays on loan approval rates. Similarly, Campbell et al. (2019) analyse loan quality during periods of high officer workload, pre-weekend periods, and around national holidays. Demiroglu et al. (2017) analyse the performance of loans originated during Ramadan in Turkey, and Baele et al. (2014) examine loan performance during Ramadan in Pakistan. Overall, these studies reveal that the emotional state of loan officers may play an important role in their credit decision-making.

Banks may be directly affected by war and peace, and so may their corporate and retail clients. de Roux and Martinez (2023) demonstrate that the quantity of business loans rises in municipalities in Colombia with a historical presence of FARC[39] after the peace agreement. An increase in loan applications drives this surge, with no change observed in supply-side variables, suggesting that the overall increase in investment is driven by a higher willingness to invest and subsequent investment returns, rather than by changes in the supply of credit.

At the aggregate macroeconomic level, a recent study by Federle et al. (2023) provides evidence on the external costs of wars in a cross-section of 60 countries over the last 150 years. The authors establish a negative supply-side shock to the countries adjacent to the territories affected by wars, with their output declining by 10% in five years after the start of the war and inflation rising sharply. Importantly, they show that these negative effects tend to shrink with distance from the war and, after a certain point, they become positive. This finding implies that there are not only countries that lose from wars but also countries that benefit from them.

1.2.2 Quantitative exercise #2: Battle deaths and prospects of the banking systems

While the previous section addressed the question of how individual banks and their borrowers adapt to wars and civil unrest, this section aims to document broader patterns of how banking systems adapted to armed conflicts in a cross-section of countries over the last decades. Given the micro-level studies reviewed above, we expect that wars may have *immediate* negative effects on the banking systems due to physical destruction, and more *prolonged* negative effects due to increased taste-based discrimination and

39 *Fuerzas Armadas Revolucionarias de Colombia* (Revolutionary Armed Forces of Colombia).

deteriorated emotional state of loan officers, which may persist even after the recovery of buildings and other facilities destroyed (or damaged) during the war. We therefore employ Jordà's (2005) local projection (LP) approach to flexibly capture the peak reaction of the banking system to wars over time.

Data

For this purpose, we use the World Bank World Development Indicators and Global Financial Development datasets and compile cross-country data on battle deaths as a proxy for the intensity of wars, and macro-financial indicators such as domestic credit to the private sector by banks. Battle deaths are retrieved by the World Bank from the Uppsala Conflict Data Program and include both battle-related deaths of armed forces and civilian deaths. We collect annual data for the years between 1960 and 2021 for all countries present in the two datasets. Initially, we have 10,912 country-year observations on the ratio of private credit by banks to GDP for 234 countries across the world, and only 1,311 observations on battle deaths for 135 countries. The intersection of the two gives us 781 observations for 87 countries that experienced battle deaths of their civilians over the period 1989 to 2019. Table 6 presents these two characteristics and other macro-financial indicators across the countries grouped in the two subsamples: one in which countries experience battle deaths in year *t* (*War*), as in the definition of the Uppsala Conflict Data Program; and the other in which countries experience no battle deaths in the same year *t* (*Peace*).

Not surprisingly, wars are associated with dramatic losses in the banking system and the macroeconomy. As the numbers presented in Table 6 show, the number of battle deaths in our sample ranges from 1 to 108,072 people, with a mean of 1,127. In the *War* state, the penetration of credit to the economy is much lower and the price of credit is much higher than in the *Peace* state, which points to restrictions from the supply side. Indeed, domestic credit to the private sector by banks equals 27% of GDP, on average, in the *War* state, which is 10 percentage points lower than in the *Peace* state. The lending rate, by contrast, holds at 17% in the *War* state, which is 3 percentage points higher than in the *Peace* state. Regulatory bank capital is also lower in the *War* state: the ratio of banks' owned funds to their risk-weighted assets averages at 16%, 1 percentage point less than in the *Peace* state, which means that assets are riskier and banks have fewer opportunities to expand the supply of loans from the regulatory perspective. Interestingly, banking concentration turns to be much lower in the *War* state: the five-bank asset concentration ratio (CR_5) is 73% on average, which is high but still 8 percentage points lower than in the *Peace* state. This echoes the observation that foreign banks are much less willing to operate in countries suffering from war: the share of foreign banks' assets in the total banking system's assets is just 21% in the *War* state and 43% in the *Peace* state. Further, wars deteriorate private depositors' confidence in the local banking system: the ratio of private deposits to GDP appears to be 5 percentage points lower in the *War* state. As a result, under these conditions, the probability of a banking crisis appears to be 8.9% in the *War* state, which is more than two times higher than in the *Peace* state. From

the perspective of financial markets, stock prices are also more volatile in the *War* state, which creates obstacles for firms and banks in attracting funds from financial markets and using stocks as collateral for banking credit. Overall, the economy grows significantly less over time in the *War* regime than in the *Peace* regime.

TABLE 6 **COUNTRIES AT WAR AND COUNTRIES IN PEACE: DIFFERENCES IN MACRO-FINANCIAL OUTCOMES**

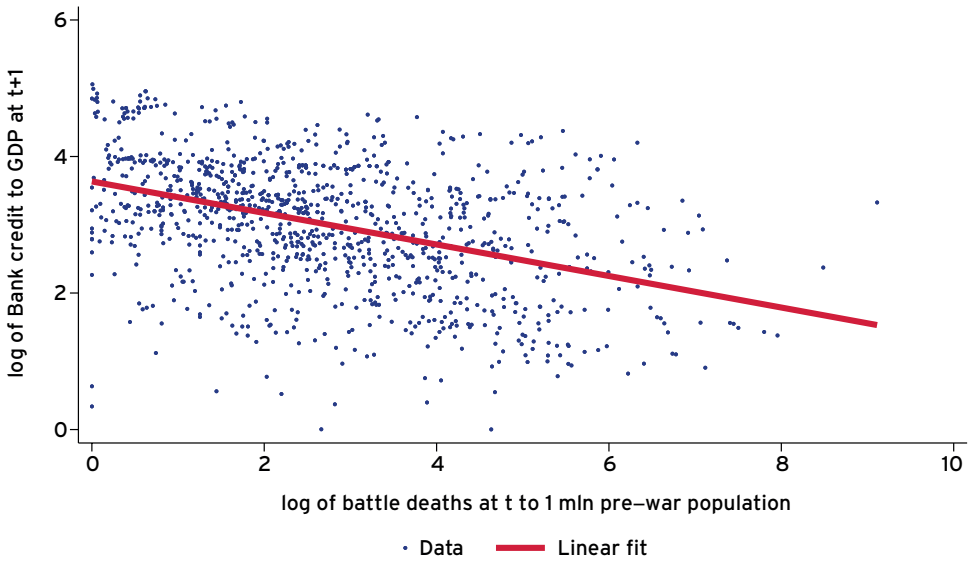
Variable	War (1)	Peace (2)	Difference (3) = (1) - (2)
Battle deaths (no. of victims)	1,127	0	1,127***
Bank credit to domestic private sector/GDP (%)	27.3	36.9	-9.6***
Bank lending rate (%)	16.7	14.2	2.5***
Bank regulatory capital (% of risk-weighted assets)	16.3	17.1	-0.8**
5-bank asset concentration (% of total assets)	73.1	81.4	-8.2***
Foreign banks' assets (% of total assets)	20.9	43.3	-22.4***
Bank deposits/GDP (%)	36.4	41.7	-5.2***
Bank non-interest income (% of total income)	39.4	38.4	1.0
Prob (Banking crisis = 1)	0.089	0.041	0.048***
Stock price volatility	22.1	20.5	1.6**
GDP growth (y-o-y %)	3.6	4.4	-0.7***

Note: The table presents the mean values of battle deaths and macro-financial indicators across the countries that are involved in war(s) (*War*) in year *t* versus the countries that are not (*Peace*) over 1989 to 2019. The table also reports the results of the Welch two-sample t-test on the mean differences across War and Peace (equal variances are assumed). The number of country-year observations in the *War* state ranges between 130 and 1,295, depending on the variable; in the *Peace* state it ranges between 840 and 11,915. See the full definitions of the variables in Table 16 in Appendix.

Source: Word Bank, IMF, and Uppsala Conflict Data Program.

We next focus on how battle deaths affect the subsequent dynamics of the banking systems. We begin with a scatterplot, in which we show the cross-country relationship between battle deaths (as a percent of 1 million of total population) in country *c* in year *t* and bank credit to the private sector (as a percent of GDP) in the same country in year *t* + 1 (Figure 11). As is clear from the scatterplot, battle deaths predict a decline in bank credit in the future. Importantly, this negative relationship persists across decades.

FIGURE 11 **BATTLE DEATHS AND THE PRIVATE CREDIT BY BANKING SYSTEMS: CROSS-COUNTRY DATA**



Note: the picture documents negative relationship between battle deaths (as a percentage of 1 million total population) in year *t* and domestic credit to the private sector by the banking system (as a percentage of GDP) in the subsequent year t + 1.

Source: Word Bank, IMF, and Uppsala conflict database

Regression design

With these considerations at hand, we now employ a panel version of Jordà's LP approach to evaluate how banking systems adapt to wars across countries and time and capture the size and the timing of the peak reaction along the corresponding adaptation pattern. We consider the following regression specification:

$$\ln\left(1+\frac{BankCredit_{c,t+h}}{GDP_{c,t+h}}\right)=\alpha_c+\gamma_t+\beta_h\cdot\ln\left(1+\frac{BattleDeaths_{c,t}}{POP_{c,1985}}\right)+BankingSystemControls_{c,t}\boldsymbol{\Psi}'+MacroControls_{c,t}\boldsymbol{\Omega}'+\varepsilon_{c,t} \quad (2)$$

where $BankCredit_{c,t+h}/GDP_{c,t+h}$ is domestic credit to the private sector by banks, as a percentage of GDP in country c in year $t + h$, and where h is the prediction horizon, i.e., the number of years after the occurrence of battle deaths (h = 1, 2, ..., 10 years ahead).[40] Variables α_c and γ_t are country and year fixed effects. $BattleDeaths_{c,t}/POP_{c,1985}$ is the ratio of battle-related deaths (the military and civilian victims of wars) in country c in year t (t = 1989, 1990, ... 2019) to 1 million of population in the same country in 1985 (i.e., before we have data on wars). $BankingSystemControls_{c,t}$ are the variables aimed at accounting

40 We take the log of 1 + $BankCredit_{c,t+h}/GDP_{c,t+h}$, because some countries experiencing wars have ultra-low penetration of credit in their economies (<1), which would result in very large negative values of the dependent variable.

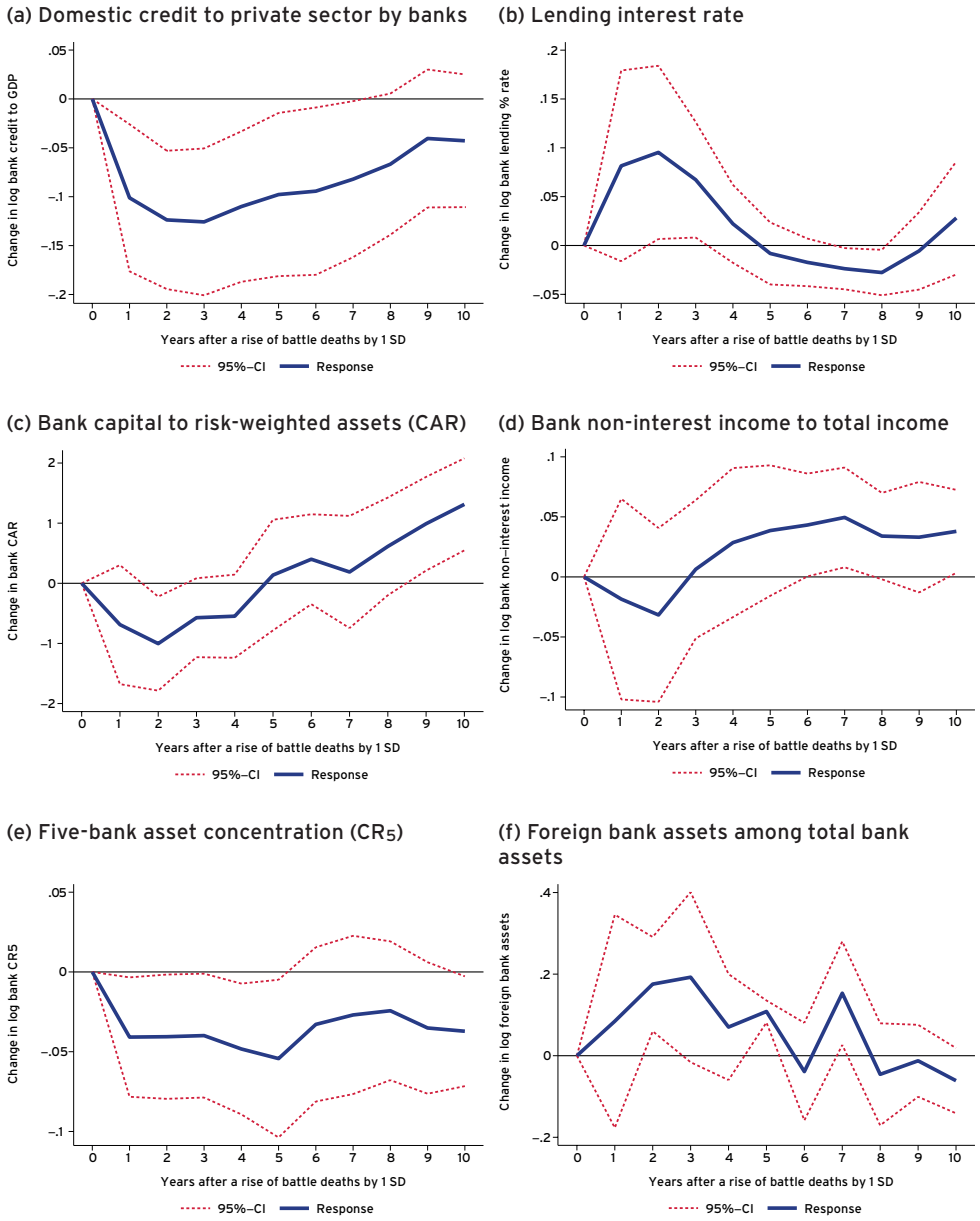
for the cross-country differences in financial development. In the baseline specification, we use only the banking crisis indicator variable, as an integral characteristic of the prospects of the underlying banking system, and also to avoid losing country-year observations. In the robustness checks, we also include the ratio of bank private deposits to GDP and other financial characteristics listed in Table 6. $MacroControls_{c,t}$ absorb the cross-country differences in the states of business cycle and, in the robustness checks, in consumer price dynamics. $\varepsilon_{c,t}$ is the regression error. Because we are predicting over an expanding time window, autocorrelation concerns arise as h runs from 1 to 10, so we double-cluster the standard errors of the estimated coefficients at country and year levels.

Results: Average effects

The estimation results suggest that battle deaths are a strong predictor of a decline in bank credit in the future (Figure 12a). Our estimates show that a one standard deviation rise in the battle deaths to pre-war population variable in year t predicts a decline in the ratio of bank credit to GDP by 10% in year $t + 1$, by another 2.4% in year $t + 2$, and by another 0.2% in year $t + 3$, when the reaction reaches its peak of -12.6% (significant at 1%). Thereafter the reaction attenuates, but remains significant until year $t + 8$. These results imply, first, that the peak reaction is economically visible, being equivalent to 0.31 of one standard deviation of the log of the bank credit to GDP variable within countries. And second, even a 'normal' (i.e., one standard deviation) rise in battle deaths (12,884 killed people) is associated with a long-lasting reduction in bank credit, which persists through the whole phase of a typical business cycle.

We further replace the bank credit variable from the right-hand side of Equation (2) with other indicators reflecting the state of the banking system and available in the World Bank's databases. We do this to comprehensively assess how far the prospects of a banking system may deteriorate in response to wars. We run a loop of Jordà LPs across all the non-credit variables present in the Global Financial Development database (roughly 100 indicators) and choose the most significant results. First, the *bank lending rate* rises by 10% in the two years following an increase in the number of battle deaths by one standard deviation (Figure 12b). This estimate is significant at 5% and is economically large, being equivalent to 0.24 of one standard deviation of the lending rate variable within countries. Together with the result on the bank credit reaction, we obtain evidence consistent with the negative effects of wars on the supply of loans in affected economies, because the amount of loans and their price move in opposite directions.

FIGURE 12 **THE EFFECTS OF ARMED CONFLICT ON BANKING**



Note: The charts report the responses of banking system indicators to a one standard deviation increase in log battle deaths in year 0 (relative to population) estimated using local projections. Sample: 781 observations for 87 countries ever experienced battle deaths of their civilians over the period 1989-2019. Standard errors are double-clustered: at country and year levels.

Second, the *capital adequacy ratio* tends to decline during the first two years after an increase in battle deaths, with the peak reaction reached in year $t + 2$ and equal to -1.0 percentage points (significant at 5%, Figure 12c). The magnitude is economically significant, being equivalent to 0.21 of one standard deviation of the CAR. This result is consistent with the more general collateral damage effect of wars and further rationalises the reduction of the supply of bank credit established above. Importantly, we also obtain a rebound of the CAR after sufficient time passes from the initial 'shock' of rising battle deaths. As our local projections demonstrate, starting from year $t + 9$, the reaction changes sign and becomes positive, which probably reflects the post-war recovery of economic activity and the profits generated by banks. By the end of $t + 10$, the predicted reaction approaches +1.3 percentage points.

Third, *banks' non-interest income* tends to first decline after the 'shock' to battle deaths, though not significantly, but as time passes the reaction switches sign from negative to positive and reaches its peak of +5% of total income in year $t + 7$ (significant at 5%, Figure 12d). This estimate is also economically significant, as it absorbs at least 0.13 of one standard deviation of the non-interest income variable. This result implies that wars and the resulting collateral damage may force banks to rely more on those activities that are not associated, or less associated, with credit risk.

Fourth, *bank concentration* reacts negatively to wars: a one standard deviation increase in battle deaths in year t predicts a decline of the five-bank asset concentration ratio (CR_5) beginning from year $t + 1$, with the magnitude of the decline reaching its peak at -5% in year $t + 5$ (significant at 5%), which corresponds to 0.18 of one standard deviation of the log CR_5 variable (Figure 12e). This result may indicate that large banks operating in certain regions of the affected country are more likely to have their branches damaged (or destroyed) and their borrowers suffer from the negative shocks and income decline compared to local banks that may operate in non-affected regions of the affected country.

Fifth, interestingly, we then find that the role of foreign banks in the affected economy tends to rise in the one to two years following the start of the war, peaking at +20% of the pre-war credit-to-GDP ratio in year $t + 2$ (significant at 5%; Figure 12f) and year $t + 3$ (significant at 10%; Figure 12f), corresponding to 0.16 of one standard deviation of the log foreign bank asset share variable. These rises in the role of foreign banks occur simultaneously with the above-established fall in bank concentration. This, in turn, may mean that the post-war recovery affects local and foreign banks differently. While local banks may have fewer opportunities to recover their loan portfolios due to, for example, shrinking CARs (see above), foreign banks may enjoy competitive advantages over the local peers and enter the market to participate in the economic recovery and increase their shares of future profits.

Additional results: Persistency and war-induced uncertainty

One concern regarding the estimates presented above is that they mix the immediate effect of wars with the war-induced uncertainty arising simply because nobody knows when wars will end. When a war hits, banks may anticipate that it will continue into the next periods. Therefore, they are likely to shrink the supply of loans to the economy by more than they would do if they believed the war will stop in the same period.

We address this concern by adding the forward-looking components reflecting the intensity of battle deaths in next periods, up to the prediction point, to the same local projection equation:[41]

$$\ln\left(1+\frac{BankCredit_{c,t+h}}{GDP_{c,t+h}}\right) = \alpha_c + \gamma_t + \beta_{1,h}\cdot\ln\left(1+\frac{BattleDeaths_{c,t}}{POP_{c,1985}}\right) + \sum_{s=1}^{h}\beta_{s,h}\cdot\ln\left(1+\frac{BattleDeaths_{c,t+s}}{POP_{c,1985}}\right) + BankingSystemControls_{c,t}\mathbf{\Psi'} + MacroControls_{c,t}\mathbf{\Omega'} + \varepsilon_{c,t} \quad (3)$$

In Equation (3), the coefficient $\beta_{1,h}$ measures the 'pure' effect of the battle deaths that occur in time t, i.e., net of the war-induced uncertainty that is captured by the sum of $\beta_{s,h}$ coefficients. The estimates of $\beta_{1,h}$ appear in Figure 13. The figure reports the results for bank credit and bank lending interest rates only (the other characteristics of banking systems considered above are not reported here to preserve space and are available upon request).

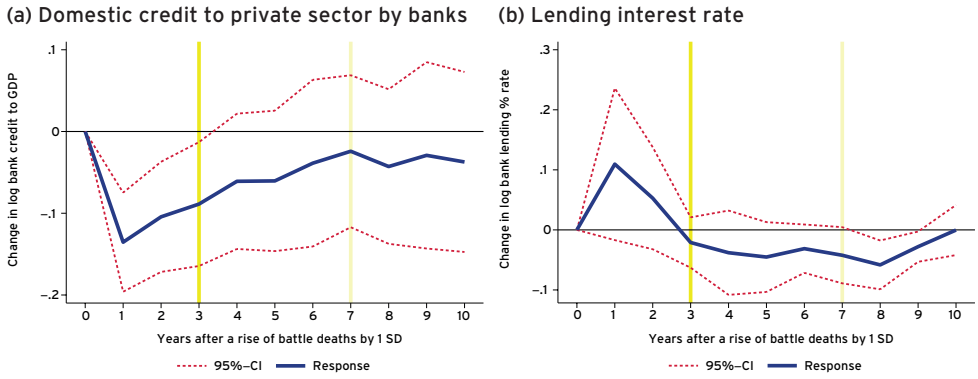
As can be inferred from Figure 13a, the bank credit-to-GDP ratio still reacts negatively and significantly to a one standard deviation increase in battle deaths, as in the baseline results discussed above. However, we now obtain that the peak of the reaction is reached much faster – in one year, not three years, after the 'war shock' – and the pattern of the reaction also changes substantially such that it turns insignificant in three years, not seven as before. Notably, the magnitude of the peak reaction has not changed and remains at -13%. Overall, these comparative estimates indicate that the total effect of wars on banking systems' private credit consists of an immediate effect and the effect induced by war-related uncertainty.

Turning to Figure 13b, we still obtain a rising response of the bank lending interest rate to the 'war shock' during the first two years, although it is now insignificant. This implies that the war-related uncertainty effect dominates in the total effects that we reported above in our baseline estimates. Apparently, at the aggregate level, banks raise interest

41 We thank discussant Fabio Trojani for pointing us towards this idea.

rates on loans not because the 'war shock' per se forces them to do so, but because they do not know how long the war will last for and add an uncertainty markup to the lending rates.

FIGURE 13 **IMMEDIATE EFFECTS OF BATTLE DEATHS ON THE SUPPLY OF BANK CREDIT**



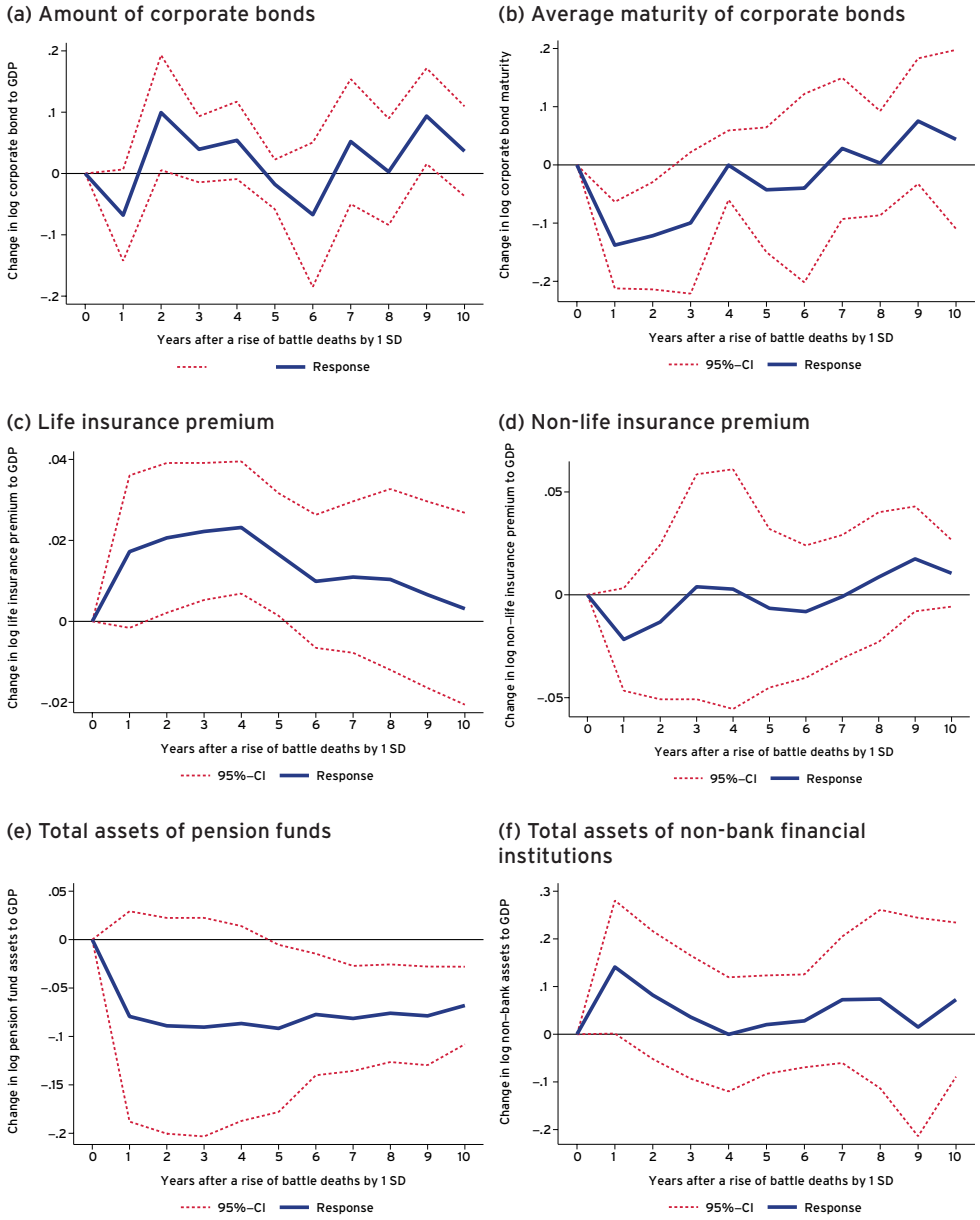
Note: The charts report the responses of banking system indicators to a one standard deviation increase in log battle deaths in year 0 (relative to population) estimated using local projections (see Equation (3)). Standard errors are double-clustered: at country and year levels. The estimated local projections are net of the war-induced uncertainty. The bold yellow vertical lines depict the timing when the net effect turns insignificant, while the pale golden vertical lines indicate the analogous moment we estimated from the baseline model (i.e., without netting the uncertainty effect).

Additional results: Potential substitution of credit?

Our baseline result that wars force banking systems to squeeze the supply of private credit raises the question of whether the economy attempts to substitute bank credit with other sources of funds, (e.g., bonds) and what happens to the other parts of the financial system (life insurance companies, pension funds, etc.). The combination of the World Development Indicators and the Global Financial Development databases provided by the World Bank delivers all the necessary cross-country data to answer this question (though the data are less rich than on private credit by banking systems). We employ the same Jordà LP approach, as implied by Equation (2), changing the right-hand side and leaving the left-hand side unchanged.

We present the estimation results in Figure 14. First, we obtain a positive and significant response of corporate bonds at $t + 2$ to a 'war shock' at t, and another positive and significant response at $t + 9$ (panel a). All else being equal, this implies that firms, having faced a shortage in loan supply, attempt to (partly) substitute it for debts placed on financial markets. However, the maturity of those bond issues tends to be lower than prior to the 'war shock', which is to be expected given the uncertainty induced by wars. This follows from the negative and significant response of the average maturity of corporate bonds to the 'war shock' at $t + 1$ (panel b).

FIGURE 14 **THE EFFECTS OF ARMED CONFLICT ON THE NON-BANKING FINANCIAL SYSTEM**



Note: The charts report the responses of non-banking financial system indicators to a one standard deviation increase in log battle deaths in year 0 (relative to population) estimated using local projections. Sample: 781 observations for 87 countries ever experienced battle deaths of their civilians over the period 1989-2019. Standard errors are double-clustered: at country and year levels.

Second, we obtain a positive and significant response of the premium earned by life insurance companies at $t + 2$ to $t + 5$ after the 'war shock' at t (panel c). Against this background, we obtain no significant reaction of the premium earned by non-life insurers (panel d). Together, these results indicate that economic agents are more willing to pay an additional price for their life insurance after the wars, while leaving other, non-life, insurance unchanged.

Finally, we obtain a prolonged negative and significant reaction of pension funds to wars (panel e) and no significant reactions from other, non-bank, financial intermediary sectors (panel f). These estimates favour the view that the war-induced uncertainty may force economic agents to partly reduce their long-run pension-related investments, substituting them with, for example, increased life insurance. Put differently, wars attenuate long-run goals for increased risk aversion in the short term.

Preliminary conclusion

To sum up our local projection exercise, we conclude that wars adversely impact the supply of credit to the affected economies in the medium term, with negative effects on local banks' profits and capital. At longer horizons, the banking system witnesses falling concentration and increasing reliance of local banks on non-interest sources of income, which are less associated with the credit risk. Last but not least, foreign banks tend to benefit from the post-war recovery more than local banks that are constrained by the lower regulatory capital. Foreign banks substantially increase their presence. We also find that the total effect of wars can be disentangled into immediate and uncertainty components, where 'immediate' reflects the 'pure' effect of the shock itself and 'uncertainty' an additional effect stemming from the anticipation of the continuation of wars in the future.

Results: Exploring the heterogeneity of war effects

Finally, we touch on the question of what factors may cause the heterogeneity of the banking system responses to wars across countries. Let us focus on bank credit for this exercise. From the local projection exercise above, we know the timing of the peak reaction of the bank credit variable to the 'shock' increase in the battle deaths variable; this occurs in year $t + 3$ and the magnitude of the bank credit decline reaches -13% of the GDP of an average country suffering from the war. We are interested in the sources of cross-sectional heterogeneity of this estimated response. Based on existing literature, we outline the following potential sources explaining why wars may differentially affect the supply of private credit by banking systems.

Source #1: *Economic policies*. Ouedraogo et al. (2022) show that wars raise the likelihood of banking crises through the channel of rising government budget deficit. We reformulate this channel slightly to reflect the adaptiveness of fiscal policy: we conjecture that the war-induced decline in bank credit may take longer if the government raises

taxes on profits during the war and the post-war recovery. All in all, when firms have to pay more towards rebuilding the economy, they may have a lower ability to repay their existing loans. Therefore, the first sources of heterogeneity in responses are fiscal policy and changes in the tax burden.

Similar logic applies to policies run by financial regulators. If the central bank has to tighten its monetary policy, for example to curb war-induced spikes in consumer prices, we can expect that the supply of private credit by banks may further deteriorate through the interest rate channel. If, finally, the central bank has to tighten its macroprudential policy to restrict the level of borrower indebtedness, this clearly reduces its ability to extend loans. Therefore, our first source of heterogeneity in responses also accommodates monetary and macroprudential policies.

Source #2: *Stocks and collateral*. Cerqueiro et al. (2020) suggest that collateral damage reduces bank loan supply. Clearly, wars are one reason why collateral may be damaged. Furthermore, Lian and Ma (2020) show that US non-financial firms have only 20% of their debts collateralised with physical assets; the other 80% are collateralised with the value of cash flows, which are typically reflected in the price of stocks. Therefore, as a second source of heterogeneity in responses, we propose cross-country variation in the prices of stocks.[42]

Source #3: *International trade*. While the local economy may suffer from depressed demand, other countries may not. If firms in the affected economy increase their income stemming from exports of goods and services to the countries not affected by the war, their ability to repay their loans may be substantially improved. Therefore, the third source of heterogeneity in responses is international trade.

Source #4: *Foreign support*. If a country experiencing a war obtains financial support from abroad, the war-induced economic slump is likely to be smoother – that is, the decline of income may be lower and the economic agents' ability to repay their debts, including loans, may be less damaged. Thus, the negative effect of wars on bank credit is likely to be partly curbed. Therefore, the fourth source of heterogeneity in responses is the loans received by an affected country from non-residents.

Source #5: *Quality of institutions*. The literature has a consensus that institutions matter for finance and credit (e.g., Djankov et al., 2007). Wars may seriously undermine governments' ability to maintain law, control corruption, and force economic agents to comply with regulations. Countries with relatively weaker institutions may thus experience longer declines in bank credit in case of wars, because banks may experience more difficulties in forcing borrowers to repay their debts. Therefore, the fifth source of heterogeneity in responses is the quality of institutions.

42 The Global Financial Development database also contains a variable reflecting the percentage of loans requiring collateral, which is what we are interested in. However, this variable has only 302 country-year observations overall and even fewer (53) for those countries that experienced at least one year of battle deaths among its population.

To test for these five potential sources of heterogeneity in responses, we slightly modify Equation (2) by introducing an interaction of the battle deaths variable with a variable reflecting the corresponding source. All variables except battle deaths are taken with the lead of $t + 3$, as discussed above. The resultant equation is as follows:

$$\begin{aligned}\ln\left(1+\frac{BankCredit_{c,t+3}}{GDP_{c,t+3}}\right) = \alpha_c + \gamma_t &+ \beta_1 \cdot \left(\ln\left(1+\frac{BattleDeaths_{c,t}}{POP_{c,1985}}\right) \times Source^{(j)}_{c,t+3}\right) \\ &+ \beta_2 \cdot \ln\left(1+\frac{BattleDeaths_{c,t}}{POP_{c,1985}}\right) \\ &+ \beta_3 \cdot Source^{(j)}_{c,t+3} \\ &+ BankingSystemControls_{c,t}\mathbf{\Psi'} \\ &+ MacroControls_{c,t+3}\mathbf{\Omega'} + \varepsilon_{c,t}\end{aligned} \tag{4}$$

We split all of the source variables that we have into three groups – 'economic policy', 'economic and financial activities', and 'quality of institutions' – and present the estimation results consecutively for each of them. Prior to running the estimations, we subtract the corresponding sample means from the battle deaths and the j-th source variable to reduce multicollinearity concerns and facilitate the interpretability of the estimated coefficients. When interpreting economic significance, we use standard deviation rises of bank credit during the war times only.

Group #1: *Economic policies*. The estimation results for this group appear in Table 7. In column (1), we obtain a negative and insignificant estimate of the coefficient on the interaction of the *profit tax* (in annual changes) and the log *battle deaths* variables. This means that a policy aimed at smoothing the effects of wars by relaxing profit taxation may have limited scope. However, in column (2) we further obtain a negative and highly significant estimate of the coefficient on the interaction of the *labour tax* (in annual changes) and the log *battle deaths* variables. This, in turn, indicates that an easing of labour taxation after a war hits may smooth the effects of the war on the dynamics of bank credit. In our sample, though, the economic magnitude of the underlying effect is not large: even if we assume that both variables are 'shocked' by one standard deviation (1.67 for wars, 0.016 for Δ labour taxes), the resultant joint effect would be equal to only -0.017 (-0.667 · 1.67 · 0.016), which is just 6.5% of one within-country standard deviation of the log credit-to-GDP variable.[43]

43 When taken in levels (or log levels), the interaction of a tax variable and the log battle deaths variable enters the equation with an opposite sign, which is counter-intuitive, and highly insignificant. This may mean that what matters during war times is how adaptive and flexible a government's fiscal policy is.

TABLE 7 **BATTLE DEATHS AND BANK CREDIT: THE ROLE OF FISCAL, MONETARY, AND MACROPRUDENTIAL POLICIES ACROSS COUNTRIES**

Source variable $X_{c,t+3}$:	Fiscal policy		Monetary policy		Macropru policy
	Δ Profit tax (1)	Δ Labour tax (2)	Δ Money market % (3)	Δ Gov't bond % (4)	Overall index (5)
Battle Deaths$_{c,t}$ × $X_{c,t+3}$	-0.255 (0.175)	-0.667*** (0.163)	-0.625*** (0.156)	-0.470*** (0.137)	-0.002 (0.005)
Battle Deaths$_{c,t}$	-0.027 (0.021)	-0.026 (0.021)	-0.159*** (0.031)	-0.079** (0.032)	-0.049* (0.026)
$X_{c,t+3}$ (by cols)	0.306 (0.406)	-0.071 (0.263)	-0.582* (0.351)	-0.055 (0.333)	0.009 (0.016)
Obs.	305	305	262	227	164
No. countries	46	46	27	27	15
R^2	0.325	0.325	0.577	0.440	0.598

Note: The table reports cross-country regression estimates reflecting the ability of fiscal, monetary, and macroprudential policies to accelerate or smooth the effect of battle deaths on bank credit in the future. The dependent variable is log of 1 + domestic private credit by banks to GDP, taken with a t + 3 lead, which, as our Jordà local projections show (Figure 12), corresponds to the peak of the effect of battle deaths on bank credit. To avoid multicollinearity concerns, the battle deaths and X variables are demeaned. All regressions contain control variables reflecting the state of the banking system and the macroeconomy, all taken at t, and sets of country and year fixed effects. See the full definitions of the variables in Table 16 in the Appendix. The money market interest rate and the government bond interest rate are adjusted to CPI inflation. Δ is a change between years t − 1 and t. Macroprudential policy measure comes from Cerutti et al. (2017). ***, **, * indicate an estimate is significant at 1%, 5%, 10% level, respectively. Standard errors are clustered at the country level and reported in the brackets below the estimated coefficients.

Turning to monetary policy, we have to use the short-term money market rate and the interest rate on government bonds as proxies for the regulated interest rates because of limitations in the World Bank/IFS cross-country data. As we report in columns (3) and (4), both proxies deliver negative and highly significant estimates of the coefficients on their respective interactions with the battle deaths variable. This clearly favours the view that tight monetary policy after a 'war shock' creates certain obstacles for the post-war recovery of the penetration of bank credit in the economy. For the money market rate, the underlying economic effect of joint rises in a monetary policy proxy and the battle death variables equals -0.064, corresponding to 20% of one (within-country) standard deviation of the credit-to-GDP variable. For the government bond rate, the effect reaches -0.044, which is equivalent to 13% of one (within-country) standard deviation of the credit-to-GDP variable. The effects of monetary policy are thus much larger than the effects of fiscal policy in our cross-country sample when it comes to smoothing the effects of wars on banking systems.

Finally, we employ the cross-country data on the overall index of the stringency of macroprudential policy from Cerutti et al. (2017). The data are available from 2000 onwards, thus reducing our sample substantially. As show in column (5), we obtain a near zero and insignificant estimate of the coefficient on the interaction of the macroprudential policy index and the battle death variables. More research is needed in this direction, including the use of more granular data.

We conclude that the efficiency of Group #1 '*Economic policies*' is mixed in our setting. Monetary policy appears to be very potent in smoothing the destructive effects of wars on the banking system's credit. Fiscal policy, by adapting tax rates on labour income, may also serve the same goal, but its effectiveness is rather limited. Given the data constraints, we do not find evidence favouring the effectiveness of macroprudential policy in our setup.

Group #2: *Economic and financial activities.* The estimation results for this group appear in Table 8. We first consider the behaviour of financial markets, namely, how volatile stock prices are and how deep the war-induced decline in stock market returns is. In column (1), we obtain a negative and marginally significant coefficient on the interaction of the *battle deaths* and the log of *stock price volatility* variables. The coefficient on the battle deaths variable is also negative and highly significant, as in the baseline estimates above. The underlying economic effects are also meaningful. Suppose that an affected economy encounters the equivalent of a one standard deviation increase in the log battle deaths variable in year t (1.48) and that, in addition, it experiences a one standard deviation increase in the log stock price volatility (0.079). Under these circumstances, our estimates suggest that the joint effect reaches -0.029, or 9.5% of one (within-country) standard deviation of the log bank credit-to-GDP variable. In column (2), we replace stock price volatility with annual returns on stocks and obtain no significant results.

TABLE 8 **BATTLE DEATHS AND BANK CREDIT: THE ROLE OF FINANCIAL MARKETS, EXPORT ORIENTATION, AND FOREIGN SUPPORT**

	Stocks and collaterals		International trade	Foreign support
Channel variable $X_{c,t+3}$:	ln Stock price volatility	Stock market return y-o-y	Δ ln Export unit value	ln Loans from abroad
	(1)	(2)	(3)	(4)
Battle Deaths$_{c,t}$ × $X_{c,t+3}$	-0.251*	0.031	0.138***	0.037**
	(0.132)	(0.054)	(0.050)	(0.018)
Battle Deaths$_{c,t}$	-0.109***	-0.096***	-0.068***	-0.104***
	(0.029)	(0.031)	(0.020)	(0.016)
$X_{c,t+3}$ (by cols)	-1.170**	-0.241**	-0.287**	-0.049
	(0.554)	(0.113)	(0.121)	(0.052)
Obs.	291	259	671	369
No. countries	25	25	68	41
R^2	0.533	0.459	0.426	0.466

Note: The table reports cross-country regression estimates reflecting the ability of domestic financial markets, international trade, and foreign support to smooth the effect of battle deaths on bank credit in the future. The dependent variable is log of 1 + domestic private credit by banks to GDP, taken with a t+3 lead, which, as our Jordà local projections show (Figure 12), corresponds to the peak of the effect of battle deaths on bank credit. To avoid multicollinearity concerns, the battle deaths and X variables were demeaned. All regressions contain control variables reflecting the state of the banking system and the macroeconomy, all taken at t, and sets of country and year fixed effects. See the full definitions of the variables in Table 16 in Appendix. ***, **, * indicate an estimate is significant at 1%, 5%, and 10% level, respectively. Standard errors are clustered at the country level and reported in the brackets below the estimated coefficients.

In column (3), we further obtain a positive and highly significant estimate of the coefficient on the cross-product of the log (real) *export unit value* and the log *battle deaths* variables, with the latter being also highly significant and negative, as in the baseline specification above. The underlying economic effect is also significant: a one standard deviation increase in the log battle death variable shrinks the log credit-to-GDP by 31 percentage points of one (within-country) standard deviation in three years, but this effect can be reduced by 8.5 percentage points during the same time if the affected economy enjoys an increase in the price of its exports by one standard deviation of the export variable. Clearly, if countries in the war regime are able to support their incomes stemming from non-affected countries, this would (relatively) raise both the banks' willingness to lend and the borrowers' ability to repay. Of course, this is difficult for countries that are price-takers in the corresponding world markets for their exports.

Finally, in column (4), we obtain a positive and significant estimate of the coefficient on the interaction of the log *battle deaths* and log *loans from abroad* variables. The economic effect is substantial: if the log battle deaths variable rises by one standard deviation now and the log loans from abroad rises by on standard deviation over the next three years, then the initial negative impact of the war, -55 percentage points of one (within-country) standard deviation of the credit-to-GDP variable, is smoothed by 18.5 percentage points, that is, by one third. Clearly, getting financial support from abroad reduces the negative impact of wars on the banking system's ability to extend loans tremendously; so far, it is the largest economic effect that we obtain when analysing the effects of wars on bank credit. This is likely because the loans from abroad enable the liability side of the affected banking system's balance sheet to recover, in turn creating the ground for lending activity to recover.

We therefore provide evidence in favour of the efficiency of Group #2 *'Economic and financial activities'* in capturing the heterogeneity of the effects of wars on the banking systems of countries affected by them.

Group #3: *The quality of institutions*. We report the estimation results for this group in Table 9. In columns (1) to (3), we employ the widely used rule of law, control of corruption, and regulatory quality indicators to capture the cross-country heterogeneity of banking systems' credit response to wars. We obtain a positive but only marginally significant estimate of the coefficient on the interaction of the *rule of law* and the *battle deaths* variables (see column (1)). The underlying economic effect is rather small, reaching -0.017, or only 5.5% of one (within-country) standard deviation of the bank credit-to-GDP variable. This is comparable to the limited effect of government fiscal policy when it comes to smoothing the effects of wars on banking systems. However, we believe that it takes much longer to change institutions and for the impact of this change to be revealed, whereas our estimates capture short-term effects, or medium-term at best.

In columns (2) and (3), we obtain no significant estimates when switching from the rule of law to the control of corruption and the regulatory quality variables. Again, it may take more time for the effects of changes in these two spheres on the economy and financial sector, in particular, to materialise.

TABLE 9 **BATTLE DEATHS AND BANK CREDIT: THE ROLE OF INSTITUTIONS**

	Quality of institutions		
Channel variable $X_{c,t+3}$:	**Δ Rule of law (1)**	**Δ Control of corruption (2)**	**Δ Regulatory quality (3)**
Battle Deaths$_{c,t}$ × $X_{c,t+3}$	0.104*	0.021	-0.051
	(0.062)	(0.042)	(0.079)
Battle Deaths$_{c,t}$	-0.013	-0.012	-0.012
	(0.028)	(0.028)	(0.028)
$X_{c,t+3}$ (by cols)	-0.258**	-0.044	0.181
	(0.124)	(0.116)	(0.145)
Obs.	461	461	461
No. countries	57	57	57
R^2	0.394	0.388	0.392

Note: The table reports cross-country regression estimates reflecting the ability of institutions to accelerate or smooth the effect of battle deaths on bank credit in the future. The dependent variable is log of 1 + domestic private credit by banks to GDP, taken with a t+3 lead, which, as our Jordà local projections show (Figure 12), corresponds to the peak of the effect of battle deaths on bank credit. To avoid multicollinearity concerns, the battle deaths and X variables were demeaned. All regressions contain control variables reflecting the state of the banking system and the macroeconomy, all taken at t, and sets of country and year fixed effects. See the full definitions of the variables in Table 16 in Appendix. ***, **, * indicate an estimate is significant at the 1%, 5% and 10% level, respectively. Standard errors are clustered at the country level and reported in the brackets below the estimated coefficients.

Our results may imply that the supply of credit shrinks during war time not because banks are afraid that borrowers will strategically default on loans, violating the institutional rules set by the government, but more likely because the war (partly) destroys the liability side of the banking systems' balance sheet, which then undermines banks' ability to extend loans to the economy. In the Appendix, we deliver supportive evidence for this interpretation: in the same Jordà LP manner, we show that battle deaths predict significant and prolonged declines in a banking system's deposits-to-GDP ratio (Figure 20a), while having no significant predictive power regarding the ratio of the banking system's non-performing loans (NPLs) to total loans even in five years after the 'war shock' (Figure 20b).[44] We therefore conclude, with a certain degree of caution, that the efficiency of Group #3 '*The quality of institutions*' is limited in our setting.

44 Notably, when we repeat the 'channel' regressions, as implied by Equation (4), but with log bank credit-to-GDP being replaced by the log bank NPLs ratio, we also obtain no significant coefficients on the interactions between the log battle deaths and each of the three institutional variables. The results are not reported to save space and are available upon request.

Summary

Overall, we conclude that wars have substantial negative impacts on banking systems around the world, with bank credit and bank deposits declining during at least three years after a war 'shock', as expected. However, there are also less expected outcomes from our analysis. First, we show that the ratios of NPLs to total loans are unlikely to rise on aggregate for roughly 30 countries suffering from wars over 1989–2020. Second, the capital adequacy ratio (CAR) tends to decline in the short run after the war, meaning that capital shrinks faster than risk-weighted assets. A (probably substantial) part of the risk-weighted assets are loans extended by banks to the economy, which implies that bank owners may be withdrawing their funds from banks after the war starts. But then, as time passes, we find that the trend reverts and CAR begins to rise again, most likely reflecting post-crisis recoveries of the affected economies. Third, we find that wars significantly reduce concentration in the banking systems of the war-affected countries. Fourth, we document that foreign banks tend to increase their presence as time passes after the beginning of a war. It may be the case that under decreased concentration, and given the potential for post-war economic recovery, it is easier for the banks from other (non-affected) countries to enter the domestic market after the war and take a larger control over future profits. Finally, we examine several sources of the cross-country heterogeneity in the effects of wars on banking systems' credit to the real economy. We find that tighter monetary and, to a lesser extent, fiscal policies, along with more volatile stock markets, accentuate the negative effects of wars, whereas a greater ability to attract loans from abroad and rising export prices both smooth the negative effects of wars.

CHAPTER 2

Bank adaptation to infectious diseases

2.1 THE IMPACT OF COVID-19 ON BANKS AND THEIR CUSTOMERS

Recent papers have analysed the impact of the COVID-19 pandemic on banks and other financiers (Table 10). Fu and Mishra (2022) find that the spread of COVID and related government lockdowns led to an increase of between 21% and 26% in the relative rate of daily finance app downloads, which was over and above the pre-COVID-19 trend and which persisted in time. The COVID-induced surge in digitisation changed the market structure and altered the future landscape of financial intermediation along several dimensions. First, 'BigTech' and fintech startups (founded after 2015) were the main beneficiaries of increased digitalisation: their app adoption grew 9% above that of traditional incumbents. Second, the growth in finance app adoption was uneven across advanced and emerging countries: the latter set of countries saw a greater increase due to a lower ex-ante level of financial inclusion and competition. Third, populations in advanced and emerging economies showed demand for different types of financial services delivered with finance apps. In advanced economies, there was a 23% increase in investment app downloads (insignificant in EMEs), while in emerging economies there was a 39% rise in lending app downloads (compared to 13% increase in advanced economies) suggesting that in EMEs, under low starting levels of financial inclusion and financial health, there was greater demand for means of adaptation to negative shocks.

Increased demand for digital banking and remote financial services in response to epidemic exposure is confirmed in Saka et al. (2022). Exposure to epidemics – the authors consider SARS in 2003, H1N1 in 2009, MERS in 2012, Ebola in 2014, and Zika in 2016 – increases the likelihood of internet bank transactions, making online payments, and ATM withdrawals as opposed to showing up at a bank branch. Importantly, this shift is more pronounced with better ex-ante 3G internet coverage and it is mostly young high-income employees that benefit from it, suggesting that epidemic exposure exacerbates the digital divide in adaptation and use of new technologies.

TABLE 10 **THE EFFECTS OF COVID-19 ON BANKS, THEIR BORROWERS, AND THE LOCAL ECONOMY**

Paper	Country, sample	COVID shock	Method	Estimated effect	Outlet
Panel 1. Effects on banks					
Fu and Mishra (2022)	Mobile application downloads in 56-71 countries, daily 2019-2020	I (first confirmed COVID-19 case); I (lockdown)	Event-study	• 21% to 26% increase in the relative rate of daily finance app downloads • Main beneficiaries: "BigTech" and fintech startups • +23% increase in investment app downloads in AEs and +39% rise in lending app downloads in EMEs	*Journal of Financial Intermediation*
Beck and Keil (2022)	US bank-, county-level and bank-county-level data. DealScan loan-level data. Quarterly 2017-2020	Intensity of bank exposure to COVID-19; to lockdown	Panel fixed effects	• ↑ loss provisions and non-performing loans • Government-guaranteed loans replace regular SME lending. • Supply-side-type of response on the syndicated loan market	*Journal of Corporate Finance*
Greenwald, Krainer and Paul (2024)	US, loan-level supervisory data FR Y-14Q (half of C&I loans), 2012:Q3-2020:Q4	-	Cross-sectional regressions	• Around 90% of increase in C&I lending during COVID-19 was driven by draws on credit lines by large firms. • Crowding out effect: banks with large withdrawals of existing credit lines restrict their term lending and SME lending by more	*Journal of Finance* (forthcoming)
Fuster, Hizmo, Lambie-Hanson, Vickery and Willen (2023)	US secondary mortgage market, mortgage offers (Optimal Blue), mortgage securitization (Black Knight eMBS) + others. 2019-2020	I (Pandemic)	Event-study	• Broad rise in mortgage intermediation markups unrelated to virus exposure, local competition, and to default risk in the prime conforming market. • Widening spread in the risky segment (e.g., jumbo and FHA mortgages)[45] • Fintech lenders gained market share among complex and labour-intensive mortgages	*Journal of Finance* (R&R)

45 'Jumbo loans' refers to non-guaranteed mortgages to high-income borrowers. These loans exceed conventional mortgage limit set by the Federal Housing Finance Agency (FHFA). 'FHA loans' refers to low down payment government loans to borrowers with a low credit score insured by the FHA.

Paper	Country, sample	COVID shock	Method	Estimated effect	Outlet
Panel 2. Effects on borrowers					
Agarwal, Chomsisengphet, Kiefer, Kiefer and Medina (2023b)	Loan-level data (Freddie Mac, Black Knight), Chetty et al. data, 2015-2020	I (2020)	Event-study	• Widening of mortgage refinancing gap between high- and low-income borrowers • Increased refinancing inequality is partly explained by financial hardship (mortgage in forbearance), mitigated by familiarity with fintech, exacerbated by limited financial literacy	*Journal of Financial and Quantitative Analysis*
Panel 3. Broader impact of COVID-19 and related government programs					
Chetty, Friedman, Stepner and Opportunity Insights Team (2023)	US, public high-frequency data from private sources; county, industry, and income level, 2020-2021	I (State Reopening), I (PPP eligibility)	DiD, Event-study	• Sharp decrease in spendings by high-income groups in Jan-Mar 2020, spending reduction concentrated in in-person services. • Widespread low-wage job losses in small businesses in affluent areas • 'V-shaped' recession for high-wage workers, 'L-shaped' for low-wage • Early (2020) cash transfer yielded equal stimulating effect on Spending while later ones (2021) affected spending of low-income groups only. • Paycheck Protection Program (PPP) had small effect on firm employment	*Quarterly Journal of Economics*
Agarwal, Ambrose, Lopez and Xiao (2023a)	US, nonresidential commercial mortgage-backed securities, 2019-2020	-	Event-study, 2WFE with variation in exposure to PPP	• PPP lowered increases in the delinquency rate of commercial mortgages during the COVID-19 outbreak by 1 - 1.5 p.p. at the average exposure of commercial mortgage to the program	*AEJ: EP*
Bloom, Bunn, Mizen, Smietanka and Thwaites (2023)	UK, firm-level Decision Maker Panel (DMP) survey data, BvD Fame dataset	-	Productivity decomposition	• TFP reduction by up to 6% in 2020-2021 • Driven by within-firm effects: higher intermediate input cost and lower capacity utilization	*ReStat*
Bergeaud, Eyméoud, Garcia and Henricot (2023)	France, county-level data, 2000-2020	I (Pandemic)	DiD	• During COVID-19 crisis, corporate real estate valuation declined more in counties more exposed to telecommuting compared to other types of building	*Reg Science Urban Economics*

Beck and Keil (2022), using spatial and time variation in the United States, find that banks with higher geographical exposure to COVID-19 and lockdown measures experienced a rise in both loss provisions and NPLs. A surge in small business lending during COVID-19 was primarily driven by a government support programme (the 2020 CARES Act's Paycheck Protection Program), suggesting a replacement of regular SME lending. Additionally, the authors find a decrease in both the quantity and average size of syndicated loans for banks most impacted by the pandemic coupled with a surge in interest spreads, suggesting adverse effects of the pandemic on the supply side of credit.

Fuster et al. (2023) show that COVID-19 altered the dynamics of the US mortgage market. First, against the backdrop of unprecedented new originations, the market witnessed a broad rise in mortgage intermediation markups, which restrained the transmission of low interest rates to borrowers. The authors show that the rise in markups was unrelated to virus exposure or local competition, and was also unrelated to default risk in the prime conforming market. Second, mortgage rate spreads widened even more in the risky segment, including both non-guaranteed jumbo loans to high-income borrowers and Federal Housing Administration (FHA) loans to borrowers with a low credit score. Third, a rise in pandemic-related operational constraints (e.g., challenges in hiring new loan officers and other mortgage employees) enabled technology-based fintech lenders to gain market share within complex and labour-intensive mortgages. Finally, purchases of mortgage-based securities during quantitative easing supported mortgage credit supply while government guarantees lowered rates. However, both QE and government guarantees target only conforming segment of the market (i.e., conventional loans below the Federal Housing Finance Agency limit).

Agarwal et al. (2023b) show that during the COVID-19 pandemic, high-income borrowers saved more from mortgage refinancing compared to low-income borrowers, and that this difference increased tenfold compared to previous refinancing waves. This suggests that mortgage refinancing is another channel through which COVID-19 increased inequality.

Broader impact of COVID-19 and related government programmes

Chetty et al. (2023) build a novel public high-frequency dataset based on private transaction-level data to document the unequal impact of the COVID-19 outbreak on spending and employment in the US and estimate the effects of major government relief programmes (stimulus cheques and the Paycheck Protection Program). Initially, 41% of the spending cut over 1 January to 15 April 2020 came from the high median income ZIP codes (the top quartile); ZIP codes in the bottom quartile of median income accounted for only 12% in the overall spending decline. Spending cuts during early months of the pandemic were concentrated in in-person services (restaurants and hotels), reflecting mostly health concerns. Affected businesses passed spending shock to their employees resulting in large and persistent decline in low-wage employment in high income areas. High-wage workers' employment rebounded quickly by the end of June 2020 (a 'V-shaped' recession), while low-wage workers experienced larger and more persistent job losses: by December 2021, employment rates in low-wage jobs remained

depressed in high-income areas that were initially hit hard by the pandemic. Stimulus cheques were equally effective for high- and low-income groups in 2020, but in 2021 they barely affected the high-income population, who cut spendings but did not experience significant employment losses and thus saved. In contrast, the low-income population continued to respond to stimulus cheques.

The COVID-19 pandemic reduced firm productivity and led to the depopulation of cities. Bloom et al. (2023), using a panel survey of UK firms, show that COVID-19 reduced total factor productivity in the UK private sector by up to 6% in 2020–21. The key driver is within-firm reductions in TFP explained by higher intermediate input costs and lower capacity utilisation. The negative within-firm effects on TFP were partly offset by positive 'between-firm' effects: low-productivity sectors involving face-to-face interactions (travel, leisure, retail, etc.) contracted by more than high- productivity sectors, and low-productivity firms within low-productivity sectors were affected the most. However, as noted by the authors, the positive between-firm effects did not entail creative destruction of inefficient businesses; instead, much of this was explained by a lockdown of low-productivity sectors.

Agarwa et al. (2023a) show that the Paycheck Protection Program dampened increases in the delinquency rate of commercial mortgages during the pandemic by about 1 to 1.5 percentage points at the average treatment intensity level (this varies with the size of the mortgage and exposure of a property to the programme). Even though commercial property investors were not directly targeted by the programme, the authors document a sizable spillover effect of the government programme in the face of the COVID-19 crisis because funding could indirectly benefit the investors: the Paycheck Protection Program was used to sustain rent payments by small businesses, thus reducing commercial mortgage delinquency rates.

In addition to the spread of fintech and digital finance, COVID-19 led to other broad transformations and left some long-lasting scars. One example of a transformation is the large shift to working from home. Aksoy et al. (2023), drawing on data for 27 countries, show that working from home during COVID-19 saved 72 minutes on average, with most of the time saved spent on working more. The same authors show that, post-COVID, workers wished to retain flexibility and on average demanded 1.7 days working from home (Aksoy et al., 2020). According to the latest available estimates as of 2023, the shift to work from home has persisted, with about 28% of paid days worked from home in the US (Barrero et al., 2021), which is three times higher than pre-COVID. This persistent change in working arrangements is reflected in the redirection of patent applications towards those advancing work from home, such as video conferencing, telecommuting, or remote interactivity (Bloom et al., 2021). The COVID-19 pandemic and the spread of working from home arrangements also shifted demand for housing away from apartments to larger single-family houses with outdoor space (Guglielminetti et al., 2022).

There are persistent scars of epidemics left in terms of socioeconomic and gender inequality as well as political trust. Eichengreen et al. (2023) show that exposure to COVID-19 among young individuals (aged 18 to 25) has a persistent and negative effect on trust in political institutions and leaders, especially if this experience was under a weak government with low policymaking capacity. According to Agostinelli et al. (2022), school closures during COVID-19 led to unequal human capital accumulation among children: students from low-income neighbourhoods suffered learning loss due to peer effects and lower parental time investment, while children from high-income neighbourhoods were barely affected. Fuchs-Schündeln (2022) estimates that school closures in the United States reduced life-time earnings of the affected children by 1.8%. She also notes that in both the United States and Germany, school closures are likely to increase inequality and decrease intergenerational mobility. COVID-19 also exacerbated gender inequality because it predominantly hit contact-intensive service sectors with high female employment shares (Alon et al., 2020). In addition, school closures disproportionally affected women due to their higher ex-ante involvement in home-based childcare and schooling.

In general, the COVID-19 negative shock, like many other disasters, affected populations unequally and exacerbated inequality along several dimensions (at the very least, schooling, gender, financial access, and solvency). To a large extent, the unequal effect of pandemics is explained by differential abilities of populations to adapt to such shocks and by different exposures to the shocks. Banks and financial institutions may learn from past lessons and project inequal future shock effects given the expected increased incidence of infectious diseases and other disasters.

2.2 QUANTITATIVE EXERCISE #3: DEATHS FROM INFECTIOUS DISEASES AND PROSPECTS OF THE BANKING SYSTEMS

We now continue our cross-country analysis of the adaptation of banking systems to various disasters that we started in Section 1.2.2. The World Bank database includes data on deaths caused by infectious (communicable) diseases retrieved for 2000, 2010, 2015 and 2019 from the World Health Organization.[46] The data are for the pre-COVID-19 period, so all the following estimates could be considered as conservative if projecting them to the time of COVID-19. Deaths caused by infectious diseases are represented as a percentage of total deaths in each country, and vary between 1.2% and 78.6% across the four years of available observations. We start our analysis by splitting all the countries into those less or more affected by infectious diseases, and we set the threshold between

46 We consider the variable reflecting communicable diseases and maternal, prenatal, and nutrition conditions that include *infectious* and parasitic diseases, respiratory infections, and nutritional deficiencies. We acknowledge that it mixes infections with other diseases, but (i) this is the best that we could find in terms of country coverage (basically, all countries during the four years) and (ii) its correlation with the deaths caused by infectious diseases *during epidemics* (disclosed through the EM-DAT database) equals 65%, i.e., the largest part of the variation in our chosen proxy is driven exactly by infectious diseases. See the full definitions of the variables in Table 16 in Appendix. For expositional brevity, we refer to this variable as infectious diseases only.

'less' and 'more' as the 50th percentile of deaths caused by infectious diseases (15%).[47] Similarly to the 'war' versus 'peace' descriptive analysis in the previous exercise, we then explore differences in the mean levels of key banking system indicators across the less and more disease-affected states.

Data

Table 11 reports the results of the two-sample t-test on the mean differences in banking system characteristics across the two states, i.e., more and less affected by infectious diseases. In the more affected state (column 1), 41% of all deaths are caused by infections, compared with only 7.6% in the less-affected state (column 2). Although we do not know the demographic structure of those deaths, we may assume that at least some of them relate to people who take credit from banks. And when the health risk is high due to greater exposure to infections, banks may put a 'health risk' premium on the interest rates on loans and thereby reduce the demand for loans. As we document in the second and third rows of Table 11, the data favour this view. Under the more-affected state, bank credit is on average just 30% of GDP, which contrasts with 62% of GDP in the less-affected state. In contrast, the average lending rate in the more-affected state reaches 16%, which is 5 percentage points higher than in the less-affected state. That is, the (equilibrium) amount of loans is lower and the lending rate is higher when an economy suffers from a greater incidence of infection-induced deaths.

However, the raw data comparison across the two states reveals no statistical differences in the mean values of many other banking characteristics, such as the capital adequacy ratio, reliance on non-interest income sources, penetration of foreign banks, or concentration in the banking system. An exception is the ratio of bank deposits to GDP, which mimics the situation with bank credit (i.e., much lower in the more affected state and larger in the less-affected state). Nonetheless, an integral indicator of the banking system state – the probability of banking crises – appears to be significantly better in the countries that are more affected by the infection-induced deaths at just 2.6%, which is 5.3 percentage points lower than in the countries that are less affected. Recall that the less-affected countries are mostly less developed economically, and the penetration of bank credit itself is two times lower. Finally, what is remarkable in this comparison is that battle deaths – the variable of focus in the previous quantitative exercise – are much higher in those countries that suffer more from infectious diseases (9,000 victims on the battlefield, versus 5,000 in those countries that are less affected by deaths from infectious diseases). This is the first evidence of how different types of disasters may overlap ('double jeopardy').

47 *Below the median* (fewer deaths from infectious diseases) are most developed countries (the United States, Australia, Belgium, Canada, Switzerland, etc.), some African countries (Tunisia, Morocco), some Asian countries (Vietnam, Thailand) and India, some Latin-American countries (Brazil, Uruguay, Chile, etc.), some Middle Eastern countries (Iran). *Above the median* (more deaths from infectious diseases) are most African countries, some Latin-American countries (Argentina, Peru), some Middle Eastern countries (Iraq, Afghanistan), India, Bangladesh, some Asian countries (Philippines, Singapore).

TABLE 11 **COUNTRIES MORE VERSUS LESS AFFECTED BY INFECTIOUS DISEASES: DIFFERENCES IN MACRO-FINANCIAL OUTCOMES**

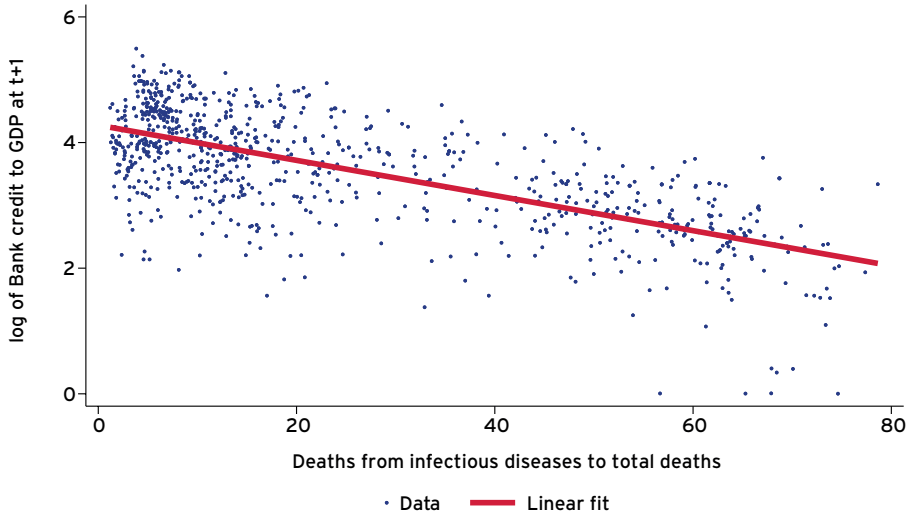
Variable	More affected (1)	Less affected (2)	Difference (3) = (1) – (2)
Deaths from infectious diseases (% of total deaths)	41.2	7.6	33.6***
Bank credit to domestic private sector/ GDP (%)	29.6	62.5	-35.6***
Bank lending rate (%)	16.3	11.3	5.0***
Bank regulatory capital (% of risk-weighted assets)	17.6	17.6	0
Five-bank asset concentration (% of total assets)	78.6	80.2	-1.6
Foreign banks' assets (% of total assets)	40.8	33.6	7.2
Bank deposits/GDP (%)	33.6	63.9	-30.3***
Bank non-interest income (% of total income)	39.0	38.9	0.1
Prob (Banking crisis = 1)	0.026	0.079	-0.053***
Stock price volatility	20.4	19.0	1.4
GDP growth (y-o-y %)	4.3	3.2	1.1***
For comparison:			
Battle deaths (no. of victims)	9054.1	5261.8	3792.3

Note: The table presents the mean values of the deaths from infectious diseases and macro-financial indicators in the two subsamples of countries: more vs. less affected by the infectious diseases, where the threshold between 'more' and 'less' is the 50th percentile of deaths caused by infectious diseases. The sample consists of 183 countries that reported infectious disease-induced death statistics to the World Health Organization in 2000, 2010, 2015, and 2019. The table also reports the results of the Welch two-sample t-test on the mean differences across the more and less affected countries (equal variances are assumed). See the full definitions of the variables in Table 16 in Appendix.

Source: Word Bank, World Health Organization, Global Health Estimates 2020.

Turning to a more formal regression analysis, we first notice the raw data on the deaths from infectious diseases predicts well a decline in the depth of bank credit penetration in the economy. There is a clear negative relationship between the log infection-induced deaths in total deaths in country c in year t and the bank credit-to-GDP ratio in that country in year $t + 1$ (Figure 15). This relationship exists for all four years for which we have observations on deaths.

FIGURE 15 **DEATHS FROM INFECTIOUS (AND OTHER) DISEASES AND THE PRIVATE CREDIT BY BANKING SYSTEMS: CROSS-COUNTRY DATA**



Note: The chart documents the negative relationship between deaths caused by infectious diseases (as a percent of total deaths) in year t and domestic credit to the private sector by the banking system (as a percent of GDP) in the subsequent year $t + 1$.

Source: Word Bank, World Health Organization, Global Health Estimates 2020.

Empirical design

Given the differences in data, we slightly modify Equation (2) from Section 1.2.2 aimed at projecting the dynamics of bank credit and other banking system characteristics to years $t + h$, where t = [2000, 2010, 2015, 2019] stands for the years of available observations on deaths from infectious diseases from the World Health Organization and h = 1, 2, ..., 10 years reflects the length of the prediction horizon. The regression reads as follows:

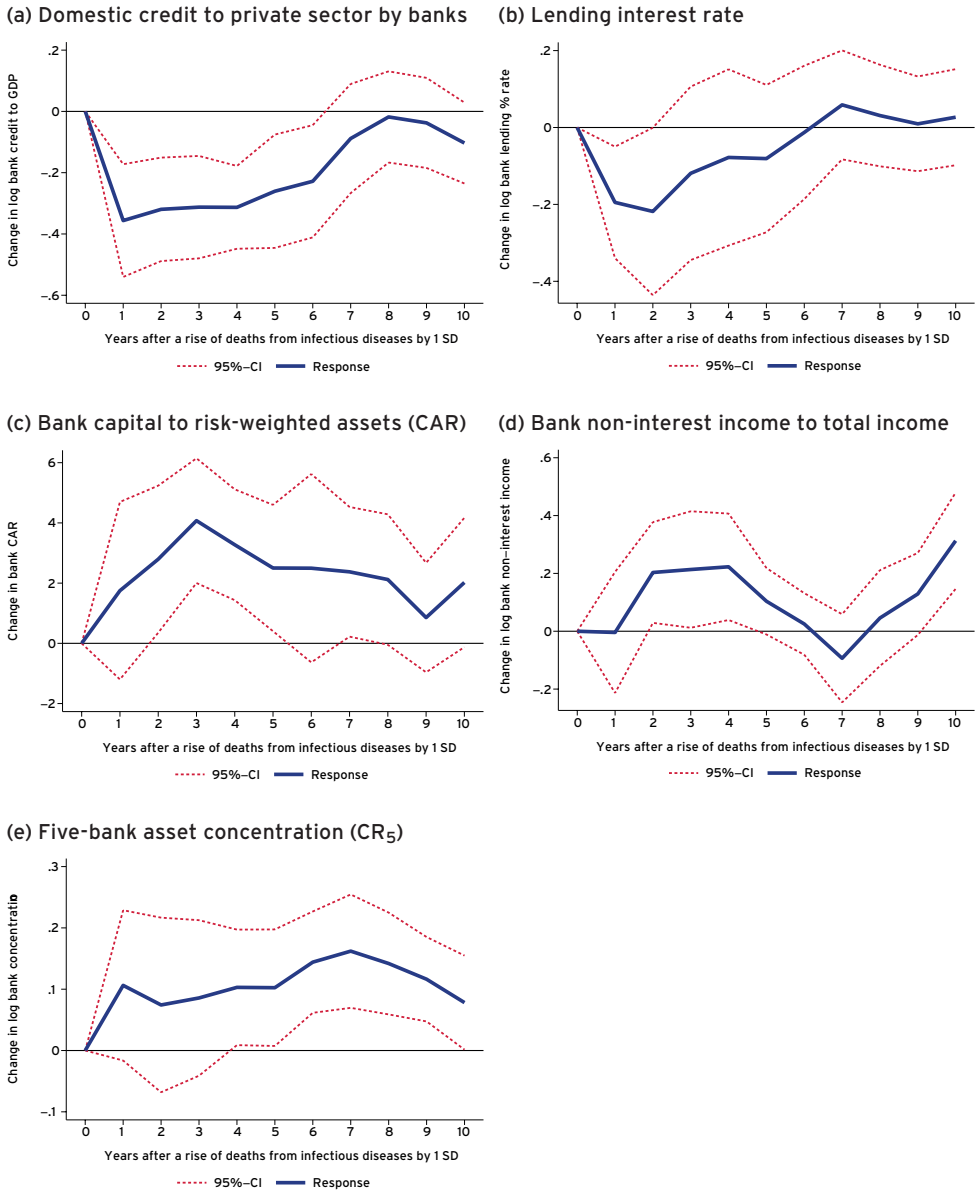
$$\ln\left(1 + \frac{BankCredit_{c,t+h}}{GDP_{c,t+h}}\right) = \alpha_c + \gamma_t + \beta \cdot \ln\left(\frac{InfectDiseaseDeaths_{c,t}}{TotalDeaths_{c,t}}\right) + BankControls_{c,t}\mathbf{\Psi'} + MacroControls_{c,t}\mathbf{\Omega'} + \varepsilon_{b,t} \quad (5)$$

where all the notations and estimation procedures are as before.

Estimation results: Average effects

We keep the structure of presentation of our main estimation results the same as in the previous exercise in Section 1.2.2 and report the projections of the log deaths from infectious diseases, 'shocked' by one standard deviation (0.97) in year 0, on the log bank credit-to-GDP and other banking system characteristics (Figure 16).

FIGURE 16 **THE EFFECTS OF DEATHS FROM INFECTIONS (AND OTHER) DISEASES ON BANKING**



Note: The charts report the responses of banking system indicators to a one standard deviation increase in log infections (and other) diseases in year 0 (in % of total deaths) estimated using local projections. The sample consists of 183 countries that reported infectious disease death statistics to the World Health Organization in 2000, 2010, 2015, and 2019. Standard errors are double-clustered: at country and year levels.

The estimates indicate that a one standard deviation increase in the log infectious disease variable predicts a significant decline in the log bank credit-to-GDP ratio, which occurs rather fast and peaks at -0.39 in year $t + 1$ (significant at the 1% level, Figure 16a). After this peak, the effect attenuates and becomes insignificant from year $t + 7$. Economically, the peak effect is large, being equivalent to one third of a standard deviation of the log bank credit-to-GDP variable across the countries in our sample. Further, a 'shock' to the disease variable of the same size also predicts a fast reduction in the bank lending interest rate, peaking at -0.22 in year $t + 1$ and then quickly attenuating and becoming insignificant from year $t + 3$ (Figure 16b). The peak effect on the interest rate is also large, reaching one third of a standard deviation of the lending rate in the cross-country sample. Therefore, and differently from the credit and wars exercise above, we now obtain evidence in favour of suppressed demand-side effects of infectious diseases rather than negative supply-side effects in equilibrium.

Regarding the other banking characteristics, our estimates suggest that a one standard deviation increase in the log infectious diseases variable in year t predicts a rise in the ratio of bank capital to risk-weighted assets (CAR), peaking in year $t + 3$ at 4 percentage points (significant at 1%) and then attenuating to zero by the end of the prediction horizon (Figure 16c). The underlying economic effect of the peak reaction is very large, at nearly one third of a standard deviation of the CAR variable. A possible interpretation is nonetheless consistent with the suppressed-demand narrative discussed above: banks could reduce riskier loans to households that suffer from increased health risks, as captured by the infection-induced deaths,[48] while holding constant the amount of capital. In other words, the numerator of the CAR variable may remain constant or decline less than the denominator.

Our estimates than suggest that banking systems' non-interest income tends to rise after an increase in infection-induced deaths in the economy: a one standard deviation increase in the deaths variable in year t predicts a jump in the log non-interest income variable of 0.20 in year $t + 2$ (significant at 5%, Figure 16d). This peak effect corresponds to half of a standard deviation of this variable, implying that the economic effect is rather large. It appears that banks tend to substitute declines of credit caused by disasters such as wars and epidemics by raising the share of assets that are not associated with the credit risk.

Finally, our estimates also deliver evidence of rising banking concentration after a health shock: a one standard deviation increase in the log infection-induced deaths in year t predicts a permanent growth of the log five-bank asset concentration (CR_5), with the prediction becoming significant from year $t + 7$ and peaking at 0.16 (Figure 16e). This peak is economically large, being equivalent to two thirds of a standard deviation of the log CR_5 variable. This finding may imply that large and small banks are differently

48 Banks could also reduce loans to the firms that are more exposed to the households at higher health risk through the employment channel. Of course, one would need to explore the with matched employer-employee health data to evaluate such a claim, and we leave this for future research.

affected by infectious diseases. Both large and small banks may operate in a region within a country that is more exposed to the health risk, but large banks are more likely to also operate in the regions that are less exposed and thus they may have more opportunities to substitute their operations across the regions. Again, we stress that the evidence we discuss here is suggestive at best, and more granular research is needed in the future.

In the Appendix, we check the sensitivity of our baseline results by running the same Jordà LPs but with a measure of infectious diseases retrieved from a different cross-country database (Figure 21). Specifically, we employ the EM-DAT Public Table database, which provides annual data on deaths caused by infectious diseases.[49] The data are quite different from our baseline measure of deaths retrieved from the World Health Organization database, with a pairwise cross-country correlation of less than 10%. Despite this substantial difference, we obtain the same results: as Figure 21a shows, the pattern of the response of bank credit to a rise in infection-caused deaths is very much the same as in the baseline (also reported in Figure 21b for comparative reasons). Our baseline results are thus robust to switching the databases.

Estimation results: Heterogeneity of the effects of diseases

We conjecture that the impact of infectious diseases on bank credit may differ across countries due to observed differences in the following sets of characteristics:

Source #1: *Consumption adaptation*. The current literature has shown that the spread of diseases is procyclical, rising during the expansionary phase of the business cycle through intensified socioeconomic interactions (Adda, 2016), and that opening bank branches in relatively underserved areas improves people's health through providing better access to health insurance programmes and extending loans to hospitals (Cramer, 2021). We may further and naturally assume that the reduction of credit in response to infectious diseases may depend on the depth of the decline in household consumption, especially in those cases when a sizeable portion of consumption is financed through bank credit.

Source #2: *Quality of institutions*. Similarly to the credit and wars analysis in the previous exercise, we may also assume that the reduction of bank credit in response to infectious diseases may be more dramatic if a country has lower-quality institutions. This is inspired by a recent work by De Luca et al. (2021), which shows that higher institutional quality leads to an improvement in the appropriateness of healthcare provision. If, more generally, higher quality of institutions improves health, we may expect that healthier borrowers will be less likely to delay repayments and default on their loans, which may support bank lending during bad times of infection spread.

49 See https://doc.emdat.be/docs/data-structure-and-content/emdat-public-table/.

Source #3: *Fiscal and monetary policy*. We conjecture that the governmental fiscal policy may affect the relationship between infectious diseases and bank credit through taxes. If a country experiences an increase in the spread of an infectious disease, the government may smooth the negative effect on the banking system by adjusting its taxes (e.g., its labour income taxes), which may help affected borrowers to continue repaying their loans. The same effect may be achieved by easing the regulated interest rate. (We no longer consider macroprudential policy as its measure is rather limited in terms of time and country coverage.)

Similarly to Equation (4) from Section 1.2.2, we test for the three sources of heterogeneity in the impact of infectious diseases on bank credit by running the following regression:

$$\begin{aligned}\ln\left(1+\frac{BankCredit_{c,t+1}}{GDP_{c,t+1}}\right) = {} & \beta_1 \cdot \left(\ln\left(\frac{InfectDiseaseDeaths_{c,t}}{TotalDeaths_{c,t}}\right) \times Source^{(j)}_{c,t+1}\right) \\ & + \beta_2 \cdot \ln\left(\frac{InfectDiseaseDeaths_{c,t}}{TotalDeaths_{c,t}}\right) \\ & + \beta_3 \cdot Source^{(j)}_{c,t+1} \\ & + BankingSystemControls_{c,t}\mathbf{\Psi'} \\ & + MacroControls_{c,t}\mathbf{\Omega'} + \alpha_c + \gamma_t + \varepsilon_{c,t+1}\end{aligned} \tag{6}$$

The estimation results appear in Table 12. First, we obtain a positive and significant estimate of the coefficient on the interaction of the consumption growth and infection-induced deaths variables, and a negative and highly significant estimate of the coefficient on the disease variable itself, as in the baseline results (see column (1)). Economically, if we imagine a situation in which deaths from infectious diseases rise by one standard deviation in year t, the underlying decrease in log bank credit-to-GDP will reach -0.36 in the subsequent year $t + 1$. If we further imagine that consumption will also decline during year $t + 1$ by one standard deviation, then the total negative effect on bank credit will reach -0.40, that is, the additional effect through the consumption channel is just -0.04. Given that one standard deviation of the log bank credit-to-GDP variable is 0.86, we may conclude that Source #1 '*Consumption adaptation*' works but its potential is rather limited.

Second, we again obtain no evidence that favours the quality of institutions channel. All estimates of the coefficients on the interactions of the disease variable with the three chosen variables reflecting institutional quality are insignificant (see columns (2) to (4)). We may conclude that although institutions support both health and credit, their potential to smooth the negative effect of infectious diseases on bank credit at the aggregate level is low. Clearly, more granular research is needed in this direction.

TABLE 12 **DEATHS FROM INFECTIOUS DISEASES AND BANK CREDIT: HETEROGENEITY ANALYSIS IN CROSS-SECTIONS OF COUNTRIES**

	Consumption	Quality of institutions			Fiscal policy	Monetary policy
$X_{c,t+1}$:	Δ ln Consum (1)	Rule of law (2)	Control of corrution (3)	Regulatory quality (4)	ln Labour tax (5)	Δ Money market % (6)
$Infect_{c,t} \times X_{c,t+1}$	0.708**	-0.137	-0.089	-0.020	-0.061**	0.429
	(0.296)	(0.106)	(0.098)	(0.122)	(0.029)	(0.615)
$InfectDiseaseDeaths_{c,t}$	-0.388***	-0.360***	-0.380***	-0.345***	-0.436**	-0.141
	(0.114)	(0.115)	(0.114)	(0.124)	(0.189)	(0.127)
$X_{c,t+1}$	-0.790**	0.089	0.055	0.093	-0.132***	0.565
	(0.360)	(0.094)	(0.090)	(0.120)	(0.040)	(0.893)
Obs	720	496	496	496	398	208
No. countries	195	170	170	170	199	68
R^2	0.437	0.162	0.156	0.152	0.245	0.445

Note: The table reports cross-country regression results with the estimates of the ability of consumption dynamism, institutional quality, and fiscal policy to smooth the effect of the deaths from infectious diseases on bank credit in the future. Dependent variable is log of 1 + domestic private credit by banks to GDP, taken with a $t + 1$ lead, which, as our Jordà local projections show (Figure 16), corresponds to the peak of the effect of battle deaths on bank credit. To avoid multicollinearity concerns, the Infect Disease Deaths and X variables were demeaned. The money market interest rate and the government bond interest rate are adjusted to CPI inflation. Δ is the change between years $t - 1$ and t. All regressions contain control variables reflecting the state of the banking system and the macroeconomy, all taken at t, and sets of country and year FEs. ***, **, * indicate an estimate is significant at the 1%, 5%, 10% levels, respectively Standard errors are clustered at the country level and reported in the brackets below the estimated coefficients.

Third, we obtain a negative and significant estimate of the coefficient on the interaction of the *disease* variable and the *labour income tax* variable (see column (5)). In terms of economic effects, the situation is close to the case of consumption adaptation considered above: the additional effect of a one standard deviation decline in the tax rate is to reduce the negative effect of infectious disease on the log bank credit variable by only 0.04, which is visible but rather limited. And finally as we show in column (6), we obtain no significant results for the money market rate, meaning that we find no evidence in favour of any potential for smoothing the effects of diseases on bank credit through monetary policy in our setup. We conclude that Source #3 *'Fiscal and monetary policy'* partly works, but the scope of its mitigating effect is not large on aggregate.

Overall, we conclude that infectious diseases may have a depressive effect on the demand for loans, with the amount of bank lending and the interest rate on loans both declining in response to the spread of disease. This demand-side narrative distinguishes the case of infectious diseases from the case of wars, which have a negative effect on the supply of loans. In addition, we document in our cross-country setting that infectious diseases may predict an increase in the bank capital adequacy ratio, which is likely due to a shrinking of loans to unhealthier borrowers while the owners' capital is held constant. Given this shrinkage of loans, we also document that banks tend to increase their reliance on non-interest sources of income in response to a spread of infectious diseases. Concentration in the banking system also tends to rise, apparently reflecting that large banks are less affected than their smaller peers due their ability to redirect their operations from regions more affected by disease to less-affected regions within (or across) countries. We also attempt to discover the sources of heterogeneity in the effect of infectious (and other) diseases on bank credit and reveal that countries with a greater decline in private consumption and higher labour income taxes may experience a deeper decline of credit in response to infections.

CHAPTER 3

Bank adaptation to natural disasters

3.1 EFFECTS OF NATURAL DISASTERS ON BANKS AND THEIR BORROWERS

The availability of credit may shape adaptation to climate shocks. However, banks may be reluctant to take the associated risks. Recent research has shown that banks reduce lending in areas affected by natural disasters with limited initial access to finance (Rajan and Ramcharan, 2023, Table 13). Moreover, banks are more likely to exit markets affected by natural disasters if they are not native to the region (Gallagher and Hartley, 2017). In the aftermath of a natural disaster, banks transfer climate risk to investors by increasing loan approval rates below the securitisation limit, which eventually helps sustain the supply of credit in disaster zones (Ouazad and Kahn, 2021). Banks face loan distress and increased delinquencies following natural disasters, though in most of the surveyed studies, the effect is short-lived and far from catastrophic even in the case of most destructive disasters like Hurricane Katrina (Gallagher and Hartley, 2017; An et al., 2023; Biswas et al., 2023). Banks price anticipated disaster risk: they charge higher interest rates for mortgages backed by properties exposed to a greater risk of sea level rise (Nguyen et al., 2022).

Populations tend to out-migrate from affected zones in search of better economic opportunities (Boustan et al., 2020; Deryugina et al., 2018; An et al., 2023). A sizable fraction of borrowers in areas affected by natural disasters use insurance payouts on damaged property to pay off or prepay mortgages rather than rebuild. Natural disasters are also shown to have multiple negative effects on local economies: they destroy capital and amenities, decrease local productivity, lead to a shrinkage of the local service sector, depress house prices, and decrease local labour demand (Table 13).

TABLE 13 **THE EFFECTS OF NATURAL DISASTERS ON BANKS, THEIR BORROWERS, AND THE LOCAL ECONOMY**

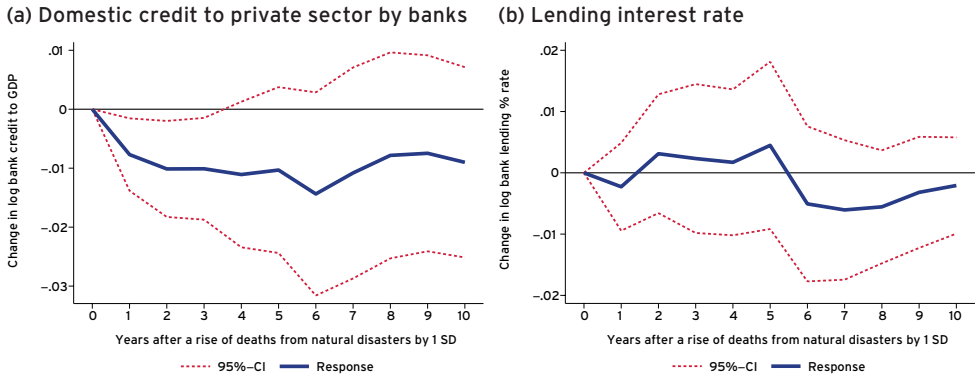
Paper	Disaster	Country, sample	Method	Estimated effect	Outlet
Ouazad and Kahn (2021)	"Billion-dollar" events	US, conventional mortgage loans, 2004-2012	RDD, GSE conforming loan limit	**Banks:** transfer climate risk. +7.3 loan approval below securitization limit + adverse selection of borrowers	*RevFinStud*
Nguyen, Ongena, Qi and Sila (2022)	Sea level rise (SLR)	US, conventional mortgage loans, 1992-2018	Granular interacted fixed effects	**Banks:** +7.5 bps long-term SLR premium, attention and attitudes matter	*Rev of Fin*
Rajan and Ramcharan (2023)	1950s US drought	US, county-level, 1950-1980	IV	**Banks:** ↓ bank lending in exposed areas with low access to bank finance **Borrowers:** out-migration mitigated by access to finance. Irrigation and shift in crops depend on bank finance. **Economy:** ↓ non-tradeable sector	NBER WP
Bilal and Rossi-Hansberg (2023)	Severe storms, heat waves	US + counties	Dynamic spatial model	**Borrowers:** mobility in anticipation =1/3 total effect **Economy:** -17% capital depreciation (storms), -5.1% productivity, -6.8% amenities (heat waves)	NBER WP
Boustan, Kahn, Rhode and Yanguas (2020)	# natural disasters	US, county-level, 1920-2010	Diff-in-Diff	**Borrowers:** population out-migration + 1.5 p.p. (Severe D.) **Economy:** - (2.5-5.0) % housing prices and rents ↓ local productivity, ↓ labour demand	*J Urban Econ*
Deryugina, Kawano and Levitt (2018)	Hurricane Katrina	US, Administrative Tax Data, 1999-2013	Diff-in-Diff + matching	**Borrowers:** transitory effect on income of victims, earnings gap erased in 2 years after the storm. **Mechanisms:** increased wages in New Orleans, moving to better economic opportunities	*AEJ: AE*

Paper	Disaster	Country, sample	Method	Estimated effect	Outlet
Gallagher and Hartley (2017)	Hurricane Katrina	US, loan-level data (FRBNY Consumer Credit Panel/Equifax), 2002-2008	Diff-in-Diff	**Banks**: local lenders resumed lending to pre-Katrina levels in 2 years, nonlocal lenders exited the market **Borrowers**: decreased total debt, larger reduction in most flooded blocks (-$11,100 vs -$4,500 in least affected), used flood insurance payouts to pay off mortgages rather than rebuild, short-lived effect on delinquency (+2.5 p.p) which vanished in 1 quarter	*AEJ: EP*
An, Gabriel and Tzur-Ilan (2023)	Wildfires in California	US, loan-level data (FRBNY Consumer Credit Panel/Equifax), 2016-2020	Diff-in-Diff	**Borrowers**: Increased credit distress among households that experienced the most destructive wildfires. Economy: Decline in house price and net out-migration from fire zones	WP
Biswas, Hossain and Zink (2023)	Wildfires, Smoke, and related air pollution in California	US, CoreLogic (location), FR Y-14M regulatory data	Diff-in-Diff	**Borrowers**: increase in delinquencies by 4 p.p. and in prepayments by 16 p.p. for properties that were damaged by wildfires compared to undamaged properties 1-2 miles outside of the wildfire	WP

3.2 QUANTITATIVE EXERCISE #4: NATURAL DISASTERS, POLICIES, AND PROSPECTS OF THE BANKING SYSTEMS

The natural choice for the variable to explore here to complete our cross-country empirical analysis of the effects of human deaths caused by various types of disasters would be deaths caused by natural disasters. Although the corresponding data on climatological, geophysical, hydrological, and meteorological disasters are available in the EM-DAT Public Table database, we find no economically significant effects of deaths from such disasters on banking systems' private credit and lending interest rates when running our Jordà local projections (see Figure 17). Though statistically the effect on credit is significant, its economic effect does not exceed 2% of one (within-country) standard deviation of the bank credit variable. Clearly, the effects of natural disasters are local and are hardly transmitted, on average, to the aggregate level.

FIGURE 17 **THE EFFECTS OF NATURAL DISASTERS ON BANKING**



Note: The charts report the responses of banking system indicators to a one standard deviation increase in log deaths caused by natural disasters in year 0 (relative to population) estimated using local projections. Standard errors are double-clustered: at country and year levels.

In this situation, we finalise our cross-country quantitative exercise by deviating from disasters and focusing on one potential cause of disasters, given the obvious cross-country data constraints. Specifically, we explore the relationship between CO_2 emissions in the economy and the prospects of its banking system. The current attempts of countries to decarbonise their economies requires a rising supply of bank credit (Accetturo et al., 2023) and growing stock markets (De Haas, 2023). We can already examine at the aggregate level whether such decarbonisation has been associated with a rise in bank credit over the past several decades.

The World Bank database contains cross-country information on the scope of CO_2 emissions (kg per 2015 US dollar GDP), which captures the degree of 'brownness' in terms of the economy's relative contribution to air pollution. The index ranges from 0 to 5

and covers most of the countries across the world over the last three decades. Similarly to the case of infectious diseases, we begin our analysis by splitting the sample of countries into more- and less-polluting countries, where the threshold between 'more' and 'less' is the median level of CO_2 emissions over GDP (0.39).

Data

Table 14 compares the mean values of the CO_2 variable and the major characteristics of the banking systems. We first note that the data on CO_2 are highly skewed to the left, so that even in the more-polluting state, the mean values of CO_2 emissions over GDP is just 0.87, while in the less-polluting state it is 0.25.

TABLE 14 **COUNTRIES WITH HIGHER AND LOWER CO_2 EMISSIONS: DIFFERENCES IN MACRO-FINANCIAL OUTCOMES**

Variable	More polluting (1)	Less polluting (2)	Difference (3) = (1) – (2)
CO_2 emission over GDP	0.87	0.25	0.62***
Bank credit to domestic private sector/GDP (%)	41.7	44.2	-2.5***
Bank lending rate (%)	16.5	18.1	-1.7
Bank regulatory capital (% of risk-weighted assets)	17.4	16.8	0.6
5-bank asset concentration (% of total assets)	79.4	81.7	-2.3***
Foreign banks' assets (% of total assets)	37.6	41.3	-3.7**
Bank deposits/GDP (%)	44.4	48.5	-4.1***
Bank non-interest income (% of total income)	36.7	39.9	-3.2***
Prob (Banking crisis = 1)	0.065	0.070	-0.005
Stock price volatility	21.2	19.5	1.7***
GDP growth (y-o-y %)	3.7	3.0	0.7***
For comparison:			
Battle deaths (no. of victims)	6623.7	2261.4	4362.4***
Deaths from infectious diseases (% of total deaths)	21.3	27.5	-6.2***

Note: The table presents the mean values of the CO_2 emission over GDP and macro-financial indicators in the two subsamples of countries: more vs. less pollutive in terms of CO_2, where the threshold between 'more' and 'less' is the 50th percentile of CO_2 emissions over GDP. The table also reports the results of the Welch two-sample t-test on the mean differences across the more and less affected countries (equal variances are assumed). See the full definitions of the variables in Table 16 in Appendix.

Source: Climate Watch, World Bank.

We then observe that more-polluting countries have, on average, lower depth of credit at 41.7% of GDP, which is 2.5 percentage points lower than in less-polluting countries. However, the mean levels of the bank lending rate are statistically similar, ranging around 17–18%, which distinguishes this case from the cases of wars and infectious diseases. We also observe no differences in the mean levels of the bank regulatory capital, which holds at 17% in both states. However, we observe statistical differences across the other banking system characteristics: local bank concentration, foreign bank

penetration, reliance on non-interest income, and the depth of deposits all appear to be lower on average under the more-polluting state than the less-polluting state. The five-bank concentration ratio (CR_5) is 79% in the more-polluting state, which is 2 percentage points lower than in the less-polluting state. The assets held by foreign banks are 37.6% of the total banking system's assets in the more-polluting state, which is 3.7 percentage points lower than in the less-polluting state. Bank deposits equal 44% of GDP, and this is 4.1 percentage points lower than in the less-polluting state. And bank non-interest income is 36.7%, which is 3.2 percentage points lower than in the less-polluting state. Despite those statistical differences in means, an integral measure of the banking system – i.e., the probability of a banking crisis – appears to be the same under both states at close to 7%, implying that the differences, though significant, are not that large economically.

What attracts attention is that battle deaths appear to be much larger, by a factor of three, under the more-polluting state compared to the less-polluting state. Infectious diseases, by contrast, contribute less to the overall deaths under the more-polluting state.

Empirical setup

We again employ Jordà local projections and run the following regressions to predict the time evolution of bank credit and other banking system characteristics in response to a change in CO_2 emissions in the cross-country setting:

$$\ln\left(1+\frac{BankCredit_{c,t+h}}{GDP_{c,t+h}}\right) = \alpha_c + \gamma_t + \beta \cdot \ln\left(\frac{CO_2Emission_{c,t}}{GDP^*_{c,t}}\right) + BankControls_{c,t}\mathbf{\Psi'} + MacroControls_{c,t}\mathbf{\Omega'} + \varepsilon_{b,t} \quad (7)$$

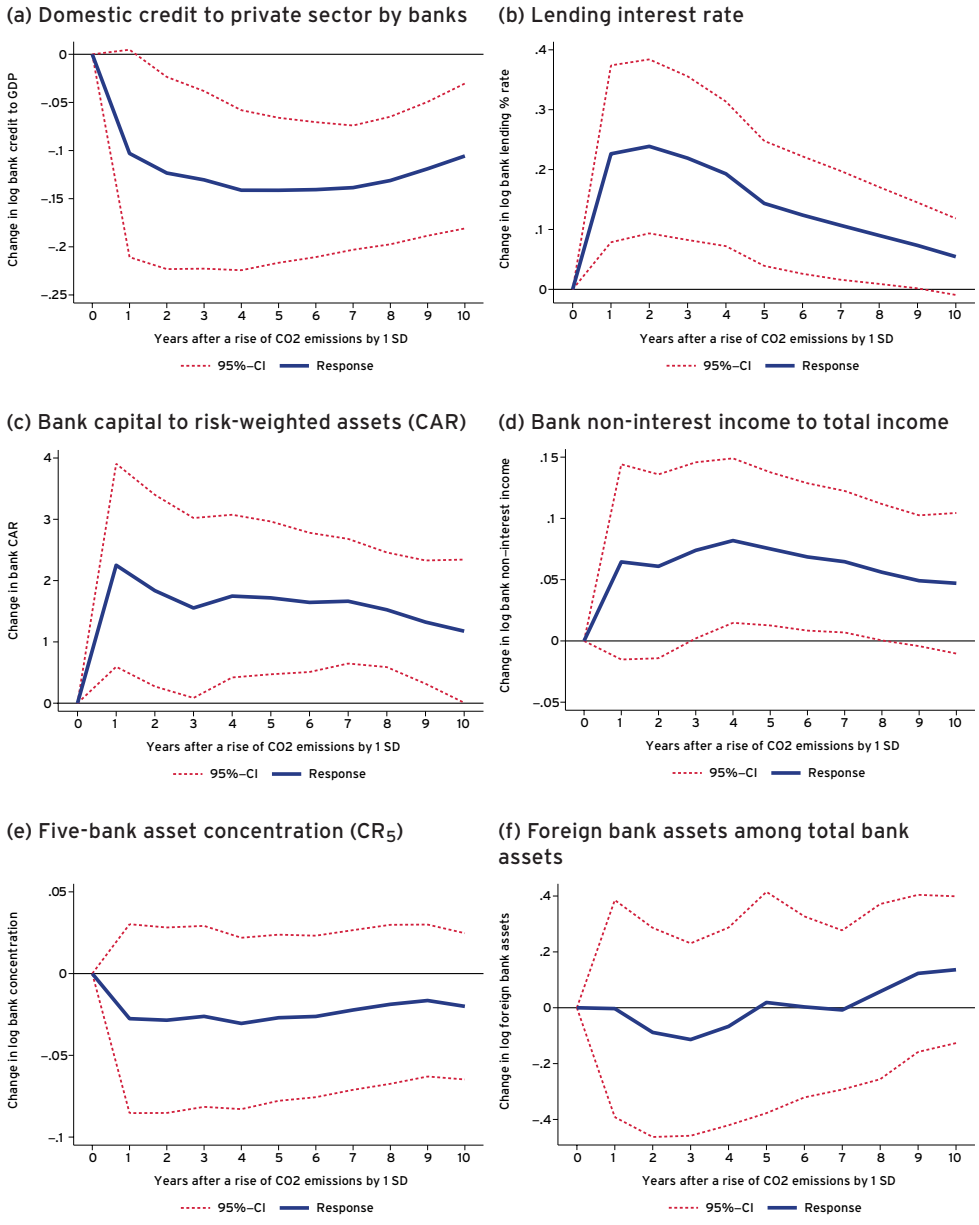
where $GDP^*_{c,t}$ is the GDP of country c in year t measured in the 2015 US dollars.

Estimation results: Average effects

First, our estimates suggest that credit negatively reacts to an increase in CO_2 emissions across countries: a one standard deviation rise in the log CO_2 emissions over GDP in year t predicts a prolonged decline in the log bank credit to GDP ratio, peaking at −0.14 in year $t + 4$ and then slowly attenuating but remaining significant even after ten years (Figure 15a). The underlying economic effect is visible, amounting to 0.15 of one standard deviation of the credit variable, but is somewhat less than the economic effect of the battle deaths (0.2, Section 1.2.2) and two times less than the economics effect of infectious diseases (0.33, Section 2.1.2). We then reveal that the lending interest rate tends to rise after the same change in the CO_2 emissions variable: in year $t + 2$, the log bank lending rate peaks at +0.22, which equals a one-third of one standard deviation (Figure 15b). We therefore provide evidence that an increase in CO_2 emissions over GDP predicts a decline in the amount of loans and a rise in the interest rate on loans, which implies a negative supply effect in equilibrium. Alternatively, this could be interpreted as

follows: a within-country decrease in CO_2 emissions over GDP (i.e., decarbonisation) is associated with increased bank credit supply in equilibrium, consistent with the macro-level effects identified in Accetturo et al. (2023).

FIGURE 18 **THE EFFECTS OF CO_2 EMISSIONS ON BANKING**



Note: The charts the responses of banking system indicators to a one standard deviation increase in log CO_2 emissions to GDP in year 0 estimated using local projections, Equation (7). Standard errors are double-clustered: at country and year levels.

Second, our findings indicate that the bank capital adequacy ratio (CAR) also tends to improve after the supply-driven decline in loans following a CO_2 emissions shock: a one standard deviation increase in the log CO_2 emission variable in year t predicts a persistent rise of the bank capital to risk-weighted assets, peaking at 2 percentage points in year $t + 1$ and then slowly fading (Figure 15c). This spike is equivalent to one-third of a standard deviation of the CAR variable and is thus economically meaningful.

Third, as was already revealed for the other two types of disasters, we find that bank non-interest income also tends to rise after a CO_2 emissions shock: a one standard deviation increase in the log CO_2 emissions variable in year t predicts a rise of the log bank non-interest income, peaking at +0.08 in year $t + 4$ (Figure 15d). Economically, this corresponds to 0.15 of one standard deviation of the log non-interest income variable, which is visible, though perhaps not that large.

Finally, we obtain no evidence in favour of any changes in bank concentration or foreign banks' presence following the CO_2 emissions shock at the aggregate level (Figures 15e and 15f). Notably, at the aggregate level, these results imply that foreign banks do not escape environmental risks by reducing their operations in the affected countries.

Estimation results: The cross-country heterogeneity of environmental effects

We consider the following three sources of heterogeneity in the effects of CO_2 emissions on banking systems' credit to the economy:

Source #1: *Stocks and collateral.* In their study, Eccles et al. (2014) reveal that investors are less likely to sell stocks of companies that encounter losses if the ESG performance of those companies is strong. In this case, the value of collateral is less likely to be damaged. We therefore may conjecture that CO_2 emissions shocks can lead to increased volatility of stock prices, thus undermining the borrowers' collateral, which, in turn, may force banks to reduce the supply of loans.

Source #2: *Quality of institutions.* We assume that under strong institutions, CO_2 emissions are less likely to be unnoticed and more likely to be punished. Any monetary punishment should reduce borrowers' ability to repay their loans.

Source #3: *Fiscal and monetary policy.* As in the previous exercises, we assume that government fiscal policy may further disincentivise firms from running projects that are associated with CO_2 emissions. In particular, the government may do so by raising profit taxes. Increased profit taxes may then undermine the firms' ability to repay their debts, including loans.

Similarly to Equation (4) from Section 1.2.2, we run the following regressions to test for the efficiency of the three channels above:

$$\begin{aligned}\ln\left(1+\frac{BankCredit_{c,t+1}}{GDP_{c,t+1}}\right) = {} & \beta_1 \cdot \left(\ln\left(1+\frac{CO_2Emission_{c,t}}{GDP^*_{c,t}}\right) \times Source^{(j)}_{c,t+1}\right) \\ & + \beta_2 \cdot \ln\left(1+\frac{CO_2Emission_{c,t}}{GDP^*_{c,t}}\right) \\ & + \beta_3 \cdot Source^{(j)}_{c,t+1} \\ & + BankingSystemControls_{c,t}\mathbf{\Psi'} \\ & + MacroControls_{c,t}\mathbf{\Omega'} + \alpha_c + \gamma_t + \varepsilon_{c,t+1}\end{aligned} \tag{8}$$

The estimation results appear in Table 15. First, we obtain a negative and highly significant estimate of the coefficient on the interaction between the log CO_2 and the log stock price volatility variables, with the log CO_2 variable itself keeping its negative and (marginally) significant coefficient as in the baseline results (see column (1)). If we imagine a shock to the log CO_2 variable equal to one standard deviation in year t, then the log bank credit-to-GDP variable declines by 0.16 in year $t + 2$, which is 52% of one (within-country) standard deviation of the credit variable. If, in addition, we assume the log stock price volatility variable also rises by one standard deviation during year $t + 2$, then we obtain another 0.03 decline in the log bank credit-to-GDP variable, or 10% of one standard deviation. We therefore find evidence supporting our Source #1 '*Stocks and collateral*'.

Second, we again obtain no empirical support for Source #2 '*The quality of institutions*', because we obtain no significant estimates of the coefficients on the interactions of the log CO_2 variable with the rule of law, control of corruption, and the regulatory quality indicators (see columns (2) to (4)). As before, the institutional characteristics themselves are positively related to bank credit, but they are not efficient in shaping the relationship of bank credit with CO_2 emissions in our cross-country sample. More research is needed at a more granular level.

Finally, we obtain a negative and (marginally) significant estimate of the coefficient on the CO_2 variable interaction with a one-year change in the profit tax rate (see column (5)). We discard this result, however, because the estimated coefficient on the CO_2 variable flips its sign from negative to positive and highly significant, which contradicts our baseline results. We also obtain no significant results for the role of monetary policy in smoothing the effects of CO_2 emissions on bank credit at the aggregate level (see column (6)).

TABLE 15 CO_2 EMISSIONS AND BANK CREDIT: HETEROGENEITY ANALYSIS IN CROSS-SECTIONS OF COUNTRIES

	Stocks and collateral	Quality of institutions			Fiscal policy	Monetary policy
$X_{c,t+2}$:	In Stock price volatility (1)	Rule of law (2)	Control of corrution (3)	Regulatory quality (4)	Δ Profit tax (5)	Δ Money market % (6)
$CO_{2c,t} \times X_{c,t+2}$	-0.367***	0.292	0.286	0.202	-2.181*	-0.340
	(0.108)	(0.222)	(0.218)	(0.186)	(1.132)	(0.525)
$CO_{2c,t}$ emission/$GDP_{c,t}$	-0.686*	-0.154	-0.210	-0.197	0.705**	-0.993***
	(0.361)	(0.260)	(0.246)	(0.245)	(0.339)	(0.330)
$X_{c,t+2}$	0.063	0.265***	0.213***	0.253***	0.004	0.122
	(0.043)	(0.069)	(0.067)	(0.069)	(0.278)	(0.099)
Obs.	1,764	3,500	3,475	3,462	2,273	1,565
No. of countries	83	179	179	179	179	88
R^2	0.286	0.334	0.335	0.337	0.164	0.320

Note: The table reports cross-country regression results with the estimates of the ability of collateral prices, institutional quality, and fiscal policy to transmit the effect of CO2 emissions on bank credit in the future. Dependent variable is log of 1 + domestic private credit by banks to GDP, taken with a $t + 2$ lead, which, as our Jordà local projections show (Figure 18), corresponds to the peak of the effect of CO2 on bank credit. To avoid multicollinearity concerns, the CO2 and X variables were demeaned. The money market interest rate and the government bond interest rate are adjusted to CPI inflation. Δ is a change between years $t - 1$ and t. All regressions contain control variables reflecting the state of the banking system and the macroeconomy, all taken at t, and sets of country and year FEs. ***, **, and * indicate an estimate is significant at the 1%, 5%, 10% level, respectively. Standard errors are clustered at the country level and reported in the brackets below the estimated coefficients.

Overall, we find cross-country evidence that decreases in CO_2 emissions per unit value of output predict expansions in the supply of bank credit to the economy. They may, however, lead to a partial and temporary deterioration in the bank capital adequacy ratio at the aggregate level (which may stem from the increased credit supply, holding the bank owners' funds constant), a shrinkage in the banks' reliance on non-interest income (which may also be a consequence of increased credit supply), and an increased presence of foreign banks in the banking system. Among the sources of the cross-country heterogeneity, we find that decreased stock price volatility can further improve the positive effect of a reduction of CO_2 emissions on bank credit dynamics in the future.

CHAPTER 4

Summary of bank adaptation to various types of disasters

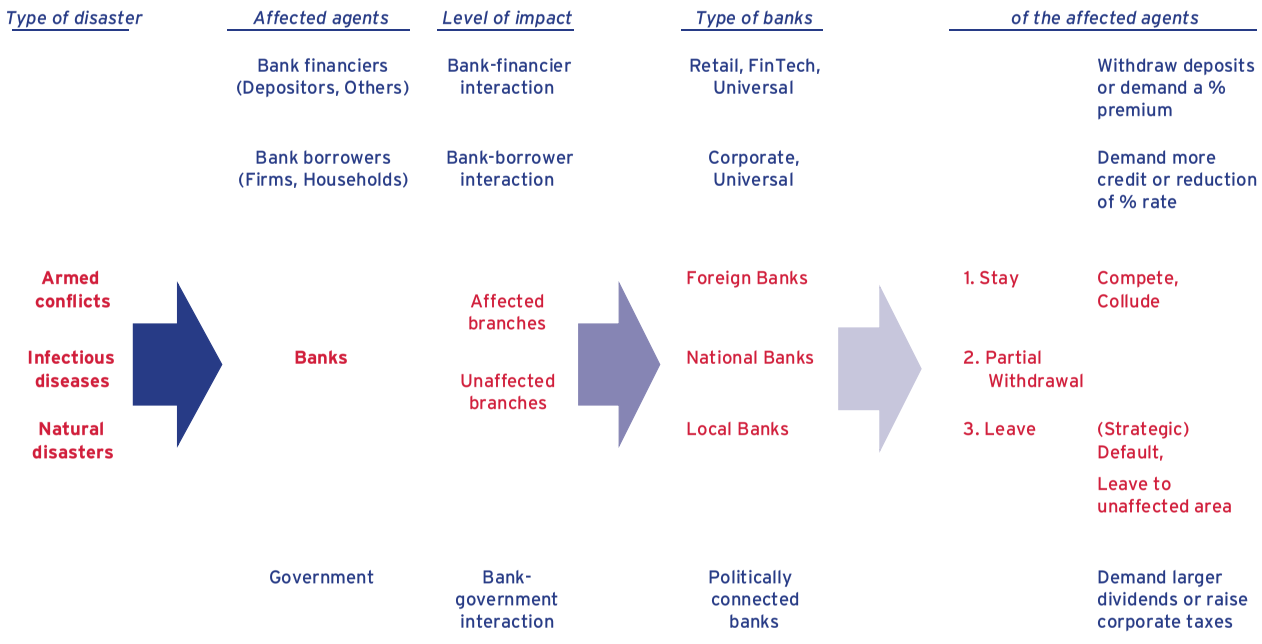
How do banks adapt to the three types of disasters – armed conflicts, infectious diseases, and natural disasters – that we study in this report? We gather qualitative predictions on banks' adaptation to the disasters from our reviews of recent research and our own quantitative exercise undertaken throughout the report in Figure 19. First, it is important to distinguish the direct effects of disasters on banks from the effects stemming from the damage to the banks' borrowers and from the government, which may provide support through subsidies or further multiply the damage by tightening monetary or fiscal policy. Second, it is important to separate the effects of disasters occurring in a given country on national banks and local banks from the effects on foreign banks. Subsidiaries or branches of foreign banks are fundamentally different from the local and national banks, because they can (i) quit the affected country and redirect their assets to non-affected countries, or (ii) increase their presence in the affected country once the negative effects of a disaster diminish using funds from their maternal company located in a non-affected country.

If they decide to continue in the affected country, foreign and both national and local banks need to decide whether to compete or collude in the markets for deposits and credit. Our research shows that wars are accompanied by a reduction in the supply of loans (the quantity declines, the lending interest rate spikes), and therefore competing may be the preferred option during the post-disaster recovery, because this would help reduce the price of credit and raise the quantities, and eventually return the banking system to the pre-disaster level. Financial regulators can also help stimulate bank competition through temporary reliefs in the CAR rules and shrinking capital buffers, where applicable.

In contrast, our research shows that, in general, infectious diseases are associated with negative lending demand effects (the quantity of loans declines and the lending interest rate declines; COVID-19 was an exception, with evidence of increased loan demand). Government fiscal policy may help to return to the pre-disaster levels – subsidies can stimulate loan demand and speed up the recovery.

Our review of existing literature suggests there is ample evidence of local negative – albeit short-lived and far from catastrophic – effects of natural disasters on bank performance. Our cross-country analysis suggests that the aggregate effect on banking is economically negligible. Current bank resilience to natural disasters may stem from advancements in their climate risk management.

FIGURE 19 **CAUSES AND IMPACT OF DISASTERS AND RESPONSE STRATEGIES OF BANKS AND THEIR BORROWERS**



CHAPTER 5

Conclusions and policy recommendations

In this report, we aim to answer the question of how banks adapt to various types of disasters, such as wars and sanctions, natural diseases, and climate change, given that such disasters have become more routine and thus expected. We review respective literature to aggregate the estimates of bank adaptation to these disasters and perform our own quantitative exercises at both micro and cross-country levels to complement and add to the results obtained before.

Our cross-country analysis confirms that **wars** significantly harm banking systems, leading to decreased bank credit and deposits for several years following the conflict. Wars result in a reduction in credit supply as they increase lending interest rates against a background of contracted lending. However, our analysis also uncovers unexpected findings:

1. Non-performing loans relative to total loans did not rise consistently across approximately 30 war-affected countries from 1989 to 2020.
2. Initially, the capital adequacy ratio declines after a war, suggesting that bank owners may withdraw their funds. Over time, however, the ratio tends to rebound, likely reflecting post-crisis economic recoveries of profits.
3. Wars reduce concentration in the banking system within countries during conflicts.
4. Foreign banks tend to increase their presence in war-affected regions as time progresses, potentially capitalising on reduced concentration and post-war economic recovery.
5. The impact of war on bank credit is shaped by several factors, including stock market volatility and fiscal and monetary policies, with volatile stocks and tighter fiscal and monetary policy measures exacerbating the negative effects. Positive terms-of-trade shocks and the ability of the war-affected countries to attract foreign loans, in contrast, mitigate the adverse consequences.

Regarding **sanctions**, we find that the first sanction announcement is the most powerful one in terms of its economic impact. Staggered sanction policy implementation leaves room for banks to adapt in advance, including 'borrowing abroad while you can' and pre-emptively bringing foreign accounts back home. We show that foreign banks operating

in a sanctioned residency may behave differently depending on the political orientation of their country of origin, with Western banks being more likely to cut operations and Eastern banks more likely to expand and partly substitute for departed competitors in response to sanctions.

Our results shed some light on how to improve the design of sanction policy to make it more effective in the future. The key point is that any staggered policy design allows not-yet-treated banks to adapt in advance, by reducing foreign assets (in the fear of asset freezes) and increasing (cheap) foreign borrowings. A straightforward recommendation could be to sanction the largest state-connected banks first and reduce the policy implementation time.

Despite a general tendency that we uncover for Western banks operating in Russia to leave the country, there are some notable exceptions. One well-known case is the Austrian Raiffeisen Bank, which did not leave Russia even after the Kremlin launched the full-scale war against Ukraine in 2022. Our review has shown that financial sanctions imposed by one government on other economies can be effectively circumvented through the cooperation of banks located within the sanctioning country (e.g., German banks), despite the international stance of the government. Possible underlying reasons for why a Western bank may be willing to sustain its operations in a sanctioned country are the high profitability of such operations and the importance of bank-firm and bank-bank relationships, which may persist through time ('a friend in need is a friend indeed'). Both reasons may be mitigated if policymakers use temporary incentives to cut undesired activities (for example, temporary regulatory relief linked to severing ties with the sanctioned country). The threat of secondary sanctions – such as those announced by the United States in December 2023 – can also be an effective measure for enforcing existing sanctions and preventing evasion.

Concerning **infectious diseases**, our cross-country analysis reveals that these can exert a dampening effect on the loan market. Both the volume of bank lending and the interest rates on loans tend to decrease as infectious diseases spread (with the exception of the recent COVID-19 pandemic). This contrasts with the impact of wars, which primarily affect the supply of loans. Furthermore, we find that infectious diseases may be associated with an increase in banks' capital adequacy ratios. This phenomenon is likely driven by banks reducing loans to riskier borrowers while maintaining their capital levels. We find that as loans shrink, banks also tend to rely more on non-interest sources of income as a response to the spread of infectious diseases. We also reveal a trend towards greater concentration in the banking sector, suggesting that larger banks are more resilient to the effects of infectious diseases than their smaller counterparts. This resilience may stem from larger banks' capacity to reorient their operations from regions more heavily affected by disease to those less affected, either within a country or across multiple countries.

And finally, regarding **natural disasters**, we find that there is no significant aggregate effect of population loss due to natural disasters on banking. This echoes findings from the recent literature suggesting that (i) such effects are local, since disaster damage has clear geographical discontinuities; and (ii) the local effect itself depends on the interplay between the actions of local and multi-market banks. Local banks are likely to sustain their operations, while non-native backs are more likely to withdraw. Multi-market banks may transfer financial resources within a country from unaffected to affected areas, thus determining spillovers across geographies.

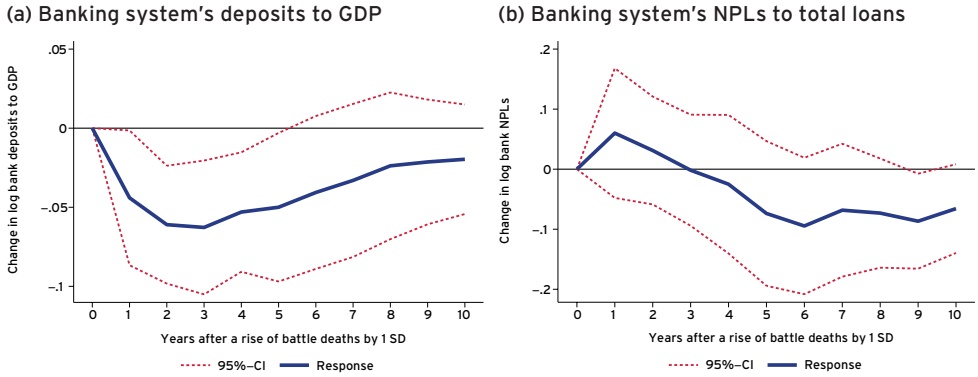
Policies aiming at, or economies' structural transformations towards, decarbonisation (reduced CO_2 emissions per unit of economic output; reduced global incidence of natural disasters) require an increased lending supply by banks, greater support of banks' capital, and a more nuanced attraction of foreign banks to the domestic market (escaping regulatory arbitrage across countries).

Appendix

TABLE 16. **DEFINITIONS OF THE MAIN VARIABLES FOR THE JORDÀ LOCAL PROJECTION EXERCISES**

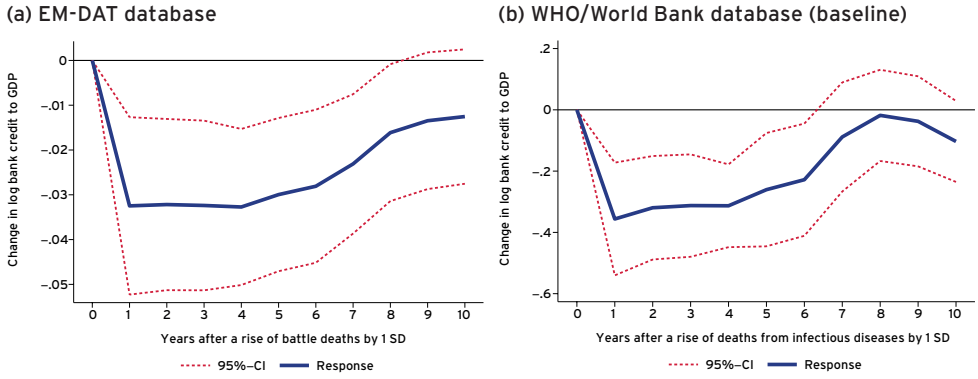
Variable name	Description and sources
Bank Credit$_{c,t}$	Domestic credit to the private sector by banks refers to financial resources provided to the private sector by other depository corporations (deposit-taking corporations except central banks), such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment. For some countries, these claims include credit to public enterprises. *Source: International Monetary Fund, International Financial Statistics and data files, and World Bank and OECD GDP estimates.*
Battle Deaths$_{c,t}$	Battle Deaths are deaths in battle-related conflicts between warring parties in the conflict dyad (two conflict units that are parties to a conflict). Typically, battle-related deaths occur in warfare involving the armed forces of the warring parties. This includes traditional battlefield fighting, guerrilla activities, and all kinds of bombardments of military units, cities, and villages, etc. The targets are usually the military itself and its installations or state institutions and state representatives, but there is often substantial collateral damage in the form of civilians being killed in crossfire, in indiscriminate bombings, etc. All deaths – military as well as civilian – incurred in such situations are counted as battle-related deaths. *Source: Uppsala conflict database*
CO_2 Emiss$_{c,t}$	Ratio of CO_2 emissions to GDP (kg per 2015 US$ of GDP). Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring. *Source: Climate Watch, World Bank*
Infect Disease Deaths$_{c,t}$	Cause of death refers to the share of all deaths for all ages by underlying causes. Communicable diseases and maternal, prenatal and nutrition conditions include infectious and parasitic diseases, respiratory infections, and nutritional deficiencies such as underweight and stunting. *Source: World Health Organization, Global Health Estimates 2020*
Stock price volatility	Stock price volatility is the average of the 360-day volatility of the national stock market index. *Source: Bloomberg*

FIGURE 20 **BATTLE DEATHS, BANK DEPOSITS, AND THE QUALITY OF LOANS**



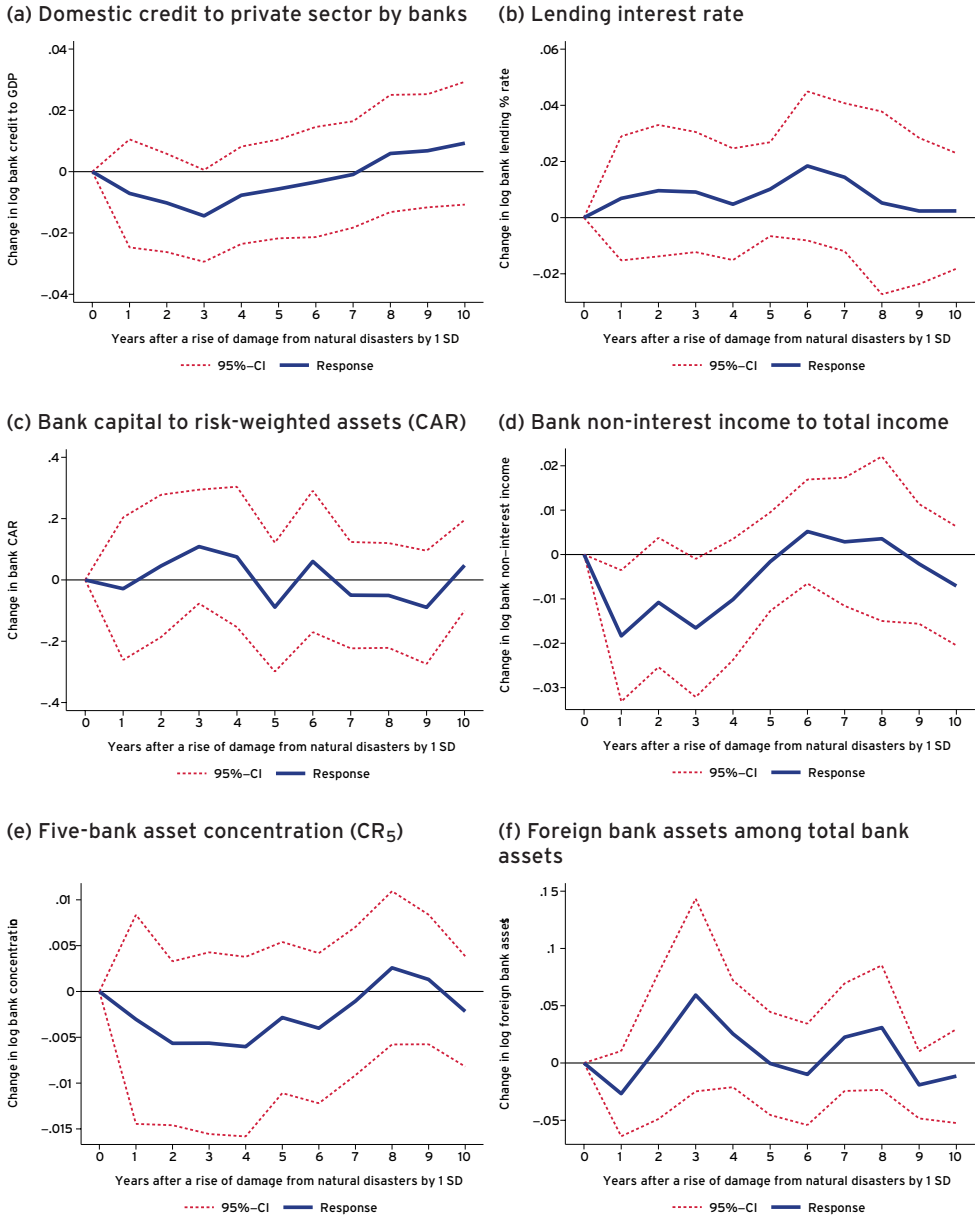
Note: The charts report the responses of banking system indicators to a one standard deviation increase in log battle deaths in year 0 (relative to population) estimated using local projections. Standard errors are double-clustered at country and year levels.

FIGURE 21 **DEATHS FROM INFECTIOUS DISEASES AND PROSPECTS OF THE BANKING SYSTEM**



Note: The charts report the responses of banking system indicators to a one standard deviation increase in deaths from infectious (and other) diseases estimated using local projections, as implied by Equation (5). The infection-induced deaths are retrieved from two databases – EM-DAT (a) and the World Health Organizations (b). In case of EM-DAT, the diseases include only infectious illnesses and are divided by the 100,000 of the population. In case of WHO, the diseases include not only infectious, as we discuss in the main text, but also parasitic diseases, respiratory infections, and nutritional deficiencies, and they are taken as % of total deaths. Standard errors are double-clustered at country and year levels.

FIGURE 22 **THE EFFECTS OF TOTAL DAMAGE FROM NATURAL DISASTERS ON BANKING**



Note: The charts report the responses of banking system indicators to a one standard deviation increase in log total damage from natural disasters (in constant prices) in year 0 estimated using local projections. Standard errors are double-clustered: at country and year levels.

TABLE 17. **TOTAL DAMAGE FROM NATURAL DISASTERS AND BANK CREDIT: HETEROGENEITY ANALYSIS IN CROSS-SECTIONS OF COUNTRIES**

	Collateral prices	Quality of institutions			Fiscal policy
$X_{c,t+3}$:	In Stock price volatility (1)	Rule of Law (2)	Control of corruption (3)	Regulatory quality (4)	Δ Profit tax (5)
$Damage_{c,t} \times X_{c,t+3}$	-0.0079***	0.0029**	0.0028**	0.0021	-0.0007
	(0.0028)	(0.0012)	(0.0013)	(0.0014)	(0.0004)
$Damage_{c,t}$	-0.0034*	-0.0022	-0.0019	-0.0021	0.0008
	(0.0017)	(0.0013)	(0.0013)	(0.0014)	(0.0012)
$X_{c,t+3}$	-0.0542	0.2573***	0.2534***	0.2895***	0.0020
	(0.0518)	(0.0678)	(0.0822)	(0.0736)	(0.0027)
Obs.	1,235	2,010	2,003	1,996	1,233
No. of countries	76	167	167	167	156
R^2	0.275	0.357	0.360	0.370	0.098

Note: The table reports cross-country regression results with the estimates of the ability of collateral prices, institutional quality, and fiscal policy to transmit the effect of the total damage from natural disasters on bank credit in the future. Dependent variable is log of 1 + domestic private credit by banks to GDP, taken with a t + 3 lead, which, as our Jordà local projections show (Figure 22), corresponds to the peak of the effect of the damage from natural disasters on bank credit. To avoid multicollinearity concerns, the CO_2 and X variables were demeaned. All regressions contain control variables reflecting the state of the banking system and the macroeconomy, all taken at t, and sets of country and year FEs. ***, **, and * indicate an estimate is significant at the 1%, 5%, 10% level, respectievly. Standard errors are clustered at the country level and reported in the brackets below the estimated coefficients.

Discussions

Fabio Trojani, *University of Geneva*

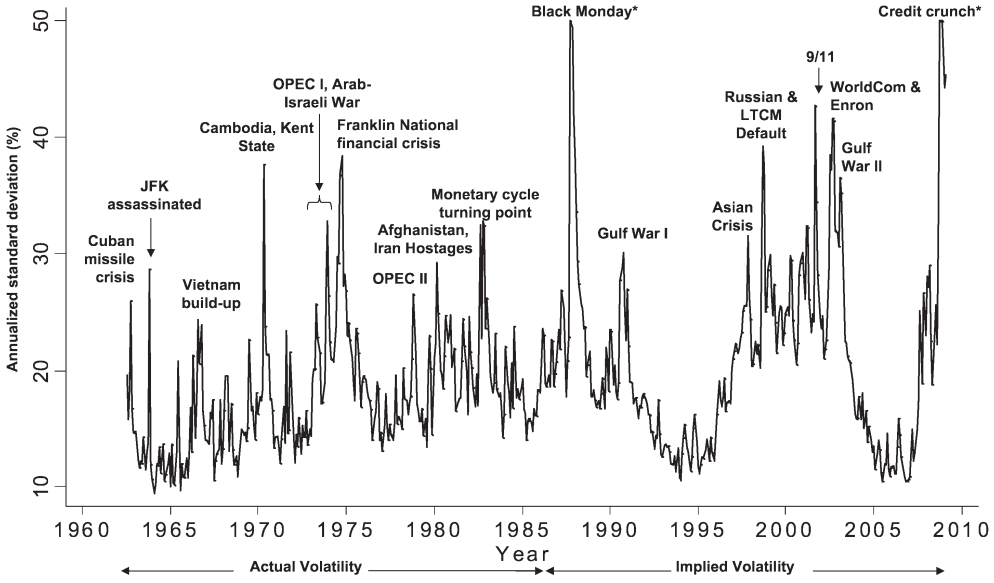
Thank you very much for having me here to discuss this interesting report. In the beginning I was a bit concerned, as this is one of the few times I have discussed a banking paper. Being an asset pricing scholar, I was hoping to be able to add something interesting, and I found that the report contains a lot of potentially useful links to the large asset pricing literature studying the implications of disaster risk. This why in part of my discussion I will expand on some of the views expressed in the report by borrowing from this literature.

Clearly, the question studied in the report is a super important one. How does the banking sector, and the overall economy in general, react to disasters? The report focuses on recent wars, pandemics, and natural disasters, providing detailed empirical evidence inferred from a variety of interesting recent data. Of course, we have a long history of such disasters and other relevant types of disasters in the past, including terrorism attacks, market-wide distress events, and so on. Therefore, in the first part of my discussion, I will elaborate on some established asset pricing background to these questions. In the second part, I will discuss issues related to the proposed empirical framework and other more forward-looking aspects.

In terms of the asset pricing background, it is fair to say that we have worked with disasters in asset pricing for a long time. Barro (2006) observed that disasters are one of the most important dimensions for understanding the pricing of risk and how asset prices move. Uncertainty related to disasters is also key for understanding different types of short-term economic reactions. In a way, in asset pricing we are quite a few steps ahead in modelling disasters, their impact on asset prices and the associated economic recoveries. One key dimension here are subjective beliefs about disaster risk and the resulting uncertainty. When disasters 'realise', there may be different perceptions in the economy about the probability of further disasters and an increased uncertainty about future economic quantities, which can create important feedback loops and additional economic impact. That is true, most likely, for both the banking sector and other parts of the real economy.

I first focus on a well-known illustration from Bloom (2009) on the link between disaster realisations, political uncertainty driven by disasters (which can be proxied by several variables) and market volatility. We can indeed observe a strong link between various types of disasters and volatility. Even though the data end at the 2008 'credit crunch', the link is still super important and illustrates why disaster-driven uncertainty, beliefs and sentiment are key to understanding economic adjustment mechanisms linked to disasters. In my view, that is an important aspect related also to the type of question addressed here.

FIGURE 1 **MONTHLY US STOCK MARKET VOLATILITY.**



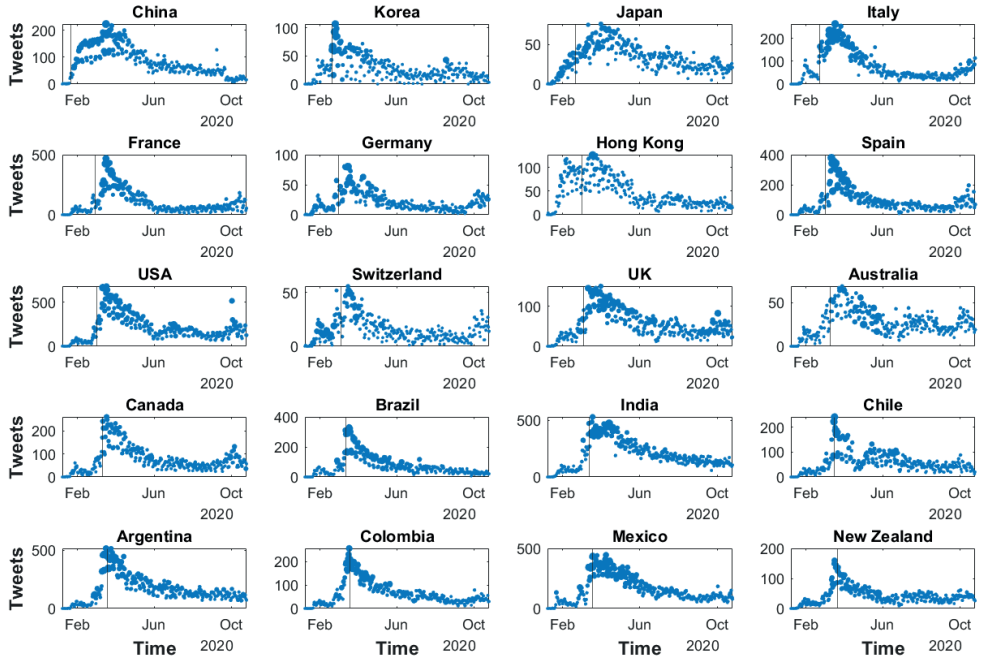
Source: Bloom (2009).

Of course, as the authors mentioned, endogeneity is a pervasive phenomenon in this type of empirical question, but one important dimension of endogeneity here relates to information and reactions to information. Disaster realisations create information. This information can create uncertainty, different types of sentiment, and associated reactions that can be heterogeneous across market participants. Separating the effect of those types of endogenous reactions is a challenge. However, there are a lot of very interesting new data one could use to try to get more disaggregated important information about these reactions.

For example, Arteaga-Garavito et al. (2020) created a new database for the COVID-19 period, trying to collect a very comprehensive set of news, news reactions, and proxies for sentiment about it. Although some years have now passed, we still have that type of period in mind. There were phases where one could collect huge amounts of heterogenous information about, for example, infectious diseases and number of deaths worldwide. There was also a very rich dynamic to these information flows, which spread from several channels including newspapers, social media and official information sources.

Just to illustrate the above discussion, the figure below, taken from Arteaga-Garavito et al. (2020), presents a summary across countries of the dynamics of sentiment about COVID news over the period where there was the peak in the number of infections in the country. Of course, there are a lot of commonalities here, but also pronounced heterogeneities. It could be interesting to use these data in an attempt to better isolate news-driven heterogeneities across countries and entities when studying the reaction of the banking system, and of the financial system more broadly, to disasters.

FIGURE 2 **INFORMATION DIFFUSION AND ATTENTION ACROSS COUNTRIES**



Source: Arteaga-Garavito et al. (2020).

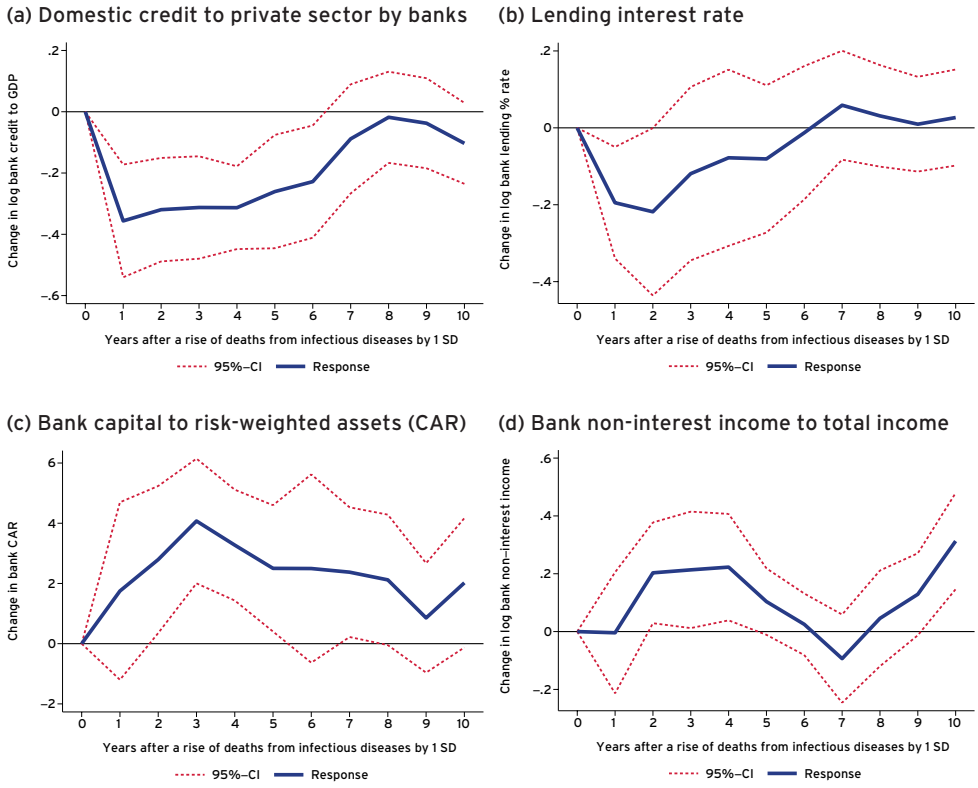
Next, I am going to dig a bit more into the basic empirical framework underlying the report.

The basic idea of the methodology is to exploit heterogeneities across regions, entities, and perhaps time, in order to quantify the sensitivity of a response to a treatment. The response would be the bank operation. The treatment is some proxy for the arrival of a disaster. Estimation is performed with an interesting technique – the 'Jordà projection' (Jordà, 2005). Simplifying, this is essentially a panel regression where you may have multiple future lead responses and variables generating future reactions. The main assumption is that there can be heterogeneous responses, but the sensitivity to a treatment should be homogeneous to be identifiable. Ideally, this is achieved after introducing in the regression model several control variables and cross-sectional or time-fixed effects.

Of course, every time you use such a technique you need to properly quantify the uncertainty in the estimation in order to produce a reliable inference. Several techniques exist to achieve this under corresponding assumptions on the underlying design, and an important parameter here is the ratio between the number of available panel observations over time and in the cross-section. It seems to me that, in a few cases, the time dimension available in the report is quite limited, so that the inference produced by standard packages may not be accurate. Here, one could try to explore existing bootstrap techniques to make the inference more reliable. While this may be felt to be a technical aspect, it seems to me that it is important for making sure that estimated sensitivities

to treatments are indeed significant. Consider, for example, Figure 16 in the report (partially reproduced below) reporting estimated sensitivities – as a function of the horizon – together with their estimated confidence intervals. In most cases, estimated confidence intervals are already quite large, and they may be even wider if the ratio between the number of cross-sectional and time series observations is too large.

FIGURE 3 **THE EFFECTS OF DEATHS FROM INFECTIONS (AND OTHER) DISEASES ON BANKING**

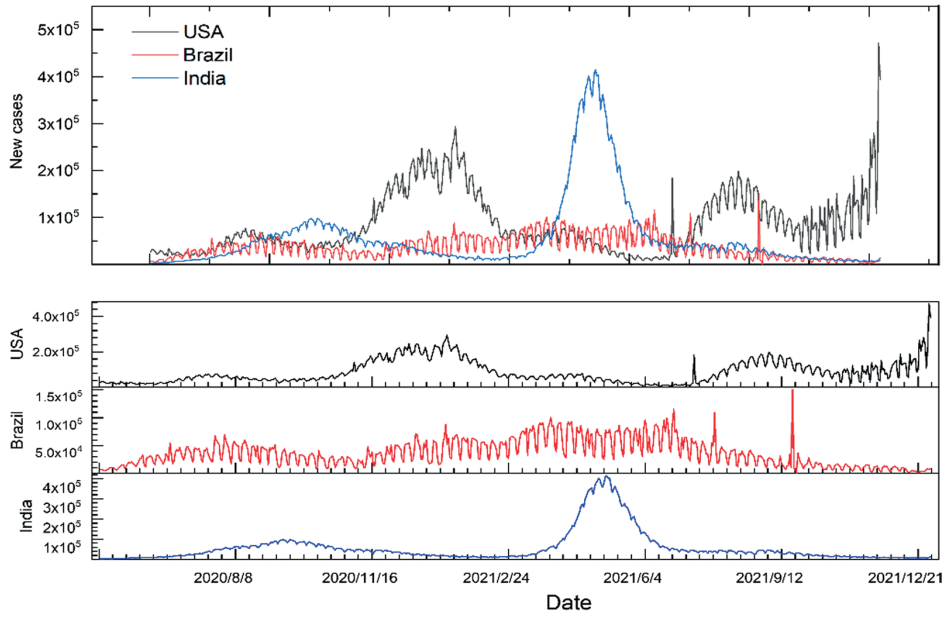


Source: Figure 16 of present report.

As I mentioned above, heterogeneous endogeneities are already a challenge in studying this type of question, as they can be driven, for example, by heterogenous demographics, infrastructure quality, or different countries that for political reasons reacted differently to COVID-19 (think about the United States or countries in Europe, for instance). A further challenge arises if you have some non-trivial persistence in some of the quantities you have in the system. It could be, for example, that either the treatment – like infections – is very persistent, or reactions in the bank behaviour are persistent. These are the effects one would like to somehow isolate and understand. Is there a persistent response? Is it really a persistent response, or a consequence of the fact that the treatment, in the beginning, was somehow persistent?

To be more explicit, the figure below, taken from Wang et al. (2022), reports the number of new COVID cases across countries. And, of course, you see by construction that it is something very persistent: there are trends with several sign changes over time, heterogeneities across countries, and so on. The point I am making here is that maybe it makes sense in the Jordà projections to try to incorporate some of these potential differences.

FIGURE 4 **COMPARISON OF DAILY NEW CONFIRMED CASES OF COVID-19 IN USA, BRAZIL AND INDIA FROM 1 MAY 2020 TO 30 NOVEMBER 2021**



Source: Wang et al. (2022).

To make the point sharper, consider a system where the treatment (e.g., infectious diseases) is autocorrelated, but the response given treatment is not:

$$\text{(a)} \quad \begin{cases} \Delta y_t = \beta \Delta s_t + v_t^y \\ \Delta s_t = \rho \Delta s_{t-1} + v_t^s \end{cases}$$

where Δy_t, Δs_t denotes variations in response and treatment, respectively. Conversely, consider a second system where the response given treatment is autocorrelated, but the treatment is not:

$$\text{(b)} \quad \begin{cases} \Delta y_t = \beta \Delta s_t + \rho y_{t-1} + v_t^y \\ \Delta s_t = v_t^s \end{cases}$$

It can be shown that if you write a model like (*a*) or (*b*), the theoretically expected response to the treatment over horizon h is identical, i.e., you cannot distinguish these very different adjustment dynamics. In order to identify these different dynamics, you actually need to specify a kind of augmented Jordà regression that explicitly models the

potential effects of future treatments in the time span between the first treatment date and the forecasting time point. I think that studying better this kind of feature in the report's data may very useful, for instance based on different forms of augmented models better capturing the persistency of treatments and responses.

Next, I would like to make some comments on more forward-looking aspects, as I feel that there is a lot of interesting future research that can be done here, profiting from new developments on the big data side and on the modelling side using machine learning techniques.

In the first place, it is likely that the level of bank disclosure related to disaster risk and disaster exposure will improve to some extent, producing new interesting data that could be studied; this may be under mandates by regulators or pressure from big investors, for instance.

Going further, an important related question concerns potential stability issues for the banking sector. If you think about the current systemic risk regulation, you could argue it is about measuring and controlling exposure to systemic distress events in the banking sector. This is currently achieved by relying on balance sheet data or market-based quantities in order to compute indicators of a bank's valuation sensitivity to systemic shocks. I think you could even imagine having a similar kind of regulation with respect to exposure to different types of disasters. Environmental disasters, for instance, are likely going to be one of the big risks to care about in the future.

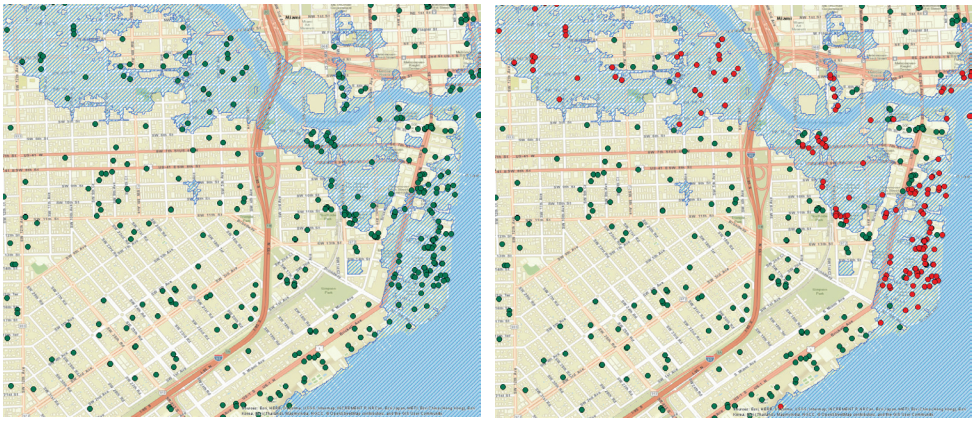
A further aspect I find interesting – which is partly mentioned in the report – is understanding the implications for some type of disruption within the banking sector. With COVID, we saw the emergence of a lot of fintech companies offering online services that were very useful for potential clients, in a way that was quite heterogeneous worldwide (e.g. in China or the United States). This is something that might be interesting to study in relation to if and how the business models of banks may adjust as various types of disasters become more likely.

Another important dimension concerns alternative data sources. There are quite a few papers in the asset pricing literature that have already produced interesting work in this direction. The main idea is that you can use new types of data to better identify, for example, measures of climate risk exposure. This aspect is related to the example I discussed above on the measurement of sentiment to infections. This type of data can be useful to precisely measure bank responses while conditioning on sentiment to climate, uncertainty to climate, or heterogeneous sentiment and exposure to climate across different units. This may be something exploitable also to better identify bank-level responses and feedback to disasters.

I have just one example here to explain a bit more in detail what I am talking about. The figure below is taken from Giglio et al. (2021). Essentially, there are ways to identify exposure to climate risk in a relatively simple manner. In the left panel, in green, you have buildings in downtown Miami which are near regions of potential flooding; in the

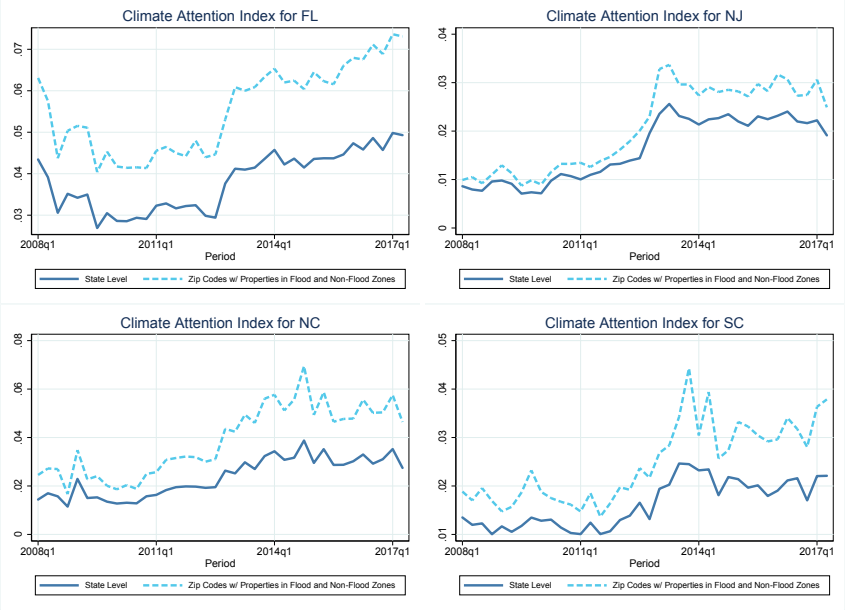
right panel these are overlapped with the locations where the floods actually occur. The idea here is to measure cross-sectional differences in valuations in this region, to better measure flood risk exposures. That is something you can naturally do not only in the United States, but also in other countries.

FIGURE 5 **ILLUSTRATION OF IDENTIFYING PROPERTIES IN THE FLOOD ZONE**



Source: Giglio et al. (2021).

FIGURE 6 **CLIMATE ATTENTION INDEX IN THE CROSS-SECTION AND TIME SERIES**



Source: Giglio et al. (2021).

A different way to build climate-related real estate valuations is to compute a 'climate attention index', which is defined as the proportion of 'for sale' listings with climate-related text included in the description. You can then exploit information provided by heterogeneities, over time and cross-sectionally across regions, in these indicators (see the figure above, also taken from Giglio et al., 2021).

For instance, you can try to use this type of indicator to measure differences across regions and in the dynamics over time of attention to climate. I think this is potentially important also in light of what I mentioned in the beginning. Disasters create news, which further creates uncertainty, belief heterogeneity and attention patterns. The latter finally impact on the actions of economic agents, asset prices and economic quantities.

The last point is even more forward-looking. Ideally, at some point we may want to write economic models in order to better understand how reactions will happen. One important issue with today's models is that – in most cases – they are too simplistic. For instance, it is very difficult to incorporate heterogeneities or non-trivial sluggish adjustments and frictions of different kinds. However, with today's advances in computational power and new machine learning solution techniques, it is possible to solve much more realistic models. For instance, Gaegauf et al. (2023) propose a machine learning framework to solve dynamic optimisation problems with potentially many state dependencies and rich forms of frictions. A related important issue concerns economic models built on more realistic calibrated models for the climate evolution, as in Folini et al., (2023).

To conclude, this report addresses a super-relevant question with a lot of potential research avenues, possibly using different types of data and techniques. The potential implications are wide, not only for regulation and bank business models, but also for understanding whether the response of banks to disasters is optimal. If the response is optimal, we may not need to regulate much; but probably it is not. As a result, we may need to measure how much suboptimality is generated and introduce suitable economic policies to mitigate it. These policies should be founded on realistic models and plausible scenarios for banks' heterogenous reactions to disaster events.

Elisa Luciano, *University of Turin and CCA*

Thank you very much for giving me the opportunity to discuss this very interesting report. Let me get straight to the main point. This is a very rich account of the consequences on bank credit of three types of disasters: armed conflicts (which are divided into sanctions and wars or civil unrest), pandemics and natural disasters. The final aim is to describe the 'triple jeopardy' and how it can hit in the future. What happens when disasters of all three types hit together?

Sanctions

First of all, let me give you a quick overview of the consequences of the sanctions against Russia, which is probably the most studied part of the issue. The authors of the report provide a difference-in-difference regression to estimate the treatment and spillover effects of sanctions on foreign banks operating in Russia. The basic idea is to regress the banks' operations – or credit issuance – against the treatment. There are two different treatments: a sectoral one, hitting only liabilities (SSI); and a fully-blocking one, hitting both liabilities and assets (SDN) – which obviously is the most severe. The controls include the type of origin country of the home bank – whether this is an 'emerging market' or 'advanced economy' – plus a number of important features, such as size. The null hypothesis is that there is an average decline and substitution in operations, and that size matters.

The results tell us that the treatment with the largest impact on operations is SDN, which determines a decline in foreign borrowing, especially significant for big banks whose 'home' is in advanced countries, over the 'long run', which means three years. There are also various indirect and volatile effects on firms. The lesson we learn is that sanctions can be evaded, and the spillovers – the macro effects – must be taken into account. The main issue raised in the report is that there is a lot of heterogeneity in the credit reaction to the treatment and in the likely effectiveness of sanctions.

My comments on sanctions have the same structure as the comments I will make later on the other aspects of the report. I performed the following exercise. I took Merton's structural model of a bank, which is based on the assumption that equity is a call option on the assets of the bank, with strike price equal to the amount of debt:

$$E_t = Call(A_t, F_t)$$

where E_t is the bank equity value at time t, A_t is the bank's assets, and F_t is the face value of bank's debt, which for simplicity we can identify with deposits (see Merton, 1970, for the seminal version). For any specific maturity $T > t$, then, the fair or market value of deposits is equal to the present value of their face value at the riskless rate r, minus a put option on the assets with the same strike:

$$D_t = F_t e^{-r(T-t)} - Put(A_t, F_t)$$

The first term is the value that deposits would have if the bank could not go into default, while the second term represents the expected loss because the bank can go into default and fail to reimburse deposits, if and when needed. It is a put option on the banks' assets, which is exercised by paying back the face value of debt, and depositors are short it. Over the last few years, I have been using versions of this reference model with co-authors to investigate bank behaviour (e.g., Luciano and Wihlborg, 2018, 2023).

I perform the following exercise: I calibrate the model to the data from the report and from a companion paper by the same authors (Mamonov et al., 2023). The aim is to examine the consequences of their credit results on two magnitudes, which are not part of their current results but are worth examining and can be estimated using the model above. One is the bank's default probability, which represents either the likelihood of default or the need to rescue, in case a government wants to avoid bank defaults.

The other is the expected loss to bank creditors, or depositors. If a bank goes into default because of a war, pandemic or natural disaster, how much do depositors expect to lose? This is a lower bound – but still an interesting measure – of the systemic risk that the bank creates. It is the product of the default probability times the loss given default, and it obtains as the difference between the value that the bank debt would have if it were given back for sure, $F_t e^{-r(T-t)}$, and the value it has, taking into consideration the possibility of default:

$$F_t e^{-r(T-t)} - D_t$$

By definition, it coincides with the put value, and can be estimated from the asset and face value of deposits, knowing the variance of the asset themselves.

The exercise helps to go beyond what we see in the report, by looking at the probability that the individual jeopardies lead banks into default, and at the effect of default in terms of creditors' losses. Not only does it serve to measure the probability that these events hit the economy and the consequent systemic risk, but it also helps to pinpoint which are, among the many jeopardies that the authors point out, the ones worth either exploring through additional research or mitigating through policy interventions. Obviously, the evidence is preliminary and the results should be taken with a lot of caution.

For the case of sanctions, I calibrate the above model separately for the different types of banks and maturities T that are studied in the report, namely, big banks, affected by sanctions on the asset side only (SSI), over one and three years; big banks, affected on the asset and liabilities side (SDN), over one and three years; small banks, affected by SSI, over one and three years; and small banks, affected by SDN, over one and three years. Corresponding to each of these eight categories/maturities, I obtain the bank asset, equity value and its variance from the market values reported by Mamov et al. (2023, Appendix C). I consider 'big' and 'small' banks to be those with assets equal to the average plus and minus a standard deviation, respectively. As in most macro models, I use as riskless rate the Russian GDP growth rate, obtained as a simple average over the years covered by the paper: 2009M1-2019M6 (source: IMF). I obtain the (unobserved)

variance of the asset value from the equity one, using Black Scholes' formula. Using the same procedure, I infer the face value of deposits from that of the market, which by definition is the difference between the asset and equity one. The face value differs between banks of the same size and with the same treatment (SSI, SDN) at different maturities. The results are reported in Table 1.

TABLE 1

0,012991	Russia GDP growth rate (r)			
	A_t	E_t	Standard deviation of assets	F_t
SSI, big, 1 year	2724.390	541.881	0.007	2211.047
SSI, big, 3 years	2724.390	541.881	0.007	2269.247
SSI, small, 1 year	28.503	1.713	0.002	27.140
SSI, small, 3 years	28.503	1.713	0.002	27.854
SDN, big, 1 year	99.484	29.368	0.022	71.033
SDN, big, 3 years	99.484	29.368	0.015	72.903
SDN, small, 1 year	1.682	1	0.045	0.691
SDN, small, 3 years	1.682	1	0.045	0.709

Note: Data in billions of rubles, average 2009M1-2019M6

Source: Own elaborations on data from Mamonov et al. (2023), Appendix C.

Equipped with the expected loss and default probabilities computed from this table, I can make some comments on the sanctions against Russia effects from this perspective. In Figure 1, we can see the bars that correspond to the discounted loss to be expected from big and small banks over one and three years, affected on the assets and liabilities side (SDN). The other bars , which correspond to the other banks and treatments, are negligible. So, there is heterogeneity across banks, and it is so large that the anticipated effect on creditors, because of the possibility of default, comes essentially from that type of banks and not from the others.

The difference between the expected loss from different treatments and types of banks measures how the 'heterogeneous response' to sanctions revealed by the current report translates into systemic risk, or expected losses to depositors.

The heterogeneity that characterises losses does not affect default probabilities, which are negligible in all cases – both under the risk-neutral and the historical or actual probability. These are different in meaning and magnitude, with the first representing the likelihood incorporated in the market values of assets, including credit default swaps, and the second representing the likelihood of the actual occurrence of banks'

default. So here, systemic risk is not necessarily accompanied by a non-negligible, actual probability of occurrence. This is quite important information for regulators, who may be interested in preventing bank defaults by decreasing the likelihood of occurrence, even before rescuing them to avoid the cascade of losses.

FIGURE 1 **DISCOUNTED EXPECTED LOSS FROM THE DIFFERENT TYPES OF BANKS AND MATURITIES IN TABLE 1, EXCLUDING INDIRECT EFFECTS (MILLIONS OF RUBLES)**

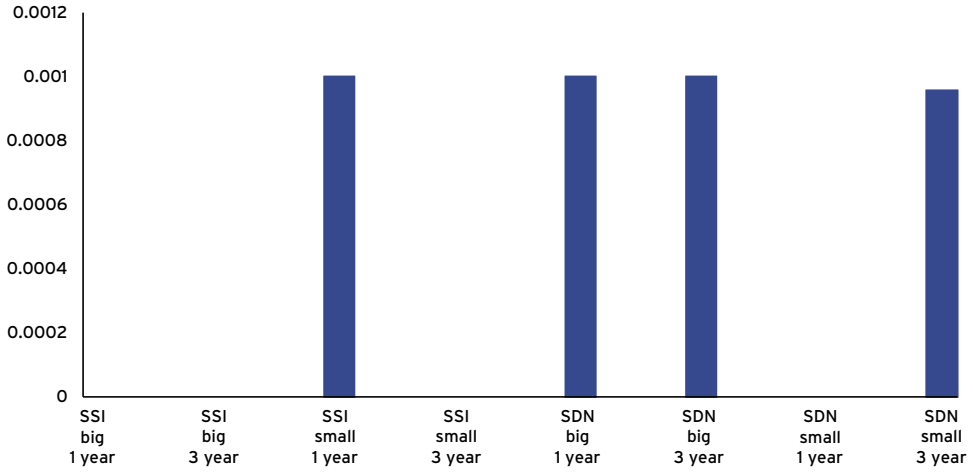
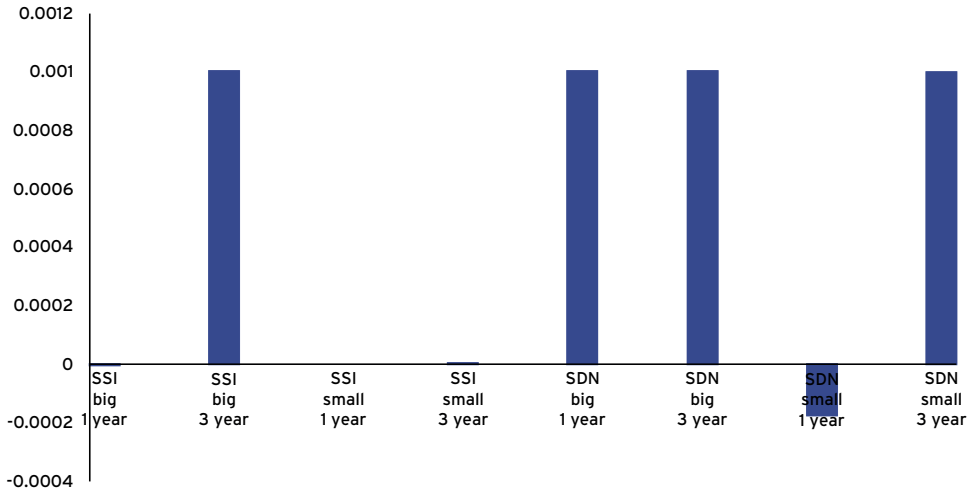


FIGURE 2 **DISCOUNTED EXPECTED LOSS FROM THE DIFFERENT TYPES OF BANKS AND MATURITIES IN TABLE 1, INCLUDING INDIRECT EFFECTS (MILLIONS OF RUBLES)**



The results up to now obtain from looking at the direct effects of sanctions, as measured in the statistics from Mamonov et al. (2023). What happens if we also look at the indirect, or spillover, effects of sanctions that the authors measure through the difference-in-difference coefficients of Table 2? Indeed, indirect effects seem to be important, and I am happy the authors did explore them because they may generate a change in the discounted expected losses or default probabilities.

In order to study them, I consider the coefficients of the indirect effects regressed by the authors and simulate through them the impact of sanctions on the initial bank asset value. I recompute the implied fair and face value of deposits and use these to re-estimate the expected loss and default probabilities. Figure 2 shows that, as concerns systemic risk, the impact is almost negligible for all types of banks. The visible bars are as in Figure 1, and almost of the same magnitude.

Wars

Now let me look at the link between war deaths and the banking system. The authors address the topic in Section 2 of Chapter 1, by dividing a sample of banks from both advanced and emerging economies into the those belonging to countries with a low and a high number of war deaths. They give us some statistics on the difference in operations and they regress – à la Jordà – credit on deaths and controls. The result is that deaths are a strong predictor of credit decline, with a capital adequacy ratio which improves after a while and a lending rate and non-interest income which increase, at different horizons.

I perform an exercise similar to the one for sanctions, using the data in Table 6. The exercise is more subtle to do, at least at the current stage, not because the asset value is not reported for these banks – and therefore I normalise it – but because the authors provide the capital at risk, and not the equity value. I use the former as a lower bound for the latter. However, the authors give us the average GDP growth rate of the home countries, which I still use as the riskless rate, as well as the average bank equity volatility, which I use to infer the asset one. I re-estimate the model for the banks of countries at war and in peace, i.e., in high- and low-death countries.

In short, the risk-neutral default probability for banks in high- and low-death countries over one year ranges respectively from 8% to 6%. Hence, there is a sizable effect on the default probability. However, the loss they generate in case default occurs is negligible in both cases. Therefore, war changes the probability of default, but not the losses by much should default occur.

Pandemics

Looking then at pandemics, in Chapter 2 the authors divide banks into those belonging to countries with respectively low and high number of COVID deaths. The structure is the same as for wars: the authors give us some statistics and estimate whether credit depends on the number of deaths, including controls and the like. The result is that deaths are a strong predictor of credit decline, again with a capital adequacy ratio which improves and higher non-interest income.

I use the same structural model as above to comment on them, but I re-estimate it for the two types of banks – those in countries with a high and low number of COVID deaths – using the data in Table 9 of the report.

If I now compute the default probabilities for banks in these countries, they do not change much: indeed, they go from 6.4% (low-death countries) to 6.7% (high-death countries). As in the war case, the losses generated are negligible, according to the authors' data filtered through this model.

Natural disasters

To model natural disasters, in Chapter 3 the authors divide banks into those belonging to countries with low and high CO_2 emissions. The structure is again the same, with statistics of the difference in operations and a regression of credit on emissions plus controls. With more pollution, one gets again lower credit, as well as a higher capital adequacy ratio, lending rate and non-interest income.

Again, I estimate a structural model for these two types of banks – those in countries with high and low pollution – using the data in Table 12 of the report.

If we compare the default probabilities for banks in high and low-emissions countries, we go from 8% to 7%, again with negligible effects on the actual losses. Therefore, natural disasters do not seem to have sizable effects on systemic risk, while they do have effects on default probability.

The triple jeopardy

What about the 'triple jeopardy'? Using the above lens of the structural model, calibrated to the authors' data, and assuming that wars, pandemics and natural disasters are independent events, I can state that the overall probability of a bank belonging to the countries studied in the report going into default because it is affected by all three types of disaster is fortunately negligible. Indeed, it is between 0.05% and 0.03%. The systemic risk that accompanies the triple jeopardy is 1% of the total liabilities.

Instead, the probability that a bank survives because it is affected by none of the disasters is close to 80%. However, the probability that at least a disaster of one type hits and brings the bank into default is around 20%. Therefore, the triple jeopardy seems worth exploring, through its individual components.

Conclusions

To conclude, the report is a very well-motivated and benchmarked account of the effects of disasters – sanctions, wars, pandemics and CO_2 emissions – on banks. It highlights a lot of heterogeneity in the credit response to sanctions, and relatively mild effects on credit in the other cases.

In my opinion, since the literature is still in its infancy, the results from both this report and some companion papers can be used as inputs to structural models to simulate the effects of disasters on both potential losses and their probabilities of occurrence. The latter also represent the probability – for a government wishing to avoid bank failures –

of being forced to rescue them. This exercise provides a sense of the impact of disasters beyond the amount of credit. It highlights the risks worth investigating and worth taking into account when designing policy interventions. Indeed, structural models allow scholars to simulate the effects of policy interventions, too.

Sanctions and their spillovers have very heterogeneous effects on systemic risk and default probability. Wars change the default probability of banks, but not the expected losses or systemic risk by much. In the case of pandemics, neither the effect on expected losses or on default probabilities is sizable. In the case of CO_2 emissions, these do not seem to have sizable effects on expected losses or systemic risk, while they do have effects on the probability of default. So, both in the case of wars and emissions, regulators may expect higher occurrence of bank defaults and can try to prevent them, even though the capital needed to face losses does not seem to change much, because the expected loss does not.

According to the structural model I calibrated to the data from the report, the probability of the three types of disasters resulting in a bank defaulting because they hit together is low. However, the probability of default due to the occurrence of at least one of them is around 20%. The report allows us to conclude that policy interventions addressing each of type of disaster remain important.

THE PERSPECTIVE OF MARKET PARTICIPANTS

Giovanna Nicodano, *University of Turin and CCA*
Thank you very much for attending both in person and online. Let me also thank the organisers for asking me to coordinate this panel, which brings to the floor the main actors implementing the policy response to the recent systemic shock.

In the report, we have been reading about scholarly studies that use several instances of disastrous occurrences – wars, diseases, etc. – but, in our minds, the memory of the recent global pandemic is alive. It is hard to perform an econometric study of global pandemics because, luckily, we do not have a sufficient number of data points. We can however appreciate the potential consequences of that pandemic – aside from the very interesting calculations by Elisa Luciano – by thinking that half of the economy had to shut down during those years to help prevent the spread of the virus. Even without making sophisticated simulations, we can then infer that, absent any quick and large intervention by policymakers, there would have been an economic meltdown: loans would have not been paid back to banks, the banks would have gone into default, and the economic consequences felt by the people would have been much larger and widespread. In other words, we would have experienced a systemic crisis. This is apparent from the estimates concerning the effects of wars in emerging economies, where the response of policy institutions was necessarily less prompt and sweeping.

Let me now introduce the panellists: Giuseppe Grande is deputy head of the Market and Payment Systems Oversight Directorate of the Bank of Italy, while Gregorio De Felice is Chief Economist at Intesa San Paolo. They are two scholars serving major European institutions, therefore what I would like them to stress in the discussion are things that may be underlying some of the estimates that are presented in the report, but do not necessarily come to the foreground. Giuseppe Grande, for instance, will let us know now about which policy measures ensured that credit continued to flow to the economy and no meltdown of the system occurred.

Giuseppe Grande, *Bank of Italy*[50]
Thank you, Giovanna, and thanks to LTI and Collegio Carlo Alberto for inviting me; it is always a pleasure to be at the Collegio. Before entering into the discussion, let me tell you that I really enjoyed this report as it is very well thought out, very balanced, it has a lot of novel insights and findings, and it is very well written as well. Congratulations to the authors and also to LTI for the initiative.

Now, before dealing with the difficult issue that the Chair asked about, I would like to make a general comment on the concept of disaster that we have used so far. The report suggests distinguishing between unexpected disasters and expected disasters; it also argues that the frequency of expected disasters is increasing. I feel a bit uncomfortable with the concept of expected disaster because, by definition, a disaster is a rare event, and so it is difficult to predict, to foretell. Indeed, this morning the authors have explained better in what sense they use the word 'disaster'.

I would like to follow up on this. The report focuses on three fundamental factors, namely, geopolitics, health safety and the natural environment. What the authors are actually telling us is that the key features of these three factors are changing. This means that the risks that they pose to banks and non-financial companies – as well as to society at large – are different, and it is the responsibility of banks, public authorities and non-financial companies to adapt to these new risks.

Let me use the example of an earthquake. In one country, a given earthquake can basically have no impact on buildings or human lives; the same earthquake in another country can be a disaster. But this does not mean that the earthquake is a disaster per se. It is a disaster in the second country because this country did not adapt to and take countermeasures to hedge a risk that can be insured. Therefore, I would say that this report is more about the changing nature of predictable risks than about disasters, to some extent.

50 The views expressed do not in any way represent those of Banca d'Italia or the Eurosystem.

Let me now address the issue that Giovanna asked, that is, what is the role of public authorities? This is an important point indeed, and I would suggest to the authors to enrich a bit the part of the report dedicated to the role of macroeconomic policies (by macroeconomic policies, I mean fiscal policy, monetary policy and macroprudential policy).

In the current draft, we only talk about fiscal policy. What we find is that fiscal policy is viewed as a way for governments to raise corporate taxes to balance their budget. This is a very limited view of fiscal policy, more suited to developing countries than advanced economies, I would say. In advanced economies, I think we have been able to use taxpayer money wisely, and the recent experience with the COVID-19 pandemic is an example. But also 15 years ago, during the global financial crisis, I think we were able to use taxpayer money wisely.

Monetary policy and macroprudential policy are powerful instruments too – especially during crisis periods – and the banks are the first beneficiaries of extraordinary monetary and macroprudential measures. In this sense, I think it would be very useful if the report could add, at least on a conceptual level, an account of how monetary and macroprudential policies are an effective tool in the hands of all public authorities to deal with these kinds of disasters. Possibly, this could also be added in the empirical part, although I understand that it is much more difficult to control for these general factors from an empirical point of view.

Regarding macroeconomic policy, I would like to make a last point: why are macroeconomic policies so important during disasters? Not only because their tools are powerful – taxpayer money, liquidity, bank liquidity and regulation are powerful tools indeed – but also because, in crisis periods, it is very important to ensure a certain degree of consistency between the actions of different countries. In fact, these public policy tools are so powerful that inevitably there can be cross-border spillovers, and so it is very important not only to coordinate countries, but also to make them cooperate with each other. This is the task of public authorities.

To conclude, let me just give you an example regarding the experience of the European Systemic Risk Board – the European Union's macroprudential authority responsible for financial stability. During the last pandemic, the ESRB was very active. There is a very nice account by Richard Portes of what was done (Portes, 2021). If you read that account, you can find out how important the action of the ESRB has been, considering not only cross-border effects but also the differences in national banking systems, thus the specificity of national needs and also of national vested interests. Of course, different structures imply different vested interests, and it is the public authority's responsibility to take them into account and to coordinate and arrive at common solutions.

Giovanna Nicodano

Thank you, Giuseppe. In his narrative, Richard Portes indeed stresses the incredible level of cooperation and coordination among European institutions and member countries that was a welcome reaction to the pandemic. It was also a first test for the ESRB, which had been created in 2010 to supervise systemic stability. Of course, in the concluding section, Portes hopes that coordination will endure also in normal times, but it is in crisis times that we typically come together.

Giuseppe Grande highlighted the key role played by the fiscal, monetary and the macroprudential authorities in handling systemic shocks in general and the pandemic in particular. Let me then ask Gregorio De Felice: was the banking system ready and did it respond adequately to the stimulus?

Gregorio De Felice, *Intesa Sanpaolo*

First of all, thank you for inviting me here to Collegio Carlo Alberto. It is a great opportunity to discuss this report – the topics are relevant, and the insights extremely interesting. Before talking about the Italian banking system, I would like to comment on a couple of results of the report.

The authors find that the COVID-19 pandemic dampened the growth of bank loans. As a matter of fact, the opposite happened in Italy, where the volume of bank lending increased during the pandemic. They also note that the improvement in capital adequacy has been driven by the reduction in banks' exposure (a kind of 'de-risking'). Indeed, in the case of Italy, better capital adequacy was essentially the consequence of the intervention of supervisory authorities: the ECB did not allow European banks to distribute dividends during 2020, at the peak of the pandemic.

In my view, monetary policy, supervision, and fiscal measures can have a crucial role in mitigating the effects of disasters on the economy – and the COVID-19 pandemic is certainly a good example.

Coming to Giovanna's question on the role of banks, I would like to start with two considerations. The first is that the banking system represents a key transmission channel of policies, be they micro- or macroprudential; the second is that, to play this role effectively, the system must be sound. If we think back to the situation at the time of the Great Financial Crisis in 2008, it is not difficult to see that it was something of a 'disaster': as a transmission channel, banks completely failed to help the economy, in contrast to what we have been able to observe during the more recent crises.

The good news is that the Italian banking system is now sounder than 10-15 years ago. The degree of capitalisation has doubled since the Great Crisis: the Common Equity Tier 1 (CET1) ratio was in the region of 7.5-8% in 2007-2008, while the figure in June 2023 is around 16%.

Much progress has also been made on credit quality. During the Great Financial Crisis, the NPL ratio in Italy was around 17% for significant banks; in other words, one-sixth or more of the total loans were non-performing. At present, the NPL ratio stands at 2.4%, close to the European average.

On top of this, Italian banks enjoy a strong liquidity position. Everybody probably remembers the case of Silicon Valley Bank. The liquidity position of the bank was not monitored, due to the different threshold introduced by President Trump in the supervision of small and medium-sized banks in the United States. In Italy, the average liquidity coverage ratio (LCR) is now at 166%, well above the regulatory minimum (100%) and higher than the average ratio achieved by significant banks in the Banking Union and in the other major European countries.

Another element to be considered in analysing the impact on the banks of the disastrous events the report deals with is the business model: diversification and a high level of operational flexibility can ensure a better response to shocks. Italian banks have changed their business models over the years, by introducing a higher degree of diversification. This made it possible to maintain a satisfactory level of profitability even in the presence of zero or negative interest rates. By entering new businesses (insurance, asset under management, mutual funds management and so on) the weight of commissions on revenues has gradually increased, balancing net interest income. Of course, the latter has also improved with the rise in interest rates but, when rates were zero or so, it was an issue in terms of profitability.

Incidentally, I would add that profitability is not only relevant for shareholders: the ability to generate profits is a crucial precondition for banks to play a supportive role towards the economy and the society.

Just a final remark comparing European versus US banks. The first key point is structural and refers to the different valuation that markets assign to banks: price/book value ratios are above one in the United States, and well below one in Europe. This reflects the higher cost of capital and lower capital remuneration in Europe, compared to the United States. Moreover, the share of investment banking on total business is much higher in the United States, leading to lower capital absorption for American banks. Another feature refers to market concentration: in the United States, the market share of the top three banks is around 35% while, looking at Europe as a whole, the share of the top three banks is around 15%. Definitely, we are still a long way from a true level playing field.

Giovanna Nicodano

We have just been given this overview of the future of risk management by both authorities and banks. The latter, in particular, respond by changing their business model, also to be resilient vis-à-vis the swings in interest rates that inevitably accompany such events. In the words of Gregorio De Felice, the role of the Single Supervisory Mechanism also helped ensure that banks across Europe became more resilient and liquid. This also prevented negative spillovers from occurring.

Now, we would like to look deeper at some details. For instance, we tend to think that the payment system is simply there, like water flowing through our taps. We can transfer money, literally in a matter of seconds, to whomever we want, but what ensures that payment systems are resilient to systemic shocks? This could be a question to address. A second issue concerns the two very relevant close-by wars that we are unfortunately living through. What should we do with respect to sanctions that often display mixed effects? If I understand it, in the new sanctions package there was a sanction which was not present in the report – the freezing of reserves.

Giuseppe Grande

Yes, now that we enter into the most technical part of the discussion, I would like to flag some of the several takeaways from this report, while taking the opportunity to reply to Giovanna's points.

First of all, I would like to follow up on the last comment by Gregorio De Felice on changes in business models. I think the first takeaway from the report relates to the importance of having a well-diversified financial system. Indeed, in all three parts of the report, a consistent result is that, after a disaster, banks tend to increase the ratio of non-interest income to total income in the long run.

Moreover, the authors find that the main transmission channel of wars and national disasters on bank loans is the volatility of the stock market, which acts as a proxy for the impact of disasters on firms' collateral and cash flows.

All these empirical results point in the direction that banks need to operate in a diversified ecosystem, composed of a strong banking sector and also of a strong non-banking financial sector, i.e., institutional investors and financial markets. This is something the Bank of Italy and the ECB have been working on for many years, in the context of actions taken at the European level to consolidate the complementary Banking Union and Capital Markets Union programmes.

It is in the banks' interest to have a strong institutional investors sector as well as strong financial markets, for at least two reasons. First, a strong non-bank financial sector allows businesses to better diversify their funding sources and to finance activities for which bank loans may not be suitable. This makes them more resilient and reduces the

riskiness of bank loans. The second reason why it is in the interest of banks to have a strong non-bank financial sector is that they can rely more on the provision of services to security issuers and investors, so that they can better diversify their income sources, as Gregorio reminded us a few minutes ago.

So, the first takeaway is that we have to promote a well-diversified financial system; it is in the interest of all players. Now, let me move to the financial sanction topic, which is one of the most important ones, then I will touch upon a couple of results and, finally, the payment issue. First, let me make a general thought. You may be as sceptical as you want about the effectiveness of economic and financial sanctions, but you have to keep in mind one very important thing: the only alternative to economic and financial sanctions the international community has to preserve and restore security and peace is force, armed conflicts, war.

This morning, Steven showed us the whole range of types of sanctions – travel bans, diplomatic sanctions, and the like – but the strongest tools we have are the economic and financial sanctions. We have to be aware of this, and this is why it is so important to have sound scientific research on the effectiveness of sanctions. This is the most powerful tool we have to preserve peace on our planet; and this is a fact, not some kind of philosophical construction.

Banks play a key role, and there are many results in this report supporting this, but I would like to specifically mention only one of the papers that are reviewed here, which is a recent paper by the authors of the report (Mamonov et al. 2023). This paper builds on an impressive data set, which allows us to distinguish not only between sanctioned firms and non-sanctioned firms but also between sanctioned banks and non-sanctioned banks; and, as the authors told us, sanctions have their most negative and persistent effects only when they hit both firms and banks. Therefore, banks are key in the transmission and effectiveness of sanctions, and some technical reasons behind this have been mentioned by the authors in the report.

I would like to add a more general explanation of the reason why banks are so important, which is very simple: wars are very expensive; it costs a lot of money to wage a war, even for authoritarian states. This is why the financial sector is central and a strategic asset for a country that wants to engage on a military front. Banks are essential if sanctions are to be effective, because the flow of money is crucial when financing a war.

A second main takeaway from this report is that sanctions are not all equal: there are differences, important differences, in the effects of sanctions, and we have seen very clear results this morning. Thus, it is important to invest in knowledge about sanctions and engage with the best research on the optimal design of sanctions, because sanctions may differ considerably in terms of their effectiveness.

Another takeaway from this report is related to the major difference between large international banks and other banks. The sanctions mainly affect the big international and Western banks, and it is important to understand why. If the authors were able to provide more insights about this heterogeneity within the banking sector, it would be very useful.

The last point is about the payment system – a topic which is very close to my responsibilities. The report argues at the end that one of the most promising tools is to close access to the payment system for targeted banks, in particular to SWIFT, which is the most important network for the international exchange of financial messages – a crucial instrument to make international payments. I do agree that imposing limits on access to the international payment system can be an effective way to increase the effects of sanctions.

At the same time, there are also bans on international payments which can be circumvented quite easily at this stage, and we have to be aware of this. Let me give you a couple of examples. First, not only can a payment between two countries be replaced with a triangular payment involving a third country, but it can also be replaced with a triangular payment involving a non-targeted bank in the sanctioned country. Second, even an international payment system can be replaced by another payment arrangement, and indeed today there are many active international arrangements to make interbank wholesale payments.

We have to be aware of this, and this is all the more reason to increase our understanding of these facts.

Giovanna Nicodano
Thank you, Giuseppe. What you said made me think that sanctions can imply longer-term consequences such as the birth not only of parallel international payment systems but also of political blocs that may be actually reinforced by the presence of sanctions. I therefore understand your demand for further research, although this can really be a tricky topic to analyse.

So, how is life for a bank during a disaster? How do banks react, and how quickly? Also, how are the spirits of the people who work for the bank and how do they contribute to the bank's reaction?

Gregorio De Felice
The COVID-19 pandemic has deeply affected our lives. Forcing people to stay and work at home, the lockdown permanently changed households' habits: for example, people at Intesa Sanpaolo are now allowed to work at home for a total of 120 days per year (quite a lot indeed, compared to the recent past!). Taking part in meetings where all the participants attend 'in person' is becoming rarer and rarer; this way of working has become our 'new normal'.

The pandemic has prompted a choral response from supervisory institutions. Basically, the following idea was applied: in case an unknown and serious disease occurs, the ideal solution is to 'freeze time' to identify the correct medicine.

Similarly, what the banks tried to do during the pandemic was to 'freeze' the economy. To achieve this goal, small entrepreneurs – who were unable to work at that time – needed to have fresh cash flows in their portfolios. Therefore, many banks created 'task forces' to elaborate thousands and thousands of loan requests, even before the introduction of state aid.

This is an extremely positive example of a prompt and far-reaching reaction to the pandemic. As a result – I go back to my first comment – while business lending was weak (or close to zero) before the pandemic, its growth rate jumped up to a peak of 8.4% at the end of 2020. Many entrepreneurs replaced existing loans with new ones, guaranteed by the state. In any case, it is true – as the authors note in the report – that the slowdown in the economy due to the pandemic dampened loan growth in the following years.

Another issue, which the report does not consider, relates to the saving ratio. During the pandemic, people were forced to stay at home – no parties, no cinema, no pizzas, no restaurants, no holidays. Personal saving ratios increased consequently. If the behaviour of households was in a sense 'understandable', that of non-financial institutions was less so: in a negative interest rate environment, their deposits at banks jumped by €130 billion, from €280 billion at the outbreak of the pandemic (an increase of almost 50%).

This helps explain why credit demand is weak now, so much so that we read almost daily in the Italian newspapers that "there is a credit crunch" and "banks do not want to lend money anymore". As we saw before, when interest rates were negative, non-financial institutions accumulated a great amount of money in bank deposits – which, at that time, could be considered a 'good' asset class: all in all, even a zero return is not too bad in a negative interest rate scenario. Now that loan interest rates are at 4–5%, it is only natural that a company prefers to reduce accumulated deposits rather than asking for new loans.

If there is still some time, I would like to dwell for a moment on Russia. Maybe you know that Intesa Sanpaolo owns a subsidiary bank in Russia; the exposure, which was around €10 billion at the start of the war, has been gradually reduced. Credit had been granted to high-rating industrial groups, but the bank suffered some losses. At present, Intesa Sanpaolo is about to sell the Russian subsidiary; President Vladimir Putin has already signed an order authorising the sale of 100% of the capital.

Perhaps more interestingly, what were the indirect effects of the Russia-Ukraine war? At the outbreak, a strong boost in loan demand was registered. Short-term loans jumped by 16–17% in September 2022 and then decelerated; at the same time, corporate deposits started decreasing. These behaviours give an idea of how customers reacted to the unexpected Russian invasion of Ukraine.

The bottom line, in my view, is that "you always need to have a buffer" so as not to be in great trouble when a crisis explodes. In a nutshell, this is the mission of supervisory authorities: keeping the banking system sound and in good shape, to face possible disasters.

Let's go back for a moment to another risk the authors mention in the report – climate change. On the one hand, the European Central Bank is asking supervised banks to increase capital provisions a bit; on the other, it is important that banks encourage, through credit, the 'green transition'. As this point would require an extensive discussion, I will stop here.

Giovanna Nicodano
Thank you. So, it appears that there is an effort from both the authorities and the financial system at large to address, possibly in advance, all these challenges that have materialised together after 50 years of relatively quiet times.

Now, there is the opportunity to ask some questions to our speakers.

Andrea Lagorio, *student at CCA*
I was thinking about the very last sentence Gregorio De Felice said about ESG loans. In the report, we realised that disasters are becoming more and more frequent. My initial question, from a risk management perspective, is how do I hedge against such disasters? Couldn't we say, even if it can be a strong sentence, that lending towards activities that are willing to shelter from disasters can actually be seen not only as an asset, but also as a hedging instrument against future disasters?

What is the view of the supervisory board on that side? If we can build a hedging instrument like this, maybe the capital requirements could be lower than a normal loan.

Gregorio De Felice
Before passing the baton to the supervisory side, let me briefly expand on what I have just said about ESG credit. On one hand, the stability of banks must be preserved, as they must be able to face natural disasters. On the other hand – and that was my point – the green transition is so important for the economy, and for society at large, that we must seek every possible solution (including credit, bonds, etc.) to encourage the transition.

At some point, during or after this transition phase, there will be higher capital requirements for non-ESG loans and lower requirements for ESG loans. This depends on the ability to prove that ESG loans are less risky than non-ESG loans; a lower default risk would justify lower capital requirements.

Giuseppe Grande

Thanks for the question, it was very well formulated. Actually, I do not have the answer at this stage. In any case, this is why research on these topics is important: risks are the fundamental factors that drive the economy and our society, and they change over time. As a consequence, risk management techniques have also to change to deal with these new types of risks, and new forms of well-known risks as well.

This is a task also for the public authorities. Bank regulators, as well as monetary policymakers, have to adjust and revise their tools as the external environment changes, so that our economic and financial ecosystem continues to be stable and promote growth.

Giovanna Nicodano

I can contribute to the discussion by pointing out that there is such a big standard error attached to these ESG investments that it is not so easy to think of lower capital requirements in the future despite the likely hedging ESG investments provide.

Now, since the speakers raised very important points, I would like to give the floor again to Steven Ongena.

Steven Ongena

Thank you so much for all the thoughtful comments.

One fundamental thing I take from the discussion is that policy – including all sorts of different policy mechanisms that respond to the disaster as well as regulation drafting – may, of course, mitigate or even undo to some extent the disastrous effect of a hurricane or a pandemic.

To some extent, if we want to make comparisons across disasters, one possible way could be to quantify the per-death effects of either one of these types of disasters; that would encapsulate already policy responses (to some extent).

On the pandemic side, we could also look at periods where, absent COVID, there were other epidemics at the country level and then again try to tease out the per-death impact of a shock, which would be sort of providing us with a modicum of comparison between them. Of course, we would then need to explicitly explain the reduction in the number of deaths as a result of specific policy measures. Clearly, this is not going to fully capture macroprudential or monetary measures, but it may improve our comparison to some extent, because this is what the report is partly about.

In terms of the longer-term consequences, we may talk more about changes to the business model. I also take the comments on the savings rate very seriously. All in all, during the revision phase we are really going to work on the many good comments we received.

Pietro Garibaldi

I just have a small question. I do not want to sound pessimistic, but my feeling is that banks can go bust for a lack of cash or ICT breakdown. For instance, ICT-related disasters, possibly triggered by natural calamities, have not been experienced yet, but I wonder whether we are dealing with a sort of 'black swan' event? If something like this happened, we may realise that not enough coverage or insurance and prevention mechanisms were put in place. I know there is quite some concern about this, given my experience in the banking system.

Anna Pestova

Let me reply to some of the comments. Regarding ICT disasters, that is a very valid point which is beyond the scope of the report, for the moment. As academics, we need data to study an event and, since we have not had an event like that yet, we may have a hard time quantifying it.

I am also grateful to both academics and market participants for all the comments raised during the discussion, and to Pietro Garibaldi as well for putting all this together.

I want to briefly respond to the policy comments, which I share. I acknowledge that the current version of the report does not treat in depth the issues raised, even though policies are a really important ingredient of both the response and the actual outcome of the disaster.

Moving on, in terms of the overall sequence of infectious diseases and health shocks, COVID was very special: first, the shock was exceptionally large; second, the policy response was exceptionally smart and very broad. As Steven Ongena said, sometimes policy may even overplay the shock, as in the case of monetary softening, where the fiscal support was really huge. As Gregorio De Felice pointed out, lending in Italy actually continued to grow and banks enjoyed increased capital buffers following the outbreak of the pandemic. What we have in the report, however, takes into account all health shocks in history, thus it is not only COVID-specific.

Additionally, I have a second thought on the comments on policy. It was raised that policy is a very important factor to consider; what I see from my reading and my understanding is that across many disasters – at least concerning sanctions and natural disasters – the coordination of policies across countries seems to be also very important. Let me give you an example, as we show in the report, of why sanctions are not as effective as we would like them to be. While there are advanced economies whose response is very strong and well-coordinated, there are also many emerging economies which are not part of this consensus. As a result, there is always a leakage based on the rate of coordination of the policy.

Another example is on climate policies: there is huge heterogeneity in terms of how stringent climate policy is across countries and banks, which are smart enough to benefit from 'climate policy arbitrage'. So, if there is a country whose climate policy is very strict, banks tend to transfer money to less strict countries. Therefore, not only does domestic policy matter, but the rate of international policy coordination also affects the response to disasters.

Fabio Trojani

I think one of the things that really concerns me is the measurement of those risks; in my opinion, the key lies in being able to quantify risks well, considering propagation effects over time horizons. Thinking about systemic risk regulations, we already have some tools from some notions of systemic risk. Furthermore, measurement is going to be very important because, if we want to develop hedging strategies, we need somehow to have measures for exposures of financial assets to these types of shocks to identify those classes which are more suitable to be good hedging vehicles.

On the other side, we want to regulate only where there is objectively some specific risk. At the moment, in my opinion, many indicators are still very vague. For example, with regard to natural risk, we may discuss to what extent ESG indicators are good proxies for greenness or not. It seems to me that measurement is a big point here; maybe we can try to use new types of data to be more precise on that dimension.

Giuseppe Grande

The point on ICT disasters by Pietro Garibaldi is very interesting because it is also related to Giovanna Nicodano's question on what ensures that payment systems are resilient to disasters. It is the public authority's job – our job – to ensure the safe functioning of the payment system and, in general, of the financial system. This is one of our most genuine primary duties; we do a lot of things in that respect, and for ICT disasters in particular there are a lot of safeguards. In fact, one of the reasons why we have not seen an ICT disaster so far is that IT systems are one of the most controlled aspects of banks and payment systems.

All of this is related to what we said at the beginning, that is, some of these disasters are not such a 'disaster' if we are able to act pre-emptively and to use the right instruments.

Gregorio De Felice

I would like to add just a couple of remarks. First, as Steven Ongena also said, there is a risk of overshooting in terms of policy reactions to disasters. In Italy, for example, this was the case in 2020, with positive effects in the short run, but the unintended consequence that our country is now facing higher public debt and deficit to GDP ratios. Unfortunately, economics is not a deterministic science, like physics.

My second point concerns coordination among European member states. The general feeling is that Europe showed great coordination in its response to the pandemic; certainly, the same level of coordination did not prevail in the reaction to the Russian invasion of Ukraine.

Also take the case of the American Inflation Reduction Act, which (by the way) has nothing to do with inflation. The European response was modest, to avoid the risk of divisions among member states. In the end, no one in Europe won; the only winner was the United States.

References

Abadie, A. and G. Imbens (2011), "Bias-Corrected Matching Estimators for Average Treatment Effects", *Journal of Business and Economic Statistics* 29(1): 1-11.

Accetturo, A., G. Barboni, M. Cascarano, E. Garcia-Appendini and M. Tomasi (2023), "Credit Supply and Green Investments", Bank of Italy, mimeo.

Adda, J. (2016), "Economic Activity and the Spread of Viral Diseases: Evidence from High Frequency Data", *Quarterly Journal of Economics* 131(2): 891-941.

Agarwal, S., B.W. Ambrose, L.A. Lopez and X. Xiao (2023a), "Did the Paycheck Protection Program Help Small Businesses? Evidence from Commercial Mortgage-Backed Securities", *American Economic Journal: Economic Policy*, forthcoming.

Agarwal, S., S. Chomsisengphet, H. Kiefer, L.C. Kiefer and P.C. Medina (2023b), "Refinancing Inequality During the Covid-19 Pandemic", *Journal of Financial and Quantitative Analysis*, forthcoming.

Agarwal, S., R. Duchin, D. Evanoff and D. Sosyura (2013), "In the Mood for a Loan: The Causal Effect of Sentiment on Credit Origination", National University of Singapore, mimeo.

Agostinelli, F., M. Doepke, G. Sorrenti and F. Zilibotti (2022), "When the Great Equalizer Shuts Down: Schools, Peers, and Parents in Pandemic Times", *Journal of Public Economics* 206, 104574.

Ahn, D.P. and R.D. Ludema (2020), "The Sword and the Shield: The Economics of Targeted Sanctions", *European Economic Review* 130.

Aksoy, C.G., J.M. Barrero, N. Bloom, S.J. Davis, M. Dolls and P. Zarate (2023), "Time Savings When Working from Home", *AEA Papers and Proceedings* 113: 597-603.

Aksoy, C.G., J.M. Barrero, N. Bloom, S.J. Davis, M. Dolls and P. Zarate (2020), "Working from Home around the World", *Brookings Papers on Economic Activity* 53(2): 281-360.

Alon, T., M. Doepke, J. Olmstead-Rumsey and M. Tertilt (2020), "The Impact of Covid-19 on Gender Equality", *COVID Economics* 4: 62-84.

Amiti, M. and D.E. Weinstein (2018), "How Much Do Idiosyncratic Bank Shocks Affect Investment? Evidence from Matched Bank-Firm Loan Data", *Journal of Political Economy* 126(2): 525-87.

An, X., S.A. Gabriel and N. Tzur-Ilan (2023), "The Effects of Extreme Wildfire and Smoke Events on Household Financial Outcomes", Federal Reserve Bank of Philadelphia, mimeo.

Arteaga-Garavito, M.J., M.M. Croce, P. Farroni, and I. Wolfskeil (2020), "When the markets get COVID: Contagion, viruses, and information diffusion", Working Paper.

Bachmann, R., D. Baqaee, C. Bayer, M. Kuhn, A. Löschel, B. Moll, A. Peichl, K. Pittel and M. Schularick (2022), *What If? The Economic Effects for Germany of a Stop of Energy Imports from Russia*, EconPol Policy Report 36, Ifo Institute.

Baele, L., M. Farooq and S. Ongena (2014), "Of Religion and Redemption: Evidence from Default on Islamic Loans", *Journal of Banking and Finance* 44(7): 141-59.

Barrero, J.M., N. Bloom and S.J. Davis (2021), "Why Working from Home Will Stick ", NBER Working Paper 28731.

Barro, R.J. (2006), "Rare disasters and asset markets in the twentieth century", *The Quarter Journal of Economics* 121(3): 823-866.

Barseghyan, G. (2019), "Sanctions and Counter-Sanctions: What Did They Do?", Bank of Finland Institute for Emerging Economies (BOFIT), 24.

Beck, T. and J. Keil (2022), "Have Banks Caught Corona? Effects of Covid on Lending in the U.S", *Journal of Corporate Finance* 72, 102160.

Beck, T., O. De Jonghe and G. Schepens (2013), "Bank Competition and Stability: Cross-Country Heterogeneity", *Journal of Financial Intermediation* 22(2): 218-44.

Bergeaud, A., J.-B. Eyméoud, T. Garcia and D. Henricot (2023), "Working from Home and Corporate Real Estate", *Regional Science and Urban Economics* 99, 103878.

Bertay, A.C., A. Demirgüç-Kunt and H. Huizinga (2015), "Bank Ownership and Credit over the Business Cycle: Is Lending by State Banks Less Procyclical?", *Journal of Banking and Finance* 50: 326-39.

Besedeš, T., S. Goldbach and V. Nitsch (2021), "Cheap Talk? Financial Sanctions and Non-Financial Firms", *European Economic Review* 134: 103688.

Bilal, A. and E. Rossi-Hansberg (2023), "Anticipating Climate Change across the United States", NBER Working Paper 31323.

Bircan, C. and R. De Haas (2019), "The Limits of Lending? Banks and Technology Adoption across Russia", *Review of Financial Studies* 33(2): 536-609.

Biswas, S., M. Hossain and D. Zink (2023), "California Wildfires, Property Damage, and Mortgage Repayment", Federal Reserve Bank of Philadelphia, Working Paper, 23-05.

Bloom, N. (2009), "The Impact of uncertainty shocks", *Econometrica* 77(3): 623-685.

Bloom, N., P. Bunn, P. Mizen, P. Smietanka and G. Thwaites (2023), "The Impact of Covid-19 on Productivity", *Review of Economics and Statistics*, 1-45.

Bloom, N., S.J. Davis and Y. Zhestkova (2021), "Covid-19 Shifted Patent Applications toward Technologies That Support Working from Home", *AEA Papers and Proceedings* 111: 263-66.

Boustan, L.P., M.E. Kahn, P.W. Rhode and M.L. Yanguas (2020), "The Effect of Natural Disasters on Economic Activity in Us Counties: A Century of Data", *Journal of Urban Economics* 118, 103257.

Braggion, F., A. Manconi and H. Zhu (2020), "Credit and Social Unrest: Evidence from 1930s China", *Journal of Financial Economics* 138(2): 295-315.

Buis, A. (2019), "Can Climate Affect Earthquakes, or Are the Connections Shaky?", NASA Global Climate Change, 29 October.

Caldara, D. and M. Iacoviello (2022), "Measuring Geopolitical Risk", *American Economic Review* 112(4): 1194-225.

Callen, M., M. Isaqzadeh, J.D. Long and C. Sprenger (2014), "Violence and Risk Preference: Experimental Evidence from Afghanistan", *American Economic Review* 104(1): 123-48.

Campbell, D., M. Loumioti and R. Wittenberg Moerman (2019), "Making Sense of Soft Information: Interpretation Bias and Loan Quality", *Journal of Accounting and Economics* 68(2-3): 101240.

Carlson, C.J., G.F. Albery, C. Merow, C.H. Trisos, C.M. Zipfel, E.A. Eskew, K.J. Olival, N. Ross and S. Bansal (2022), "Climate Change Increases Cross-Species Viral Transmission Risk", *Nature* 607(7919): 555-62.

Cerqueiro, G., S. Ongena and K. Roszbach (2020), "Collateral Damaged? On Liquidation Value, Credit Supply, and Firm Performance", *Journal of Financial Intermediation*, 100824.

Cerutti, E., R. Correa, E. Fiorentino and E. Segalla (2017), "Changes in Prudential Policy Instruments - a New Cross-Country Database", *International Journal of Central Banking* 13(2): 477-503.

Chetty, R., J.N. Friedman, M. Stepner and Opportunity Insights Team (2023), "The Economic Impacts of Covid-19: Evidence from a New Public Database Built Using Private Sector Data", *Quarterly Journal of Economics*, forthcoming.

Chodorow-Reich, G. (2014), "The Employment Effects of Credit Market Disruptions: Firm-Level Evidence from the 2008-09 Financial Crisis", *Quarterly Journal of Economics* 129: 1-59.

Cipriani, M., L.S. Goldberg and G. La Spada (2023), "Financial Sanctions, Swift, and the Architecture of the International Payment System", *Journal of Economic Perspectives* 37(1): 31-52.

Cortés, K., R. Duchin and D. Sosyura (2016), "Clouded Judgment: The Role of Sentiment in Credit Origination", *Journal of Financial Economics* 121(2): 392-413.

Cramer, K.F. (2021), "Bank Presence and Health", LSE Research Online Documents on Economics 119194.

Crozet, M. and J. Hinz (2020), "Friendly Fire: The Trade Impact of the Russia Sanctions and Counter-Sanctions", *Economic Policy* 35(101): 97-146.

Crozet, M., J. Hinz, A. Stammann and J. Wanner (2021), "Worth the Pain? Firms' Exporting Behaviour to Countries under Sanctions", *European Economic Review* 134: 103683.

De Haas, R. (2023), "Sustainable Banking", EBRD Working Paper 282.

De Haas, R. and N. Van Horen (2013), "Running for the Exit: International Bank Lending During a Financial Crisis", *Review of Financial Studies* 26(1): 244-85.

De Luca, G., D. Lisi, M. Martorana and L. Siciliani (2021), "Does Higher Institutional Quality Improve the Appropriateness of Healthcare Provision?", *Journal of Public Economics* 194: 104356.

de Roux, N. and L. Martinez (2023), "Forgone Investment Amid Conflict: Evidence from Credit Microdata in Colombia", Universidad de los Andes, mimeo.

Demiroglu, C., O. Ozbas, R.C. Silva and M.F. Ulu (2017), "Does Religion Affect Economic Decisions? Evidence from Ramadan Loans", Koc University, mimeo.

Deryugina, T., L. Kawano and S. Levitt (2018), "The Economic Impact of Hurricane Katrina on Its Victims: Evidence from Individual Tax Returns", *American Economic Journal: Applied Economics* 10(2), 202-33.

Djankov, S., C. McLiesh and A. Shleifer (2007), "Private Credit in 129 Countries", *Journal of Financial Economics* 84(2): 299-329.

Doerr, S., S. Gissler, J.-L. Peydró and H.-J. Voth (2022), "Financial Crises and Political Radicalization: How Failing Banks Paved Hitler's Path to Power", *Journal of Finance* 77(6): 3339-72.

Dwarkasing, M. (2014), "The Dark Side of Social Capital? Battles and Mortgage Lending", University of Bonn, mimeo.

Eccles, R.G., I. Ioannou and G. Serafeim (2014), "The Impact of Corporate Sustainability on Organizational Processes and Performance", *Management Science* 60(11): 2835-57.

Efing, M., S. Goldbach and V. Nitsch (2023), "Freeze! Financial Sanctions and Bank Responses", *Review of Financial Studies*, forthcoming.

Eichengreen, B., O. Saka and C.G. Aksoy (2023), "The Political Scar of Epidemics", *Economic Journal,* forthcoming.

Etkes, H. and A. Zimring (2015), "When Trade Stops: Lessons from the Gaza Blockade 2007–2010", *Journal of International Economics* 95(1): 16-27.

Federle, J., A. Meier, G.J. Müller, W. Mutschler and M. Schularick (2023), "The External Costs of War", University of Tuebingen, mimeo.

Federle, J., A. Meier, G.J. Müller and V. Sehn (2022), "Proximity to War: The Stock Market Response to the Russian Invasion of Ukraine", CEPR Discussion Paper 17185.

Felbermayr, G., A. Kirilakha, C. Syropoulos, E. Yalcin and Y.V. Yotov (2020), "The Global Sanctions Data Base", *European Economic Review* 129.

Fisman, R., A. Sarkar, J. Skrastins and V. Vig (2020), "Experience of Communal Conflicts and Intergroup Lending", *Journal of Political Economy* 128(9): 3346-75.

Folini, D., F. Kubler, A. Friedl, and S. Scheidegger (2023), "The Climate in Climate Economics", *Review of Economic Studies,* forthcoming.

Fu, J. and M. Mishra (2022), "Fintech in the Time of Covid–19: Technological Adoption During Crises", *Journal of Financial Intermediation* 50, 100945.

Fuchs-Schündeln, N. (2022), "Covid-Induced School Closures in the United States and Germany: Long-Term Distributional Effects", *Economic Policy* 37(112): 609-39.

Fuster, A., A. Hizmo, L. Lambie-Hanson, J. Vickery and P.S. Willen (2023), "How Resilient Is Mortgage Credit Supply? Evidence from the Covid-19 Pandemic", EPFL, mimeo.

Gaegauf, L., S. Scheidegger, and F. Trojani (2023), "A comprehensive machine learning framework for dynamic portfolio choice with transaction costs", working paper.

Gallagher, J. and D. Hartley (2017), "Household Finance after a Natural Disaster: The Case of Hurricane Katrina", *American Economic Journal: Economic Policy* 9(3): 199-228.

Ghironi, F., D. Kim and G.K. Ozhan (2023), "International Economic Sanctions and Third Country Effects", Bank of Canada Staff Working Paper 46.

Giglio, S., M. Maggiori, K. Rao, J. Stroebel, and A. Weber (2021), "Climate change and long-run discount rates: Evidence from real estate", *Review of Financial Studies* 34: 3527-3571.

Greenwald, D.L., J. Krainer and P. Paul (2024), "The Credit Line Channel", *Journal of Finance*, forthcoming.

Gropp, R., T.C. Mosk, S. Ongena and C. Wix (2019), "Bank Response to Higher Capital Requirements: Evidence from a Quasi-Natural Experiment", *Review of Financial Studies* 32(1): 266-99.

Guglielminetti, E., M. Loberto, G. Zevi and R. Zizza (2022), "Living on My Own: The Impact of the Covid-19 Pandemic on Housing Demand", Bank of Italy, mimeo.

Gutmann, J., M. Neuenkirch and F. Neumeier (2023), "The Economic Effects of International Sanctions: An Event Study", *Journal of Comparative Economics.*

Hassan, T.A., S. Hollander, L. van Lent and A. Tahoun (2019), "Firm-Level Political Risk: Measurement and Effects", *Quarterly Journal of Economics* 134(4): 2135-202.

Hilgenstock, B., E. Ribakova, N. Shapoval, T. Babina, O. Itskhoki and M. Mironov (2023), "Russian Oil Exports under International Sanctions", KSE Institute Kyiv School of Economics, mimeo.

Huynh, T.L.D., K. Hoang and S. Ongena (2022), "The Impact of Foreign Sanctions on Firm Performance in Russia", CEPR Discussion Paper 17415.

International Monetary Fund (2015), "Russian Federation 2015 Article Iv Consultation", IMF Country Report 15/211.

Itskhoki, O. and D. Mukhin (2022), "Sanctions and the Exchange Rate", NBER Working Paper, 30009.

Jiménez, G., S. Ongena, J.-L. Peydró and J. Saurina (2017), "Macroprudential Policy, Countercyclical Bank Capital Buffers and Credit Supply: Evidence from the Spanish Dynamic Provisioning Experiments", *Journal of Political Economy* 125(6): 2126-77.

Jordà, O. (2005), "Estimation and Inference of Impulse Responses by Local Projections", *American Economic Review* 95(1): 161-82.

Keerati, R. (2023), "The Unintended Consequences of Financial Sanctions", Board of Governors of the Federal Reserve System, mimeo.

Kempf, E., M. Luo, L. Schäfer and M. Tsoutsoura (2023), "Political Ideology and International Capital Allocation", *Journal of Financial Economics* 148(2): 150-73.

Kholodilin, K.A. and A. Netšunajev (2019), "Crimea and Punishment: The Impact of Sanctions on Russian Economy and Economies of the Euro Area", *Baltic Journal of Economics* 19(1): 39-51.

La Porta, R., F. Lopez-de-Silanes and A. Shleifer (2002), "Government Ownership of Banks", *Journal of Finance* 57(1): 265-301.

Lastauskas, P., A. Proskute and A. Zaldokas (2023), "How Do Firms Adjust When Trade Stops?", Bank of Lithuania Working Paper 114.

Laudati, D. and M.H. Pesaran (2023), "Identifying the Effects of Sanctions on the Iranian Economy Using Newspaper Coverage", *Journal of Applied Econometrics* 38(3): 271-94.

Lian, C. and Y. Ma (2020), "Anatomy of Corporate Borrowing Constraints", *Quarterly Journal of Economics* 136(1): 229-91.

Luciano, E. and C. Wihlborg (2018), "Financial synergies and systemic risk in the organization of banks", *Journal of Banking and Finance* 88: 208-224.

Luciano, E. and C. Wihlborg (2023), "Why are BHCs organized as parent-subsidiaries? How do they grow in value?", *Journal of Financial Stability* 67, 101155.

Mamonov, M., A. Pestova and S. Ongena (2023), ""'Crime and Punishment?'' How Russian Banks Anticipated and Dealt with Global Financial Sanctions", CEPR Discussion Paper 16705.

Merton, R. (1974), "On the pricing of corporate debt: The risk structure of interest rates", *Journal of Finance* 29: 449-470.

Mian, A., A. Sufi and E. Verner (2017), "Household Debt and Business Cycles Worldwide", *Quarterly Journal of Economics* 132(4): 1755-817.

Mishra, M. and S. Ongena (2022), "The Conflict Induced Costs of Lending", Swiss Finance Institute Research Paper 20-50.

Morales Acevedo, P. and S. Ongena (2020), "Fear, Anger and Credit. On Bank Robberies and Loan Conditions", *Economic Inquiry* 50(2): 921-52.

Morgan, T.C., C. Syropoulos and Y.V. Yotov (2023), "Economic Sanctions: Evolution, Consequences, and Challenges", *Journal of Economic Perspectives* 37(1): 3-30.

Müller, K. and E. Verner (2023), "Credit Allocation and Macroeconomic Fluctuations", *Review of Economic Studies*, forthcoming.

Neuenkirch, M. and F. Neumeier (2015), "The Impact of Un and Us Economic Sanctions on Gdp Growth", *European Journal of Political Economy* 40: 110-25.

Nguyen, D.D., S. Ongena, S. Qi and V. Sila (2022), "Climate Change Risk and the Costs of Mortgage Credit", *Review of Finance* 26(6): 1509-49.

Nigmatulina, D. (2023), "Sanctions and Misallocation. How Sanctioned Firms Won and Russia Lost", London School of Economics, mimeo.

Ouazad, A. and M.E. Kahn (2021), "Mortgage Finance and Climate Change: Securitization Dynamics in the Aftermath of Natural Disasters", *Review of Financial Studies* 35(8): 3617-65.

Ouedraogo, R., M. Mlachila, W. Sandrine Sourouema and A. Compaoré (2022), "The Impact of Conflict and Political Instability on Banking Crises in Developing Countries", *World Economy* 45(6): 1937-77.

Paravisini, D., V. Rappoport, P. Schnabl and D. Wolfenzon (2015), "Dissecting the Effect of Credit Supply on Trade: Evidence from Matched Credit-Export Data", *Review of Economic Studies* 82(1): 333-59.

Pestova, A. and M. Mamonov (2023), "The Price of War: Macroeconomic and Cross-Sectional Effects of Sanctions on Russia", CERGE-EI, mimeo.

Portes, R. (2021), "The European Systemic Risk Board In 'Crisis Mode'", *Financial Stability Review* 24: 39-48.

Rajan, R. and R. Ramcharan (2023), "Finance and Climate Resilience: Evidence from the Long 1950s Us Drought", NBER Working Paper 31356.

Rizzi, C. (2023), "Nature as a Defense from Disasters: Natural Capital and Municipal Bond Yields", University of Miami, mimeo.

Saka, O., B. Eichengreen and C.G. Aksoy (2022), "Epidemic Exposure, Financial Technology, and the Digital Divide", *Journal of Money, Credit and Banking* 54(7): 1913-40.

Sapienza, P. (2004), "The Effects of Government Ownership on Bank Lending", *Journal of Financial Economics* 72: 357-84.

van der Kolk, B. (2015), *The Body Keeps the Score: Mind, Brain, and Body in the Transformation of Trauma*, Penguin Books Ltd.

Verdickt, G. (2020), "The Effect of War Risk on Managerial and Investor Behavior: Evidence from the Brussels Stock Exchange in the Pre-1914 Era", *The Journal of Economic History* 80(3): 629-69.

Voors, M.J., E.E.M. Nillesen, P. Verwimp, E.H. Bulte, R. Lensink and D.P. Van Soest (2012), "Violent Conflict and Behavior: A Field Experiment in Burundi", *American Economic Review* 102(2): 941-64.

Wang, Y., Z. Yan, D. Wang et al. (2022), Prediction and analysis of COVID-19 daily new cases and cumulative cases: times series forecasting and machine learning models", *BMC Infectious Diseases* 22: 495.

CENTRE FOR ECONOMIC POLICY RESEARCH

How are banks affected by unexpected disasters? And how can they prepare as the occurrence of disasters becomes more routine and thus expected? This report reviews the literature and performs empirical analyses to distill key lessons for three types of disasters: armed conflicts, pandemics, and natural disasters.

Armed conflicts decrease output, raise inflation, reduce lending, and increase lending rates. They also drain bank capital and reduce bank concentration. In the post-war recovery stage, however, there is increased entry of foreign banks and demand for lending. Adaptiveness of monetary and fiscal policies as well as terms-of-trade shocks play an important role in shaping these effects.

Financial sanctions to punish conflicts affect the international operations of sanctioned banks, and also spill over from targeted banks to partner firms. Their effects can be cushioned by (i) governments shielding targeted banks and corporations; (ii) banks from neutral or politically aligned emerging countries partially substituting for domestic banks in the sanctioned country; and (iii) their staggered introduction giving banks time to adapt in advance.

The effects of infectious diseases on banks depend on the scope of the spread (local or global) and the government health policy response. They accelerate the use of mobile transactions and technology in banking and can increase inequality along several dimensions.

Finally, natural disasters negatively impact bank performance, though the effects are moderate and short-lived. Despite rising physical damage from natural disasters, banks manage climate risks well through securitisation and pricing the anticipated risk.

In the future banks may have to respond more actively than ever to such disasters given that political and demographic developments and climate change may put them in 'triple jeopardy'. Their responses will likely consist of a combination of balance sheet strengthening, technological developments, and personnel training.

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