INTERNATIONAL MONETARY FUND

The Sovereign-Bank Nexus in Emerging Markets in the Wake of the COVID-19 Pandemic

Prepared by Andrea Deghi, Salih Fendoglu, Tara Iyer, Hamid Reza Tabarraei, Yizhi Xu and Mustafa Y. Yenice

WP/22/223

2022
NOV

WORKING PAPER

 WP/22/223

IMF Working Paper
Monetary and Capital Markets Department

The Sovereign-Bank Nexus in Emerging Markets in the Wake of the COVID-19 Pandemic

Prepared by Andrea Deghi, Salih Fendoglu, Tara Iyer, Hamid Reza Tabarraei, Yizhi Xu, and Mustafa Yasin Yenice*

Authorized for distribution by Mahvash Qureshi
November 2022

ABSTRACT: The COVID-19 pandemic has brought the relationship between sovereigns and banks—the so-called sovereign-bank nexus—in emerging market economies to the fore as bank holdings of domestic sovereign debt have surged. This paper examines the empirical relevance of this nexus to assess how it could amplify macro-financial stability risks. The findings show that an increase in sovereign credit risk can adversely affect banks' balance sheets and credit supply, especially in countries with less-well-capitalized banking systems. Sovereign distress can also impact banks indirectly through the nonfinancial corporate sector by constraining their funding and reducing their capital expenditure. Notably, the effects on banks and corporates are strongly nonlinear in the size of the sovereign distress.

JEL Classification Numbers:	E44, F34, F65, G21
Keywords:	Sovereign-bank nexus, emerging markets; financial stability, sovereign risk, COVID-19, banking sector, corporate investment
Author's E-Mail Address:	ADeghi@imf.org; SFendoglu@imf.org; HTabarraei@imf.org; TIyer@imf.org; YXu@imf.org; MYenice@imf.org

* The authors are very grateful for comments by Viral Acharya, Tobias Adrian, Fabio Natalucci, Mahvash Qureshi, Jérôme Vandenbussche and seminar participants at the International Monetary Fund, the Association of Supervisors of Banks of the Americas (ASBA), Central Bank of Colombia, Yale Financial Stability Program, The Hong Kong Monetary Authority, The Monetary Authority of Singapore, and The Joint Vienna Institute. Oksana Khadarina and Dmitry Yakovlev provided outstanding research assistance.

WORKING PAPERS

The Sovereign-Bank Nexus in Emerging Markets in the Wake of the COVID-19 Pandemic

Prepared by Andrea Deghi, Salih Fendoglu, Tara Iyer, Hamid Reza Tabarraei, Yizhi Xu, and Mustafa Yasin Yenice

Contents

ANNEXES

I. Introduction

Public debt in emerging market economies has surged in the wake of the COVID-19 pandemic as economic activity has declined and governments have increased fiscal support to nonfinancial firms and households to cushion the impact of the crisis. Most of the additional government financing needs have been met by domestic banks—and their exposure to domestic sovereign debt has reached historic highs—which has reinforced the two-way relationship between the financial health of the sovereign and banking sectors. In this paper, we examine the empirical strength of this relationship and the channels through which the sovereign and banking sectors interact.

The interconnectedness of banks and sovereigns is often referred to as the sovereign-bank "nexus", whereby shocks originating in one of the two sectors may cause a negative "feedback loop" and amplify the effect of the shock. Earlier literature has identified three main channels through which shocks from one sector may transmit to the other: the exposure of banks to the sovereign debt through their government debt holdings (the "exposure" channel); the implicit and explicit guarantees of the sovereign to banks (the "safety net" channel); and the indirect connection between the two sectors through non-financial firms (the "macroeconomic" channel). In the face of an adverse sectoral shock, these channels tend to interact and amplify vulnerabilities, generating an adverse feedback loop (Farhi and Tirole 2018; Dell'Ariccia et al. 2018).

While the linkages between sovereign and banking sector risk have been well explored for advanced economies in previous studies (for example, Acharya et al. 2018; Gennaioli, Martin and Rossi, 2018), their findings may not be directly generalizable to emerging markets, which tend to have different structural characteristics—such as a lower level of financial sector development, a larger share of foreign-currency-denominated public debt and higher refinancing risks. These factors could render them more sensitive to external shocks and strengthen the interconnectedness between the sovereign and banking sectors.

Furthermore, the relationship between sovereigns and banks has also become more complex during the pandemic, as interdependencies with the real sector have deepened. Governments have generally supported firms through unprecedented policy measures. In turn, the corporate sector has become highly dependent on the continuation of policy support in cases where the economic recovery has yet to firmly take hold and corporate vulnerabilities are high, thereby increasing potential spillovers across corporates, banks and sovereign.

Against this background, this paper uses country-level, bank-level, and firm-level data to provide both an overall analysis of the cross-sectoral propagation of sovereign, bank and corporate default risk, and specific analyses of three main channels through which sovereigns and banks can affect each other's financial health. Our overall sample comprises 54 countries and covers the period 1990-2021.

The overall shock propagation analysis relies on estimating simultaneous equations at the country level. We exploit the heteroskedasticity in the data to identify structural shocks to the endogenous variables, following Rigobon (2003). This identification strategy exploits the fact that changes in the volatility of the structural shocks contain additional information on the relationship between endogenous variables.[1] We find that there are significant feedback effects within the nexus in emerging markets and that the strength of the links varies

[1] For example, in a period of large bank risk shocks, we learn more about the response of sovereign risk to bank risk as the covariance between both risks increases. During these periods, bank risk shocks are more likely to occur and can be used as a "probabilistic instrument" to trace the response of sovereign risk.

between different sectors. Notably, spillovers from sovereign default risk to banks are, on average, larger than those in the opposite direction from banks to sovereign default risk.

To analyze the exposure channel, we identify the effect of sovereign distress on banks' performance by exploiting fiscal shocks and cross-sectional variation in banks' holdings of government debt. Fiscal shocks are defined as periods in which the credit default swap spread is above a certain threshold, or a sovereign is in outright default. We find that, in the event of sovereign distress, banks with a 10-percentage-point higher ratio of government debt holdings to total bank assets face an expected default frequency (EDF), that is, 0.4 percentage points higher than the average bank. The difference is economically significant considering that it corresponds to about one-third of median banks' EDF. Notably, we also find this effect is almost twice as large for banks with relatively less capital and increases with the level of sovereign distress, thereby curtailing banks' capital and lending significantly in severe sovereign distress episodes. These results are robust to a range of sensitivity checks, including alternative identification strategies to construct fiscal shocks.

To examine the relevance of the safety net channel, we focus on the impact of implicit government guarantees (proxied by the Fitch government support rating) on bank equity returns. We find that such guarantees mitigate banking sector tail risks in the first few months following a fiscal shock by improving banks' market returns. However, this effect turns negative after six months, suggesting that the perception of a weaker ability to support banks following sovereign distress could undermine investor confidence. Notably, banks with higher implicit guarantees and lower capital expand their loan portfolios relatively more aggressively after sovereign distress, leading to a cumulative credit growth of about 8 percentage points higher than other banks and to a larger increase in nonperforming loans. These results suggest that higher government guarantees could increase banks' risk-taking behavior after sovereign distress.

Finally, in our analysis of the macroeconomic channel, we show that sovereign distress may also pose risks to non-financial firms, with adverse effects on bank asset quality. Following Almeida et al. (2016), to identify the impact of sovereign downgrades on firm behavior, we exploit the variation across firms as a consequence of the sovereign ceiling policies that rating agencies typically apply. These policies require that firms' ratings remain at or below the sovereign rating of their country of domicile (i.e., the sovereign ceiling). The findings show that the sovereign ceiling leads to an asymmetric change in corporate ratings and firm investment following a sovereign downgrade. For instance, firm capital expenditure (as a percent of fixed assets) decreases on average by about 10 percent two years after a sovereign downgrade, and the effect is more pronounced for firms subject to sovereign ceiling policies. In addition, we find that banks' loan portfolio quality worsens more in countries where such firms are more prevalent. Overall, these findings have important policy implications, including for the treatment of sovereign debt holdings in banking regulation and supervision.

The remainder of the paper is organized as follows. Section II presents the conceptual framework underlying our empirical analysis. Section III presents some stylized facts on the strength of the nexus in emerging markets before and after the COVID-19 pandemic crisis. Section IV gauges the causal relationship across sovereign, bank and corporate default risks. Section V provides empirical evidence on the key transmission channels. Section VI concludes.

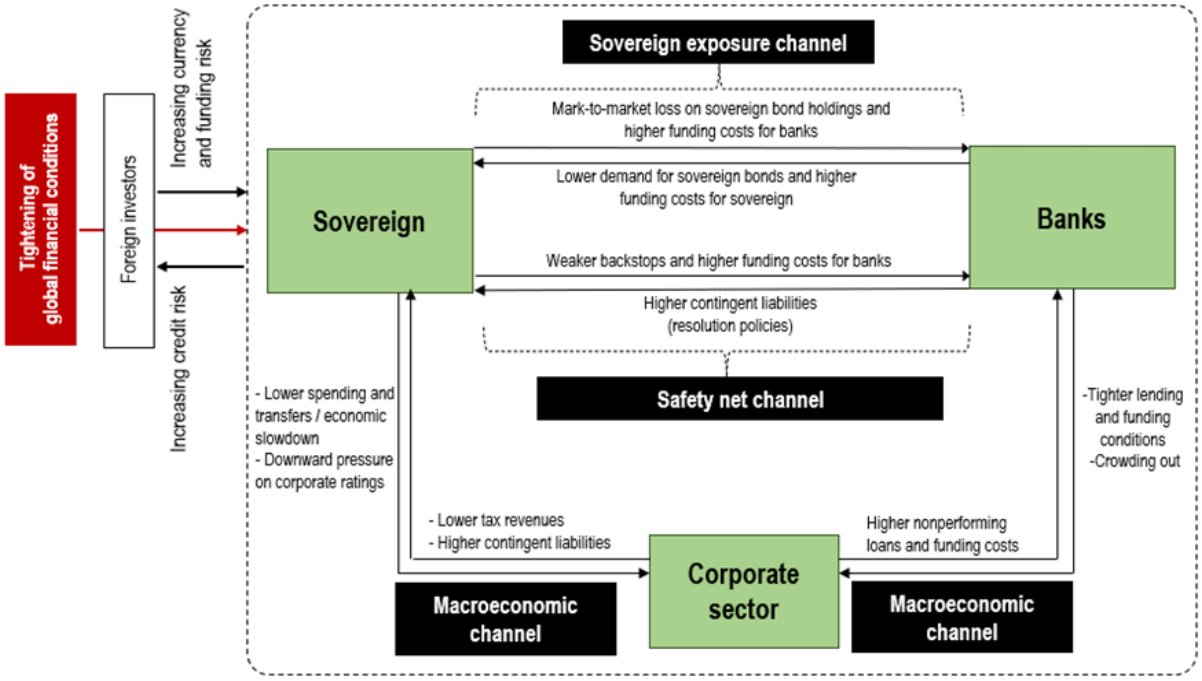
II. Conceptual Framework

The sovereign and banking sectors are connected through three key channels that facilitate the transmission of shocks from one sector to the other: the exposure channel, the safety net channel, and the macroeconomic

channel. These channels tend to interact with each other and can magnify vulnerabilities in each sector, generating adverse feedback loops (Figure 1).[2]

The *exposure channel* stems from the direct exposure of banks to sovereign risk through their holdings of government debt. A rise in sovereign spreads could reduce the market value of government debt that banks hold and use as collateral to secure financing. As a result, higher bank exposure to sovereign debt has been shown to be a strong predictor of a future credit crunch as sovereign distress or default can tighten banks' capital constraint and impair their loan supply (Acharya et al., 2018; Bouis, 2019; Popov and Van Horen, 2015; Feyen and Zuccardi, 2019; Gennaioli, Martin, and Rossi, 2018). Banks can also reduce private credit in the attempt to increase sovereign bond holdings to pledge as collateral for additional funding (Acharya and Steffen, 2015); because of government moral suasion or financial repression (Ongena, Popov, Van Horen, 2019; Becker and Ivashina, 2018; Altavilla, Pagano, and Simonelli, 2016); or by gambling for resurrection when experiencing financial distress (Horváth, Huizinga, and Ioannidou, 2015).

Figure 1 Key Channels of the Sovereign-Bank Adverse Feedback Loop



Note: A sudden tightening of global financial conditions is one type of shock that may trigger an adverse sovereign-bank feedback loop. Other possible shocks include a terms-of-trade shock that may affect the sovereign, banking, and corporate sectors; a domestic banking crisis triggered by a deposit run that could disrupt credit supply to the corporate and household sectors, reducing economic activity and leading to fiscal sustainability pressures; and a shock to economic activity, for example, because of a health crisis or natural disaster, which could strain sovereign and banking sector balance sheets.

[2] See Dell'Ariccia et al. (2018) for a more detailed description of the three channels.

The second channel relates to the *safety net*, or government support provided to banks in the form of implicit and explicit guarantees.[3] Sovereign distress could reduce the ability of governments to provide these benefits, threatening the stability of banks. A weaker banking sector may in turn increase the need to activate the guarantees, straining fiscal accounts and further aggravating pressures on the sovereign. Several studies investigate spreads on bank credit default swap contracts (Demirgüç-Kunt and Huizinga 2013), spreads on bank bonds (Balasubramnian and Cyree 2011), deposit costs (Baker and McArthur 2009), and bank stock returns (Correa et al. 2012; Gandhi and Lustig, 2015) providing evidence in support of the benefits that large banks' shareholder can enjoy. At the same time, however, large or complex banks might have a greater appetite for risk if they expect future rescues to impact their asset quality (Afonso, Santos, and Traina, 2014).

The third channel refers to the indirect link between sovereigns and banks through the broader macroeconomy (the *macroeconomic channel*). A weakening of the sovereign balance sheet could hurt the corporate sector by raising borrowing costs or through fiscal consolidation (for example, by raising taxes or reducing expenditure) and policy uncertainty (Sufi,2009, Tang, 2009, Chernenko and Sunderam, 2012, and Harford and Uysal (2014). Almeida et al. (2017) show that nonfinancial corporates reduce their investment and reliance on credit markets due to a rising cost of debt capital following a sovereign rating downgrade. A weaker corporate sector could, in turn, hurt banks' balance sheets following a deterioration in the loan portfolio quality and higher credit provisioning.

These three channels could also work in reverse—that is, the stress in the banking sector could lead to sovereign stress—for example, by disrupting the government bond market, activating fiscal backstops, or dampening economic activity (Becker and Ivashina, 2014). Moreover, these three channels tend to feed into one another as financial conditions tighten, thus transmitting and amplifying shocks from one sector to the other, weakening balance sheets and creating a mutually reinforcing vicious "doom loop."

Although extensive literature has examined the implications of shocks through some of these channels, the sovereign-bank nexus in emerging markets has not received much attention in the financial stability literature. Some exceptions are Gennaioli, Martin, and Rossi (2018) and Feyen and Zuccardi Huertas (2019). These studies document the existence of a sovereign-bank nexus in emerging markets but use pre–COVID-19 pandemic data to only partially quantify the potential shock propagation mechanisms following sovereign distress, primarily through the exposure channel.[4]

Our analysis complements the findings on the existing empirical literature on the sovereign-bank nexus by (i) estimating causal effects across sovereign, bank and corporate sector default risks in emerging markets; (ii) documenting strong non-linear effects of sovereign distress on banks' balance sheet through the exposure channel (iii) isolating empirically the effect of government guarantees on bank market performance and risk-

[3] Such guarantees are provided to support banks and reduce the likelihood of a financial disruption if the banking sector comes under severe financial stress. As discussed later in the paper, this channel is likely to be stronger for domestic state-owned banks—which are also more likely to be financing the fiscal deficit, relaxing the government's borrowing constraint and potentially leading to greater public debt accumulation. Because these banks also tend to be subject to limited market discipline and weak governance and supervision, they could pose additional financial stability risks (Feyen and Zuccardi Huertas 2019).

[4] IMF (2022) discusses the deepening of the sovereign-bank nexus in recent years in the context of South Africa. Laeven and Valencia (2018) further explores the pattern between twin crisis across regions: First, the number of crisis episodes in which a banking crisis is followed by a sovereign crisis in a 3-year window period is 9 (4.8% of total cases), particularly concentrated in Latin America and the Caribbean, with 5 cases between 1970 and 2017. Second, the number sovereign crises followed by banking crises in a 3-year window period is 2 (1.08% of total cases), concentrated in Sub-Saharan Africa. Third, the number of sovereign and banking crises starting simultaneously is 10 (5.4% of total cases), especially in Latin America and the Caribbean, Sub-Saharan Africa, and Europe and Central Asia. Therefore, in 11.3% of total crisis episodes, sovereign and banking crises occurred (almost) together.

taking. In addition, we extend previous studies on the real effects of sovereign-driven corporate downgrades by shedding light on their potential spillover effects on banks' asset quality. All of these represent important contributions to the empirical literature on the sovereign-bank nexus, which improve the understanding of the channels of risk transmission for emerging market economies.[5]

III. Developments in the Sovereign-Bank Nexus in Emerging Markets: Some Stylized Facts

The average public-debt-to-GDP ratio in emerging markets surged to a record 67 percent in 2021 from about 52 percent before the pandemic, as economic activity declined and governments greatly increased fiscal support to nonfinancial firms and households to cushion the impact of the crisis (Figure 2, panel 1). Although public debt levels have also risen in advanced economies, the domestic sovereign debt exposure of banks has increased relatively more in emerging markets (Figure 2, panel 2)—reaching 17 percent of total banking sector assets in 2021—as the additional government financing needs have been met mostly by domestic banks amid declining foreign participation in local currency bond markets (Figure 2, panel 3).

The overreliance of governments on domestic banks for their financing needs amid a higher exposure of banks to sovereign debt increases, in turn, the likelihood of shock transmission between the two sectors. This is reflected, for instance, in the positive correlation between sovereign and bank expected default frequency, a proxy of default risk (Figure 2, panel 4). The relationship is not only persistent across time, but it is also much tighter when global financial conditions are under strain, such as after the onset of the pandemic in March 2020.[6]

Banks in emerging markets are generally better capitalized than in the past because of reforms enacted following the global financial crisis and the policy support provided during the pandemic. Average capital adequacy ratio in 2021 was thus 18 percent in 2021 up 3 percent from the average in 2008 (April 2022 GFSR). However, sovereign debt exposure constitutes a significant share of regulatory capital in some countries.

Furthermore, a sizable share of banks' sovereign debt holdings follows mark-to-market accounting in several emerging markets, which could undermine banks' capital adequacy if the market value of these assets were to decline.[7] Sovereign stress could thus potentially quickly transmit to the banking sector in these economies. In this regard, it is worth noting that countries whose banks are more exposed to sovereign debt are also those with a higher public debt-to-GDP ratio and lower bank capital ratios (Figure 2, panels 5 and 6).

[5] Details on the sample, identification strategies and additional empirical analysis are in the Annexes I-III.

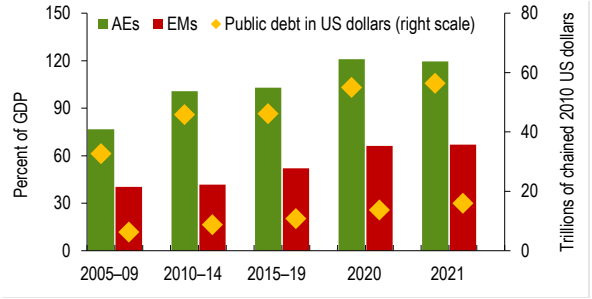
[6] The time-varying correlation coefficient between sovereign and bank default risk is computed with a 24-month rolling window. The relationship jumped during the global financial crisis and at the onset of the COVID-19 pandemic in March 2020 to about 0.6. Notably, the strength of this relationship varies with the level of distress in the banking sector: at low levels of bank distress. In unreported results, we find that a 1 percentage point increase in sovereign default risk is associated with a 0.4 percentage point increase in banks' expected default frequency. However, the association is 10 times stronger at higher levels of distress.

[7] In some major emerging markets, banks hold floating-rate bonds, inflation-indexed bonds, and "non-defaultable" bills issued by central banks, which may be less sensitive to interest rates and sovereign risk and could provide some insulation from a rise in sovereign risk.

Figure 2. Developments in Emerging Market Public Debt and Banks' Sovereign Exposures

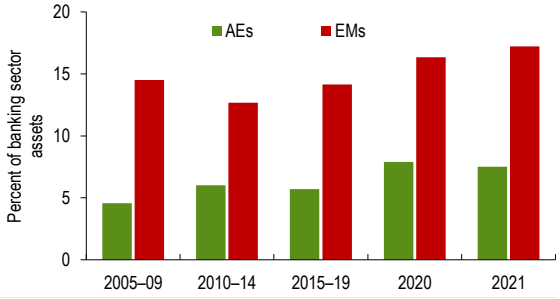
1. Public Debt, 2005–21

(Percent of GDP)



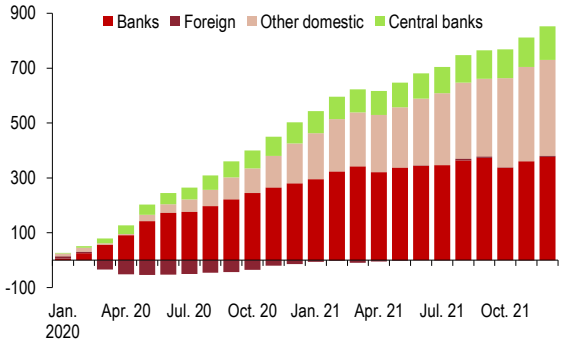
2. Banks' Domestic Sovereign Debt Exposure, 2005–21

(Percent)

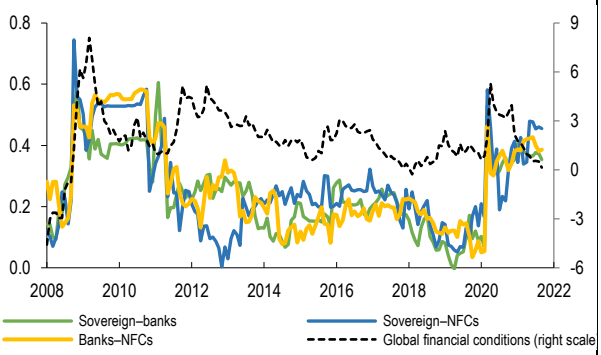


3. Change in Local Currency Sovereign Bond Holdings

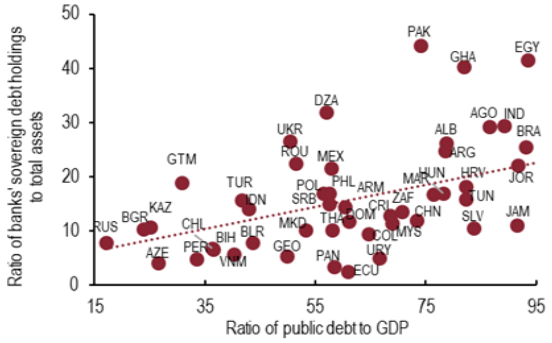
(Billions of US dollars, cumulative change since end-2019)



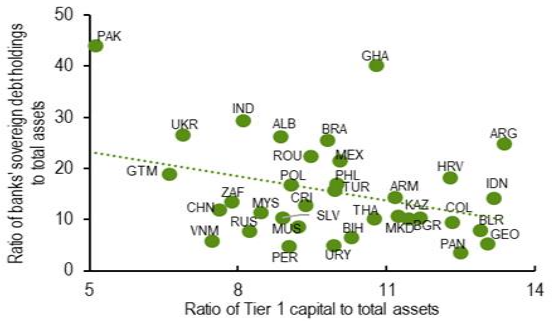
4. Median Correlation among Sovereign, Banks and Nonfinancial Corporate Sector Stress, and Global Financial Conditions, 2008:M1–2021:M9 (Index)



5. Public Debt and Banks' Holdings of Sovereign Debt, 2021 *(Percent)*



6. Tier 1 Capital-to-Total-Assets Ratio and Banks' Holdings of Sovereign Debt, 2021 *(Percent)*



Sources: Fitch Connect; IMF, Financial Soundness Indicators, Monetary and Financial Statistics, World Economic Outlook, and Fiscal Monitor databases; and authors' calculations.

Note: In panels 1 and 2, indicators are country averages weighted by purchasing-power-parity GDP. Public debt is in real terms; that is, in trillions of chained 2010 US dollars. In panel 2, banks' sovereign exposure corresponds to claims on central government debt divided by total banking sector assets. Emerging markets are identified according to the IMF's Vulnerability Exercise for Emerging Market Economies classification. Advanced economies comprise economies classified as advanced in the IMF World Economic Outlook database. Panel 4 shows the median time-varying correlation between changes in sovereign, bank, and nonfinancial corporation' EDFs across countries using a 24-month rolling window. The median correlation is a number between −1 and 1. The global financial conditions indicator refers to the common component of monthly equity price returns estimated across advanced economies and emerging markets using a factor-augmented vector autoregressive model. In panel 5, red dots reflect public-debt-to-GDP ratios in 2021 vis-à-vis banks' central government debt holdings in 2021 (third quarter). In panel 6, total assets are used in the denominator of the Tier 1 capital ratio (instead of risk-weighted assets) to provide greater comparability across countries. Given limited country-level data availability, banks' sovereign debt exposures for India and Argentina are computed using bank-level Fitch Connect data. Data labels use International Organization for Standardization (ISO) country codes. AEs = advanced economies; EMs = emerging markets; NFCs = nonfinancial corporations.

It is worth noting that banking sector health also depends on the viability of banks' corporate borrowers, which have faced strains during the pandemic. In most emerging markets, the sustainability of corporate debt—as measured by earning capacity relative to debt—has declined as corporate revenues have fallen. While it is still difficult to fully ascertain the soundness of bank balance sheets at the current juncture because of regulatory flexibility and other financial sector support measures in place, nonperforming loans are more than one-tenth of total loans in some countries and could edge up as policy support measures are unwound to curb inflationary pressures and financial conditions tighten (April 2022 GFSR).

IV. Evaluating the Strength of the Nexus

To quantify the overall strength of the nexus in emerging markets, two-way relationships between the sovereign, banking, and nonfinancial corporate (NFC) sectors default risks are examined for individual countries, while controlling for relevant domestic and external factors that may impact these relationships. A structural vector autoregression model (SVAR) is estimated at the country-level using daily data.[8] The SVAR model takes the following form:

$$Ay_t = \tilde{a} + \tilde{A}_1 y_{t-1} + \cdots + \tilde{A}_p y_{t-p} + \tilde{\Gamma}_0 x_t + \cdots + \tilde{\Gamma}_q x_{t-q} + \epsilon_t \quad (1)$$

where t indicates time, y_t is a vector of endogenous variables capturing sovereign default risk, bank default risk, non-financial corporate default risk, term spread and equity indices. Default risk is proxied by expected default frequency (EDF). $\tilde{A}_j$ with $j = 1, \ldots, p$ and $\tilde{\Gamma}_j$ with $i = 1, \ldots, q$, are coefficient matrices. The matrix A contains the contemporaneous effects of structural shocks on the endogenous variables and allows to track the strength of linkages from one sector to another. x_t is the vector of exogenous variables, including a measure of global financial conditions (or U.S. monetary policy shocks) and the daily return on a trade-weighted dollar index.[9] To account for non-stationarity of the EDF data, the model is estimated in first differences for the three EDF variables. For equity indices, log differences are used. The term ϵ_t is a vector of structural shocks with diagonal variance matrix $\sum_\epsilon = E(\epsilon_t \epsilon'_t)$.

To identify structural shocks to the endogenous variables, the analysis exploits the heteroskedasticity in the data following Rigobon (2003).[10] This identification strategy relies on the fact that changes in the volatility of structural shocks contain additional information on the relationship between the endogenous variables. Thus, large shocks to bank risk, for example, are considered to contain more information about the response of sovereign risk to bank risk as the covariance between the two types of risks increases. Thus, bank risk shocks can be used as a "probabilistic instrument" to trace out the response of sovereign risk.

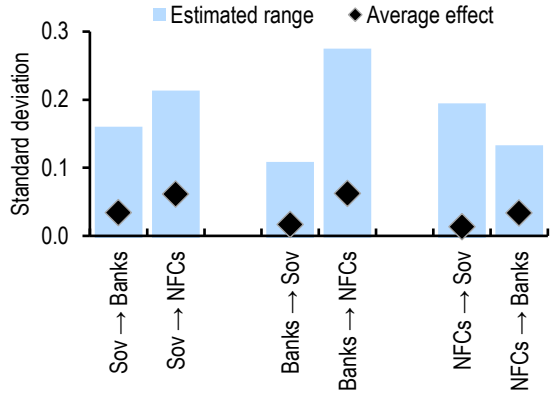
[8] See Annex I for more details and description for this and following sections.

[9] The trade-weighted US dollar index, also known as the broad index, is a weighted average of the foreign exchange value of the US dollar against the currencies of a broad group of major U.S. trading partners.

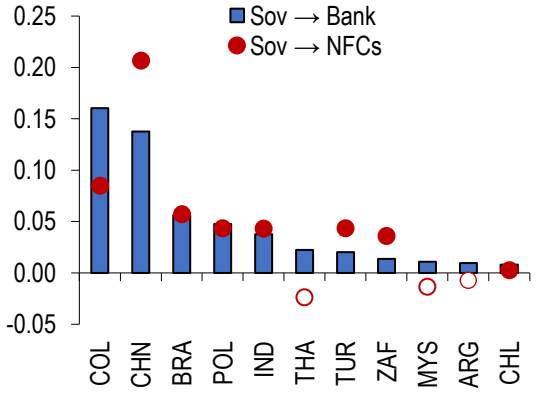
[10] Identification through heteroskedasticity yields consistent estimates even if the regimes are misspecified (see Rigobon, 2003). Alternatively, a structural form-GARCH can be used. One challenge related to the identification strategy is the interpretation of the structural shocks that are not based on priori assumptions. Although more restrictive, alternative standard identification strategies could be used for robustness. For instance, zero restrictions could be imposed on *A*, arguing for delayed responses of some endogenous variables to the others. Sign restrictions on *A* could also be used allowing for contemporaneous effects among all variables.

Figure 3. Transmission of Risks through the Sovereign-Bank Nexus: Strength of the Main Channels across Emerging Markets

1. Effect of a One Standard Deviation Shock on Other Sectors' Default Risk (Standard deviation)



2. Strength of the Feedback Effects between Sovereign and Banks (Standard deviation)



Sources: Haver Analytics; Moody's; Refinitiv Datastream; and IMF staff calculations.
Note: The figure shows the estimated range of coefficients for 11 individual emerging markets obtained from a structural model using daily data of default risk for sovereign, banking, and corporate sectors. NFCs = nonfinancial corporations; Sov = sovereign.

Three key findings emerge from this analysis, which are presented in Figure 3. First, the nexus is strong, with significant spillover effects between sectors (Figure 3, panel 1). The estimated spillover effects are statistically and economically significant in most of the countries of the sample. A standard deviation increase in sovereign risk increases bank EDF directly by 5 percent of its standard deviation on average, while the same shock increases NFCs risk by 6 percent standard deviation.[11]

Second, the strength of the transmission of risk between sectors varies. For example, spillovers from sovereign default risk to banks are, on average, larger than those in the opposite direction from banks to sovereign default risk. Overall, the largest spillovers are from sovereign and bank to firms default risk.

Third, the relevance of the nexus differs across countries (Figure 3, panel 2). Across the eleven countries in the sample, the strongest shock transmission from sovereign to banks is found in Colombia and China, which could reflect a greater presence of state-owned banks, or a larger share of marked-to-market sovereign exposures on banks' balance sheets.[12] For instance, a one standard deviation shock to the sovereign EDF increases banks' EDF by about 0.15 standard deviation. Together, the estimates suggest a significantly positive two-way causality between sovereign and bank risk that could generate a feedback loop.

The heterogeneity in the size of the transmission of shocks suggests that some country-specific factors, such as the fiscal position and financial vulnerabilities, may be at play in amplifying the impact of an adverse shock.

[11] Our results are similar to the findings of Acharya, Drechsler, and Schnabl (2014) based on data released as part of the 2010 Eurozone bank stress tests. These authors' estimates imply that a 1 standard deviation increase in sovereign CDS spread translates into about 5 percent increase in bank CDS spreads' standard deviation. Our specification using high frequency data for the period from 2007 to 2020 finds that the transmission of shocks from sovereign to banks have a similar average effect but can reach on average about 15 percent of banks default risk standard deviation for economies with the strongest spillover effects.

[12] Data compiled from banks' accounting statements and Basel Pillar III disclosures for Colombia, indicate a larger share of mark-to-market sovereign bonds reaching almost 80 percent of the total sovereign exposures in 2020.

Further empirical analysis supports this observation. For example, after a sharp tightening in global financial conditions, emerging markets with a higher level of public debt and banks' holdings of sovereign debt experience an increase in sovereign and bank default risks that is twice as large as the average increase (see Annex II for more details on the analysis).[13] The impact of the shock is persistent and remains larger than the average effect for up to six quarters after the shock.

These findings confirm that the interlinkages underlying the sovereign-bank nexus are relevant in emerging markets. The next section further explores these linkages and examines some of the key channels and vulnerabilities that facilitate the transmission and amplification of shocks across sectors.

V. An Empirical Evaluation of the Transmission Mechanisms

To investigate the importance of the various transmission channels underlying the nexus in emerging markets, this section focuses on the direct shock transmission from the sovereign sector to the banking and corporate sectors.

A. Sovereign Exposure Channel

First, we examine how strongly sovereign distress may affect directly banks' balance sheet through mark-to-market losses to their sovereign debt exposures. The following empirical model is estimated:

$$\begin{aligned} Y_{i,c,t} = {} & \beta_1 Sovereign\ exposure_{i,c,t-1} \times Sovereign\ Distress_{c,t} \\ & + \beta_2 Sovereign\ exposure_{i,c,t-1} \times Sovereign\ Distress_{c,t} \times Capital\ Ratio_{i,c,t-1} \\ & + \beta_3 Sovereign\ exposure_{i,c,t-1} + \beta_4 Sovereign\ exposure_{i,c,t-1} \times Capital\ Ratio_{i,c,t-1} \\ & + \beta_5 Sovereign\ Distress_{c,t} \times Capital\ Ratio_{i,c,t-1} + \beta_6 Capital\ Ratio_{i,c,t-1} \\ & + X_{i,c,t-1} + \gamma_{c,t} + \gamma_i + \varepsilon_{i,c,t} \end{aligned} \quad (2)$$

where $Y_{i,c,t}$ denotes (i) change in bank expected default frequency; (ii) change in pre-tax profits divided by lagged total equity; (iii) change in total gross loans-to-total assets ratio; (iv) log change in total government debt holdings, or (v) log change in equity; of bank *i* in country *c* from the end of the year *t-1* to the end of year *t*. Variables are sourced from banks' annual consolidated financial statements (see Annex I for details on the data sample). [14]

[13] For this exercise, a local projection panel regression model is estimated to exploit the cross-country variation in vulnerabilities using the same sample of countries and model specification as in Figure 3. High levels of public debt and bank sovereign exposure are defined as one standard deviation above the sample average (equivalent to about 80 percent and 20 percent, respectively, while the mean value is about 50 percent and 9 percent, respectively). See Annex II for further details.

[14] This follows the approach of the existent literature (e.g., Acharya and Steffen (2015); Bofondi et al. (2018); Acharya et al. 2018; Gennaioli et al., 2018; Ongena et al., 2019). It is also worth noting that banks' exposure to sovereign stress could arise from various other channels –including through loans to or receivables from the government, government guarantees, or more broadly, indirect macroeconomic effects driven by exchange rate movements or changes in aggregate demand conditions (Acharya et al. 2018; Dell'Ariccia et al., 2018; Gennaioli et al., 2018; Feyen and Zuccardi (2019); and references therein). We attempt to control for these factors to the extent possible in the model.

$Sovereign\ exposure_{i,c,t-1}$ is total government bond holdings divided by total assets at the end of year *t-1*. $Sovereign\ Distress_{c,t}$ is an indicator variable taking a value 1 if sovereign is in distress in year *t.* Specifically, it takes a value 1 if the sovereign CDS spread exceeds a given threshold at least once on a monthly average basis during year *t*, or is in outright default or S&P rating of long-term foreign-currency debt of CCC- or lower; and 0 otherwise. To explore non-linearities in relationship, we consider thresholds for the sovereign CDS spread ranging from 300 to 1000 basis points, following Pescatori and Sy (2007). [15]

$Capital\ Ratio_{i,c,t-1}$ is defined as total equity-to-total assets ratio at end-year *t-1*. $X_{i,c,t-1}$ denote the set of bank controls at end-year *t-1*, and include size (log of total assets), capital ratio, liquidity (non-cash assets-to-total assets ratio), profitability (return on assets), total exposure to central bank divided by total assets, interbank balances (interest-earning balances with central and other banks divided by total assets), and loans outstanding divided by total assets. The set of controls follows Gennaioli et al*.* (2018) and is lagged by one year to mitigate potential endogeneity concerns. We focus on a horizon of up to one year (tracing the impact at the end-of-the-year *t* following a sovereign stress event in year *t)*, given that sovereign stress can quickly transmit to banks in a relatively short period of time.[16]

Identification is achieved through cross-sectional variation in outcome variables across banks with different levels of government debt holdings within a country in a given year. The model includes country-time fixed effects ($\gamma_{c,t}$), which absorb any time-varying country characteristics (including aggregate demand-side effects). We assume that country-time fixed effects, together with an extensive set of bank-level controls are sufficient to control for differences across banks that would potentially explain bank-level outcomes following a sovereign distress beyond the exposure to sovereign debt. The model also includes bank fixed effects (γ_b) to control for any time-invariant bank characteristics. The model is estimated via ordinary least squares, and standard errors are clustered at the bank level.[17]

The key hypotheses we want to test are that banks with higher holdings of sovereign debt experience worse outcomes following a sovereign stress event, and that banks with lower capital ratios face amplified effects. The effect of higher government exposures is estimated at the mean capital ratio (that is, we compute "$\beta_1 + \beta_2$ * capital ratio" at the mean capital ratio when the sovereign is under distress) using estimates from equation (2) and is then compared to that for banks with a one-standard-deviation lower capital ratio than the mean. The results are presented in Figure 4 (panels 1-4).

These two hypotheses are supported by our data. A sovereign distress event—defined as an explicit default or a period with sovereign credit default swap spreads higher than 500 basis points—is followed within the same year by a significantly greater increase in default risk for banks with a greater sovereign exposure. For instance, in the event of sovereign distress, banks with 10 percentage point higher ratio of government debt holdings to total bank assets (relative to average bank holdings of government debt) face an EDF that is, on average, 0.4 percentage point higher (Figure 4, panel 1). Notably, this differential effect is about twice as large

[15] See Table A.I.2 for the years in which sovereigns are in distress for our sample of countries based on the above stress definition.

[16] The results are by and large robust to studying distress in year t-1.

[17] The median credit default swap spread in the sample is about 250 basis points. Banks' indirect exposure to changes in sovereign stress (such as through economic growth, inflation, or exchange rate) is considered in the analysis by including country-year fixed effects. Furthermore, to address potential reverse causality concerns that sovereign distress in itself may be driven by banking sector stress, the analysis focuses on the effect of a sovereign distress on bank outcome variables at the end of the year when the sovereign distress occurred. Alternative definitions of sovereign distress—such as high government refinancing needs during tight global financial market conditions, or large changes in foreign-currency-denominated public debt due to currency depreciation—are also considered for robustness.

for banks with relatively less capital and is accompanied by a decline in their equity-to-assets ratio, presumably because more exposed banks face higher funding costs that affect their profits and equity. These effects appear meaningfully large, as the average EDF in the sample is 1.2 percent.

Higher bank EDF could, in principle, transmit into higher borrowing spreads for the bank. Together with mark-to-market losses due to government debt holdings, banks with higher holdings would then likely experience lower net interest income too following sovereign distress. We find that banks with an ex-ante 10-percentage-points-higher government-debt-holdings-to-total-assets ratio experience a 5.5 percentage points decline in profits-to-lagged-equity ratio following a severe sovereign distress (defined as a sovereign CDS spread above 1000 bps; Figure 4, panel 2), with stronger effects for less capitalized banks (8.5 percentage points, or close to ½ standard deviation of the change in profit-to-equity ratio).

Intuitively, lower profits could transmit into losses in equity. This is a key step to verify the transmission channel as the loss in equity would then likely translate into lower risk-taking capacity and lending. Results in Table 1 confirm this intuition. Following sovereign distress, the decrease in profits is accompanied by a decline in bank equity, as more exposed banks face higher mark-to-market losses and elevated funding costs, eventually driving down overall profits and equity. Quantitively, banks with a 10-percentage-points higher government-debt-holdings-to-assets ratio experience a nearly 6 percent stronger decline in equity than banks with average exposure following severe sovereign stress, i.e., CDS spread above 1000 bps.[18]

Finally, the results also show that banks with a higher sovereign debt exposure also cut back on lending more than their peers following sovereign distress (Figure 4, panel 3). The reduction in lending is consistent with losses from sovereign debt exposures tightening banks' capital constraints and thus impairing their loan supply, but it could also result from crowding-out effects, which occur when banks lend more to the government at the expense of firms and households. Empirical evidence supports this latter assertion: banks with an average capital ratio that are more exposed further increase their holdings of government debt when the sovereign is in distress (Figure 4, panel 4).[19]

Intuitively, banks could be forced to hold more sovereign debt since sovereign refinancing needs are typically higher during sovereign distress. However, banks may also increase their sovereign debt holdings because of risk shifting, which can occur during times of sovereign distress when banks increase their sovereign debt exposure to take advantage of higher sovereign yields. Annex III explores more in detail the presence of moral suasion and risk shifting in emerging markets. Overall, the analysis finds that domestic state-owned banks, generally dominant in emerging markets and potentially more likely to be induced to hold government debt, purchase significantly more sovereign debt in times of high fiscal need or when the sovereign is in distress. However, there is no such evidence of government pressure on private banks. Moreover, less-capitalized state-owned banks are more likely to purchase sovereign debt during periods of sovereign distress.

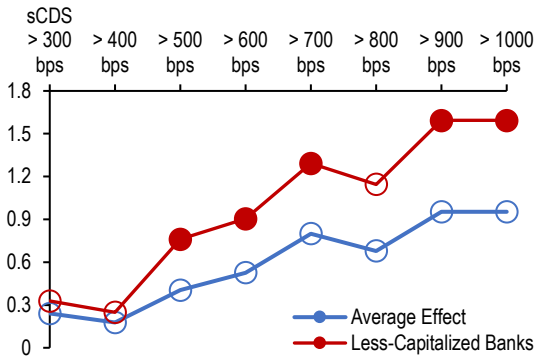
[18] The results are stronger if a stricter definition of sovereign distress is used. For example, using annual average of sovereign CDS spread to define distress years, rather than assuming sovereign distress if the CDS spread breaches the threshold in at least one month during the year, implies stronger effects (6-10 percent decline in equity). This, however, reduces the set of distressed countries/years substantially.

[19] The results are robust to defining the dependent variables as percentage changes in bank equity and lending, and the results are similar to those reported in the literature on the euro area sovereign debt crisis (Acharya et al. 2018; Bofondi, Carpinelli, and Sette 2018).

Figure 4. Transmission of Sovereign Risk through the Exposure Channel

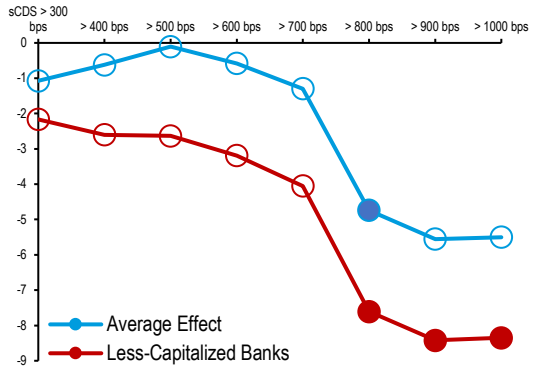
1. Change in EDF

(Percentage points)



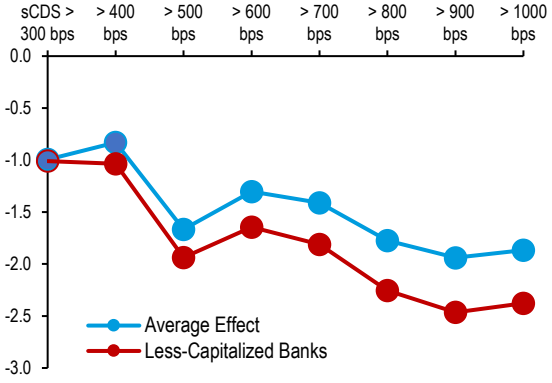
2. Change in Profits-to-Lagged-Equity Ratio

(Percentage points)



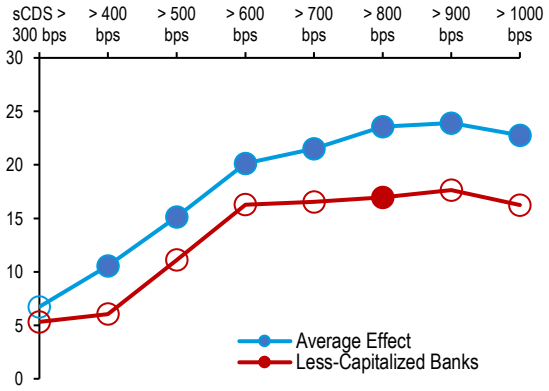
3. Change in Loans-to-Total-Assets Ratio

(Percentage points)



4. Change in Government Debt Holding

(Percent)



Sources: Bloomberg Finance L.P.; Fitch Connect; IHS Markit; IMF, World Economic Outlook database; Standard & Poor's Capital IQ; and authors' calculations.

Note: Panels 1–4 report results from bank-level panel regressions. The dependent variable is the change in banks' expected default frequency (panel 1); change in profits to lagged equity (panel 2); change in total loans to total assets (panel 3); and log change in total government debt holdings (panel 4). Balance sheet variables and expected default frequency are based on year-end data. The focus variable is the ratio of banks' holdings of government debt securities to total assets (sovereign exposure) interacted with sovereign distress (or an alternative measure of sovereign stress in panel 4) and the bank capital ratio (total-equities-to-total-assets ratio).The average effect refers to the impact of 10 percentage point higher bank sovereign exposure on the dependent variable for banks with an average capital ratio (which is close to a one standard deviation in the sample). The impact of "less-capitalized" banks corresponds to a bank capital ratio one standard deviation below the mean. Sovereign distress indicates periods when the monthly average of sovereign credit default swap spreads is higher than 500 basis points within a given year, or Standard & Poor's long-term rating for sovereign foreign exchange debt is CCC– or lower, or the government is in external or domestic default according to Harvard Business School Global Crises Data by Country. Solid markers indicate statistical significance at 10 percent or lower.

Addressing endogeneity concerns. To further mitigate potential endogeneity concerns in equation (2), we use alternative proxies of sovereign distress that are exogenous to domestic banking stress. The first is an increase in fiscal debt due to an exchange rate depreciation, following the approach described in Panizza and Presbitero (2013). We define $FX\ Public\ Debt^{f}_{i,t-1}$ as the stock of debt issued by country *i* in foreign currency *f* in year *t-1*, and $\Delta\ ER^{f}_{i,t}$ as the log change in the nominal exchange rate (of local currency of country *i* against the

foreign currency *f*, expressed in annual averages). The valuation effect on the public debt, relative to the total, is then given by:

$$VE_{i,t} = \frac{\sum_f \left(FX\ Public\ Debt^f_{i,t-1} \ \cdot \Delta\ ER^f_{i,t} \right)}{Public\ Debt_{i,t-1}} \quad (3)$$

As a full breakdown of currency denomination of foreign debt is generally not available, we assume that all foreign-currency debt is denominated in US dollars.[20] We replace sovereign distress in equation (2) with $VE_{i,t-1}$ (one-year lag to further mitigate endogeneity concerns). Given that banks may differ in their exposure to changes in the exchange rate, (lagged) net open foreign currency position is also used as an additional control in the regressions (in levels and interaction with the variable capturing the increase in public debt due to currency depreciation).

Second, we consider the volume of maturing debt as an exogenous measure of sovereign stress (à la Almeida et al., 2009; Ongena et al., 2019) given that this is determined sufficiently in advance and is likely to be independent of stress in the banking sector. Specifically, we construct for each country an indicator variable equal to 1 in years when the expected maturing debt-to-total fiscal debt ratio is historically high (upper tercile of the distribution of maturing debt-to-fiscal debt for each country over time); and 0 otherwise. We multiply this measure with the change in the (log of) VIX, given that a deterioration in global risk appetite (largely exogenous to individual emerging markets) would reduce international investors' demand for EM sovereign debt and increase debt rollover risks.

The results for these exercises are presented in Tables 2 and 3. Following currency depreciation leading to higher fiscal debt, banks with ex-ante higher government bond holdings experience a higher perceived EDF (albeit not significantly at conventional levels of statistical significance), and lower profitability, lower equity, and lower lending. Similarly, when global risk aversion is high (proxied through higher VIX), banks with greater sovereign exposure in countries with high rollover risks experience lower profits, lower equity, and loans-to-total assets ratio. Their default probability in turn also increases, although the effect is not statistically significant.

B. Safety Net Channel

Banks hold government promises not only in the form of bonds, but also in the form of potential government backstops. Sovereign distress can, however, call into question the credibility of these safety net arrangements, increasing the cost of banks' liabilities and possibly their ability to attract funding. To understand the financial implications of these mechanisms, in this section we explore the association between the strength of the safety net and banks' performance following sovereign distress.

Our key safety net strength measure is the Support Rating Floor (SRF) provided by the rating agency Fitch. The measure captures banks' propensity to receive government support during bank distress (Fitch Ratings, 2013). An advantage of using this measure is that the rating explicitly captures the likelihood the rated bank will receive extraordinary support, in case of need, specifically from government authorities (e.g., national

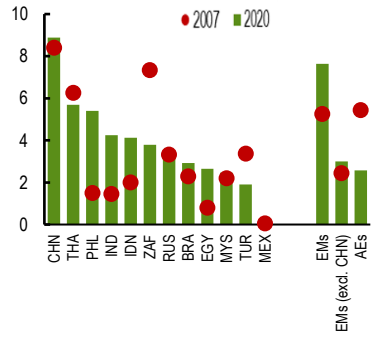
[20] This is likely to be a mild assumption considering that: i) US dollar is the dominant currency in emerging markets sovereigns' hard-currency debt issuance and ii) bilateral exchange rate vis-a-vis the US dollar typically closely follows those vis-a-vis other major currencies due to strong presence of a common factor in foreign exchange markets.

authorities where the financial institution is domiciled), but does not incorporate support from the entity's shareholders.

Figure 5. Stylized Facts on Bank Support Rating Floor in Emerging Markets

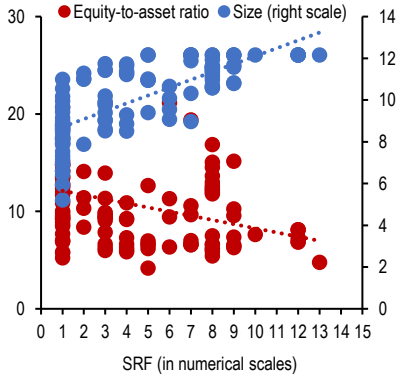
1. Distribution of Emerging Market Banks Across Notches of Support Rating Floor

(Support Rating Floor on a numerical scale from 0 to 17)



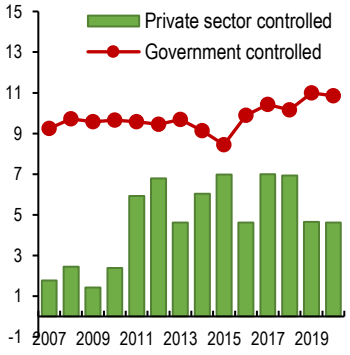
2. Relationship Between Support Rating Floor, Capital Ratio and Size

(LHS axis: bank-equity-asset ratio in percent; RHS axis: log of bank size in USD)



3. Weighted Average of Support Rating Floor by Government Ownership

(Support Rating Floor on a numerical scale from 0 to 17)



Source: Fitch Connect; and authors' calculations.

Note: Panel 1 shows the weighted average of Fitch support rating floors in major emerging markets, in which weights correspond to banks' total assets in US dollars. The support rating floor ranges from AAA to NF and is converted to a numerical scale of 1–17 (higher values correspond to a higher rating or higher likelihood of receiving government support during distress). In panel 2, each dot represents one bank in the sample. In panel 3, the weighted average is calculated based on bank total assets. Government-controlled banks are those with government ownership greater than 50 percent. The Support Rating Floor ranges from AAA to NF and is converted to a numeral scale of 1-17 (higher values correspond to higher rating or higher likelihood of receiving government support during distress). Data labels use International Organization for Standardization (ISO) country codes. AEs are identified according to the WEO classification. AEs = advanced economies; EMs = emerging markets.

In general, the extent to which banks benefit from the public safety net varies across emerging markets and is importantly associated with bank-specific characteristics. In a few major emerging markets, implicit government guarantees to the banking sector have been elevated since the GFC and have further increased in recent years (Figure 5, panel 1). In contrast, a large shift to the lowest rating, "no floor" (NF), is evident for banks in advanced economies, which could at least partly be attributed to the implementation of too-big-to-fail (TBTF) reforms post-2016. For instance, the Global Systemically Important Banks (G-SIBs) have been subject to both capital surcharges and reporting and disclosure requirements. In addition, all advanced-economy jurisdictions home to G-SIBs have imposed external Total Loss-Absorbing Capacity (TLAC) requirements. Thus, advanced economies, where most G-SIBs are based in, may see diminishing safety net coverage on systemic banks in the banking sector that precede these trends in emerging markets.[21]

[21] Simple correlations between bank size and SRF support this and show that TBTF subsidies were similarly strong in both country groups before 2015. However, in advance economies, the TBTF subsidies have weakened notably since end-2015, reflecting market's anticipation of the TBTF resolution reforms in these countries.

There is also a strong positive relationship between bank size and government support ratings, implying large implicit subsidies for too-big-to-fail banks in emerging markets (Figure 5, panel 2). Further, banks with higher SRFs tend to have lower capital-to-asset ratios, pointing to potential moral hazard concerns. State-ownership is also closely tied to banks' level of government support in emerging markets: banks with a greater than 50 percent government ownership stake have notably higher SRFs (Figure 5, panel 3).

Based on this preliminary evidence, we next explore whether a bank's safety net differentially affect banks' stock returns. We adopt a local projection specification as follows:

$$CAR_{i,c,t-1,h} = \beta_{1,h} SRF\ purge_{i,c,t-1} + \beta_{2,h} SRF\ purge_{i,c,t-1} \times Sovereign\ Distress_{c,t} + \lambda_h Controls_{i,c,t-1} + \theta_{c,t,h} + \lambda_{i,h} + \epsilon_{i,c,t-1,h} \quad (4)$$

where the dependent variable $CAR_{i,c,t-1,h}$ is the cumulative abnormal returns of bank i in country c' s stock from month $t-1$ to $t+h$, and the abnormal returns are derived from a capital asset pricing model (CAPM). Among the explanatory variables, $SRF\ purge_{i,c,t-1}$ is the one-month lagged Support Rating Floor (in numerical values) that is (statistically) purged of domestic financial conditions to mitigate endogeneity concerns.[22] $Sovereign\ Distress_{c,t}$ is a dummy variable that is equal to 1 if country c is in sovereign distress in month t. The criteria for sovereign distress are the same as those used in Section V.A. The control variables are as of the end of the previous calendar year (t-1) and include the same set of variables as in the exposure channel analysis (equation 2). In addition, banks' government-bond-holdings-to-total-assets ratio is added to control for the impact of the exposure channel. The econometric model also includes country-month and bank fixed effects. The sample for this analysis is composed of 10 major emerging markets covering the period 2007:M1–2020:M12 (see Annex I for additional details of the sample and data).

Figure 6 presents the baseline estimates of $\beta_{1,h}$ and $\beta_{1,h} + \beta_{2,h}$ to assess the relationship between banks' government support rating and future abnormal returns in normal times and in case of sovereign distress (significance of parameters are reported in Table 4 panel A). In addition, the analysis includes interactions with pre-distress fiscal vulnerabilities (captured by a dummy variable equal to 1 if the public-debt-to-GDP ratio is higher than 60 percent, and zero otherwise), to assess if the relationship is amplified by the presence of fiscal vulnerabilities, as reported in Table 4 panel C.

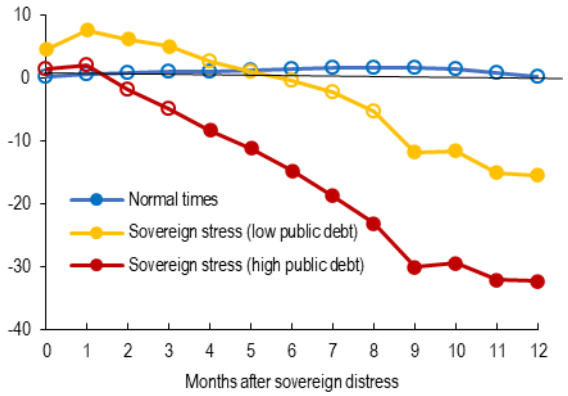
The results show that the government safety net provides some protection to banks in times of sovereign distress, whereas in normal times there is no significant difference across banks with different SRFs. A possible explanation for these findings is that safety net protection lowers banks' funding costs more substantially when the cost of capital is most sensitive to the expectation of future bank distress and future bailout (Gandhi and Lustig, 2015).

[22] SRF is statistically purged from financial condition via OLS regression. SRF purged corresponds to the residual of an OLS regression regressing SRF on a composite measure capturing the level of financial conditions for a given bank (see Annex 3.2 of the October 2017 GFSR). In so doing, we consider only the orthogonal variation in safety net which is unrelated to an overall deterioration of financial health of a given country.

Figure 6. The Effect of Safety Nets on Banks' Returns following Sovereign Distress in EMs

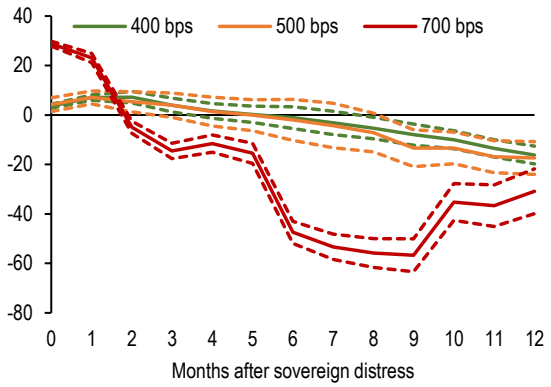
1. Cumulative Abnormal Returns of Banks with a One-Notch-Higher Government Support Rating in Countries with Different Public Debt Levels

(Percentage points)



2. Cumulative Abnormal Returns of Banks with a One-Notch-Higher Government Support Rating after sovereign distress with various sovereign CDS spreads thresholds

(Percentage points)



Sources: Fitch Connect; IHS Markit; Refinitiv Datastream; Standard & Poor's Capital IQ; and authors; calculations.
Note: Panel 1 shows the capital asset pricing model-based cumulative abnormal returns associated with a one-notch- higher support rating floor after sovereign distress using a local projection methodology. Sovereign distress indicates the months with average sovereign credit default swap spreads higher than 500 basis points, or Standard & Poor's long-term rating for sovereign foreign exchange debt that is CCC– or lower, or months when external or domestic debt defaults occurred. Estimated abnormal returns are shown for economies with a sovereign-debt-to-GDP ratio greater than 60 percent ("high public debt") or lower than 60 percent ("low public debt"). Panel 2 shows the same impact of bank cumulative abnormal returns due to sovereign stress with different sovereign CDS spreads thresholds.

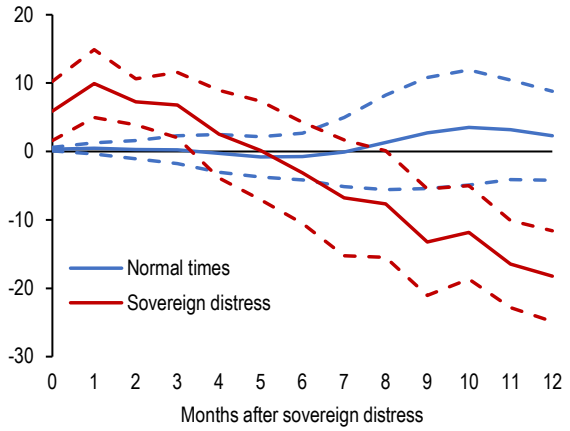
However, the findings also show that the positive effect of higher implicit guarantees immediately after sovereign distress declines over time, turning negative six months after the shock—potentially suggesting that the weakened sovereign strength eventually hurts the credibility of these guarantees. Accordingly, the negative effect on banks with high government support ratings starts sooner and is larger if the economy enters a distress event with a higher public debt burden. The effects are statistically and economically meaningful. For instance, after sovereign distress, market returns for banks with a one-notch-higher SRF can be 30 percentage points lower than the average bank twelve months after the shock.

To examine whether the effect of government support on bank returns varies by the extent of sovereign stress, Equation (4) is estimated for different thresholds of sovereign distress as reported in Table 4 panel B. Figure 6 panel 2 shows the estimated cumulative abnormal returns associated with a one-notch-higher Support Rating Floor for sovereign distress as defined in the baseline (CDS spreads greater than 500 bps, orange line), as well as for sovereign CDS spread over 400 bps (green line) and 700 bps (red line). The findings confirm the presence of nonlinear effects—for instance, ten months after sovereign distress, banks' abnormal returns decrease by twice as much if the sovereign was under extreme stress (i.e., CDS above 700 bps) relative to the baseline.

Figure 7. Additional Robustness Analysis on the Effect of Safety Net on Banks' Returns

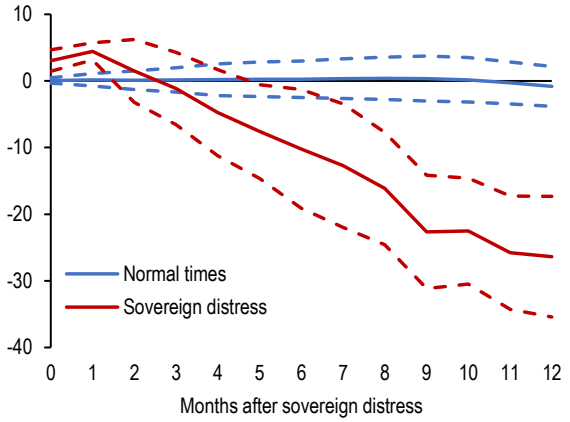
1. Cumulative Abnormal Returns Associated with one Notch Higher Government Support Rating

(Percentage points)



2. Cumulative Abnormal Returns Associated with one Notch Higher Government Support Rating

(Percentage points)



Sources: Fitch Connect; IHS Markit; Refinitiv Datastream; Standard & Poor's Capital IQ; and authors' calculations.
Note: Panel 1 presents the association between banks' abnormal return and Fitch Support Rating Floor when including quarterly lags of Support Rating Floor and its interaction with the sovereign stress dummy. The blue line is based on the estimates of β_(1,h,0) and the red line shows β_(1,h,0)+β_(2,h,0). In panel 2, abnormal returns are computed based on 24-month rolling-window CAPM. In both charts, dashed lines represent 90 percent confidence intervals.

To confirm that the projected adverse impact of sovereign distress on bank stock returns is not due to prior (prolonged) sovereign stress, we include lagged (up to 12 months) sovereign stress dummies to isolate the projected impact of current sovereign stress from the preceding sovereign stress months. The red line in Figure 7 panel 1 shows the cumulative impact on higher-government-support-rating banks' stock returns due to more recent sovereign stress from the extended Equation (4), which confirms that the baseline results are not driven by prolonged sovereign distress. Furthermore, to address the concern that banks' risk exposure could be time-varying, especially after large shocks such as a sovereign distress, a rolling-window capital asset pricing model (CAPM) is considered for computing abnormal stock returns.[23] As shown in Figure 7 panel 2, the results of the baseline specification hold (and in fact get stronger after allowing for time-varying risk exposure by banks).

Risk-Taking and Moral Hazard. The strength of sovereign support may also matter for the ability of banks to lend following a sovereign distress event. To examine if this is indeed the case, we estimate the following econometric model:

$$
\begin{aligned}
y_{i,c,t-h} = {} & \beta_{1,\mathrm{h}} SRF\ purge_{i,c,t} + \beta_{2,h} Capital\ Ratio_{i,c,t-1} + \\
& + \beta_{3,\mathrm{h}} SRF\ purge_{i,c,t} \times Sovereig\ Distress_{c,t} + \beta_{4,\mathrm{h}} SRF\ purge_{i,c,t} \times Capital\ Ratio_{i,c,t-1} \\
& + \beta_{5,\mathrm{h}} SRF\ purge_{i,c,t} \times Capital\ Ratio_{i,c,t-1} \times Sovereign\ Distress_{c,t} \\
& + \lambda_h Controls_{i,c,t-1} + \theta_{c,t-1,\mathrm{h}} + \lambda_{i,\mathrm{h}} + \epsilon_{i,c,t-1,h}
\end{aligned}
\tag{5}
$$

[23] Specifically, abnormal returns are re-estimated based on a 24-month rolling window CAPM model. Banks' risk exposure to the market excess returns is estimated in each month based on the past 24-month excess returns. The intuition of this alternative test is based on the fact that banks' risk exposure could likely be time varying especially after large financial shocks such as sovereign distress. Thus, adopting rolling-window abnormal returns controls for banks' time-varying risk changes in the projection horizon. Results remain overall robust.

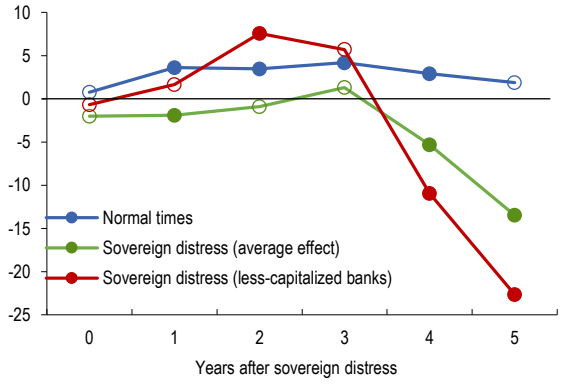
where the dependent variable, $y_{i,c,t-h}$, is either cumulative growth in bank i's gross loans from year t-1 to year t+h or the cumulative change in the nonperforming loan ratio over the same period, both of which are taken as proxies for the intensity of banks' risk-taking activities. $Capital\ Ratio_{i,c,t-1}$ represents bank i's risk-taking-related characteristics (i.e., standardized capital-to-asset ratio), lagged by one year.

Similar to the previous analysis, we focus on the interaction effect of (the purged) SRF with bank characteristics and sovereign stress to capture the relationship between banks' government support rating and future cumulative credit growth or nonperforming loan ratio change after the sovereign distress event and in normal times for banks with different levels of capital buffers. The estimated key coefficients are reported in Table 5.

Figure 8. Banks' Risk-Taking and Moral Hazard during Sovereign Distress

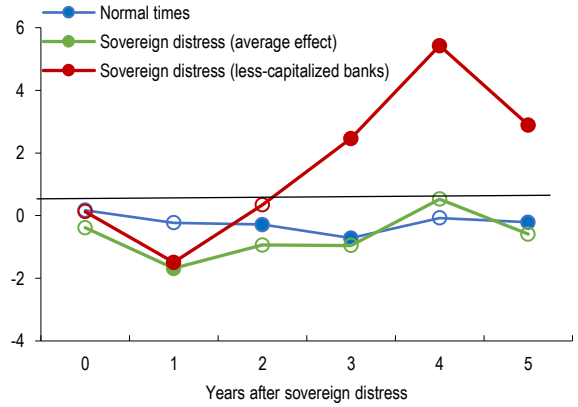
1. Cumulative Bank Credit Growth with a One-Notch-Higher Government Support Rating across Banks with Different Capital Buffers

(Percentage points)



2. Cumulative Change in Bank Nonperforming Loan Ratio with a One-Notch-Higher Government Support Rating across Banks with Different Capital Buffers

(Percentage points)



Sources: Fitch Connect; IHS Markit; Refinitiv Datastream; Standard & Poor's Capital IQ; and authors' calculations.
Notes: The three lines in each panel represent the estimated values of β_(1,h), β_(1,h)+β_(3,h,) β_(1,h)+β_(3,h)-β_(3,h)-β_(3,h) from Equation (5). Panel 1 shows cumulative bank credit growth associated with a one-notch-higher support rating floor up to five years after the sovereign distress or during normal times. The green line shows the impact after the sovereign distress for banks with an average equity-to-capital ratio, while the red line shows the cumulative impact following the same sovereign distress but for banks with an equity-to-capital ratio that is one standard deviation below average. Panel 2 shows results for a similar analysis in which the dependent variable is the cumulative increase in the bank nonperforming-loans-to-assets ratio. In panels 1-2, the analysis is based on the sample of firms with available support rating floor information. Solid dots indicate statistical significance at 10 percent or lower.

Banks with higher government support ratings experience lower credit growth, particularly after three years (Figure 8, panel 1, green line), which is in line with the negative impact on bank stock returns observed after the sovereign distress event. However, banks with a higher support rating floor but lower capital expand their loan portfolios more aggressively within two years after the sovereign distress event, with cumulative credit growth about 8 percentage points higher than that of other banks (Figure 8, panel 1, red line).

This increase in lending goes hand in hand with a worsening of bank credit quality, which suggests greater risk-taking by these banks. For example, although nonperforming loans do not seem to depend much on the level of the government support rating on average in both normal times and sovereign distress (blue and green lines), banks with both a one-standard-deviation-lower capital ratio and a higher support rating experience a

significant jump in nonperforming loans in the medium term (Figure 8, panel 2). The largest effect occurs four years after the sovereign stress when the cumulative change in bank nonperforming loan ratio is about 6 percentage points greater than in other banks in the baseline.

C. Macroeconomic Channel

In addition to the direct exposure and safety net channels, the sovereign and banking sectors could affect each other indirectly through the macroeconomic channel stemming from their interconnectedness with the nonfinancial private sector. Empirically analyzing this channel—that is, the interconnectedness of sovereigns and banks through the real economy—is particularly challenging because of difficulties in isolating shocks to different sectors (Dell'Ariccia et al., 2018). For simplicity, the first part of the analysis focuses on one component of this channel, which is the direct transmission of risk from the sovereign to the corporate sector.

Following Almeida, Fos, and Kronlund (2016), we exploit the uneven effect of sovereign downgrades on firms with different credit ratings to identify the effect of a rise in sovereign risk on firms. While downgrades of firms and sovereigns may both be driven by a deterioration in economic fundamentals, sovereign downgrades are more likely to cause the downgrades of highly rated firms because of rating agencies' ceiling policies. These policies often require that firms' ratings remain at or below the sovereign rating of their country of domicile.[24]

This approach allows us to isolate the direct effect of a sovereign downgrade on firms by comparing the performance of firms subject to ceiling policies ("bound firms"—that is, those with a rating equal to or above that of the sovereign) with that of firms not subject to these policies ("unbound firms"—that is, those with a lower rating than the sovereign) under the assumption that both groups of firms are equally affected by the change in fundamentals. In this context, it is worth noting that unbound firms are by definition those with lower credit quality than bound firms. Thus, a main advantage of this empirical approach is that alternative explanations based on changes in fundamentals and credit risk are unlikely to explain the differential impact on firms' performance around the sovereign ceiling.

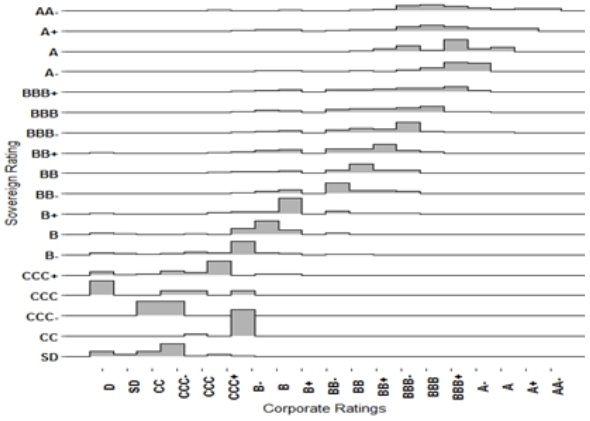
The data for this analysis relies on firms' consolidated data from S&P Capital IQ. The data comprises 84 unique sovereign downgrade events in 34 emerging markets, including 717 firms. We verify the validity of our intuition in three steps. We first analyze the distribution of firm ratings by the level of the sovereign rating, as shown in Figure 9 (panel 1). We find that firms with ratings above their respective sovereign ratings, defined as "bound" firms in the analysis, constitute 20.4 percent of the sample. The figure indicates that their ratings are higher by only a few notches at most with respect to sovereign ratings of their countries.

Second, we consider the distribution of the difference between firm ratings and sovereign ratings two years after a sovereign downgrade and find that the distribution of bound firms is more skewed to the left as these firms have been downgraded more relative to unbound firms (Figure 9, panel 2). Bound firms are therefore more likely to be downgraded than unbound firms following a sovereign downgrade, which is consistent with the ceiling rule.

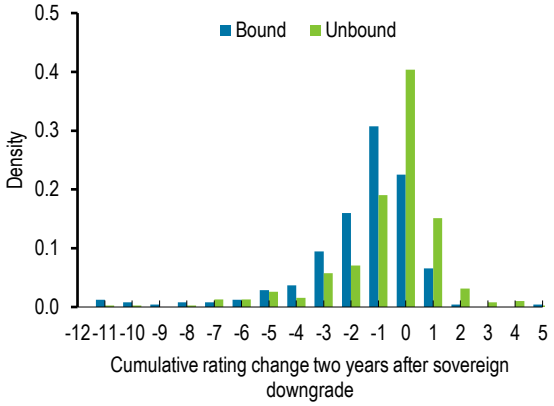
[24] These policies are set after taking into account the risk of capital and foreign exchange controls, which could hamper a firm's ability to service its debt.

Figure 9. Sovereign Downgrades and Bound vs. Unbound Firms in Emerging Markets

1. Frequency of Firm Ratings by Level of Sovereign Rating



2. Distribution of Difference Between Firm and Sovereign Ratings for Bound vs Unbound Firms



Sources: Haver Analytics; IHS Markit; Standard & Poor's Capital IQ; and authors' calculations.
Notes: Panel 1 shows the frequency of firm ratings by level of sovereign rating. Panel 2 shows the distribution of the cumulative change in firm ratings two years after a sovereign downgrade.

Finally, we analyze the presence of an asymmetric reaction of bound and unbound firms' investment and debt issuance choices after a sovereign downgrade. Figure 10 depicts the evolution of investment (panel 1) and net debt issuance (panel 2), both as a ratio to total assets, two years before and after sovereign downgrade events, respectively (the downgrade occurs at t=0). While investment after sovereign downgrade falls by an average of 17 percent for both groups of firms, the asymmetric effect on ratings leads to greater reductions in ceiling-policy-sensitive funding and investment in bound firms relative to unbound firms. Importantly, the figure also shows that there is no disparity in the response of firms before the sovereign downgrade. This asymmetric reaction between bound and unbound firms after the sovereign downgrade is therefore likely related only to sovereign downgrades and credit agencies' ceiling rules.[25]

After having assessed the validity of our identification strategy, we next examine the direct impact of sovereign downgrades on firm decisions and real economic activity using a difference-in-difference approach to control for other firms' characteristics (beyond bound and unbound) and macroeconomic factors that could explain the differential behavior between bound and unbound firms after a sovereign downgrade. We compare changes in firms' annual investment ratio and net debt issuance between bound and non-bound firms around the time of a sovereign downgrade:

$$\Delta_h y_{c,j,s,t} = \beta_{1,h} Bound_{j,s,c,t-1} + \beta_{2,h} Sovereign\ Downgrade_{c,t} + \beta_{3,h} Bound_{j,s,c,t-1} \times Sovereign\ Downgrade_{c,t} + \beta_{4,h} Controls_{j,s,c,t-1} + \lambda_{s,h} + \gamma_{c,h} + \eta_{t,h} + \epsilon_{j,s,c,t,h} \quad (6)$$

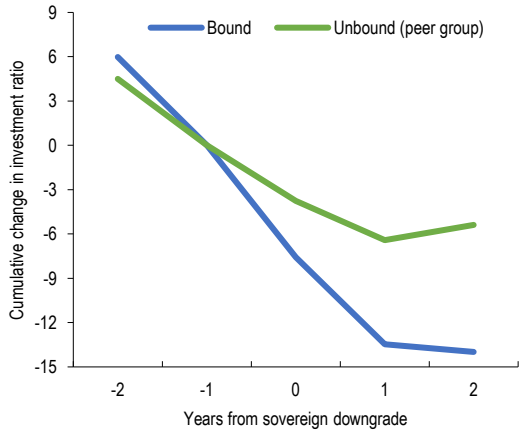
[25] If other factors such as macroeconomic fundamentals were responsible, then the only explanation would be that these factors increased the credit risk for bound firms more than unbound firms which would be counterintuitive. Since unbound firms have by definition lower credit quality compared to bound firms, other explanations based on changes in fundamentals and credit risk cannot explain why the change in firms' investment and debt issuance is discontinuous around the sovereign ceiling.

where subscripts j, s, c, and t represent the firm, sector, country and time, respectively. $\Delta_h y_{j,s,c,t}$ denotes the cumulative change in firms' investment or debt issuance over the next h years relative to the pre-downgrade period. The control variables are firms' size, Tobin's Q, cash flow, cash holdings, leverage, and government ownership. The regressions also include sector $\lambda_{s,h}$, country $\gamma_{c,h}$ and year fixed effects $\eta_{t,h}$. The working hypothesis is that bound firms cut investment and reduce debt issuance more than non-bound firms ($\beta_{3,h}$< 0) in the aftermath of a sovereign downgrade. Since some sovereign debt and banking crises happened simultaneously, we exclude those observations from the baseline sample. The banking crisis indicator used for this purpose are taken from Laeven and Valencia (2018).

Figure 10. Sovereign Downgrades Impact on Bound vs. Unbound Firms in EMs

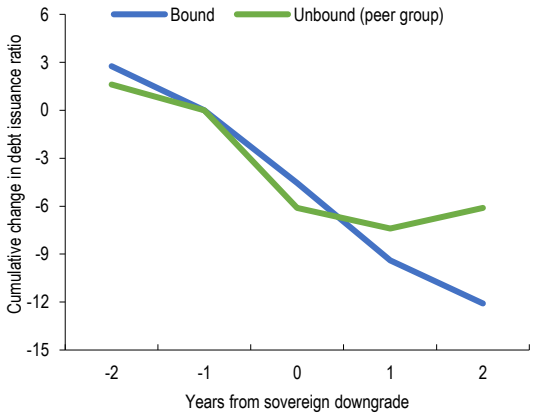
1. Change in Firm-Level Investment after a Sovereign Downgrade

(Percent)



2. Change in Firms-Level Debt Issuance after a Sovereign Downgrade

(Percent)



Sources: Haver Analytics; IHS Markit; Standard & Poor's Capital IQ; and authors' calculations.

The results of the analysis are reported in Table 6. We find that following a sovereign downgrade, bound firm's cumulative investment drops nearly 17 percentage points more than unbound firm's cumulative investment two years after a sovereign downgrade. Furthermore, the effect on investment is non-linear and significantly larger if the sovereign downgrade is accompanied by higher sovereign stress, proxied by sovereign credit default swap spreads greater than 500 basis points. Similarly, the effect is much larger in countries with higher public debt-to-GDP ratio (Table 7).

Overall, we interpret our results as follows. Bound firms find it more expensive to raise debt in the aftermath of a sovereign downgrade, which leads them to reduce investment. This difference across bound and unbound firms arises only following the sovereign downgrade, as there is no evidence of significant preexisting differential trends in outcome variables, as shown in Figure 10.

To check the sensitivity of the baseline results, several robustness tests are conducted.[26] First, the estimates reported in Table 6 pertain to the cumulative change in investment ratio two years after a sovereign

[26] The full results for these robustness exercises are available upon request.

downgrade. However, further analysis shows that the difference across bound and unbound firms' cumulative change in the investment ratio three years after a sovereign downgrade remains statistically significant. Thus, sovereign downgrades have a protracted impact on bound firms. Second, we further test the assumption of parallel trends before a sovereign downgrade by considering lagged values of "bound" firms (i.e., in period t-2), "sovereign downgrade" and their interaction term. The results show that the coefficient on lagged interaction term is not statistically significant when the cumulative change to the investment ratio two years after a downgrade is considered—suggesting no significant difference between the two groups in the pre-downgrade period.

To rule out that the results may be driven by macroeconomic factors other than the sovereign downgrade, several placebo tests are conducted. The findings are reported in Table 8. First, sovereign downgrades that are combined with recession years (two consecutive quarters with negative quarter-over-quarter real GDP growth rate) are excluded from the analysis, which does not make a significant difference to the results. In an alternative specification, the sovereign downgrade variable is replaced with an indicator variable for banking crisis, as defined in Laeven and Valencia (2018). No statistically significant difference is found between bound and unbound firms in terms of investment ratio before and after the recession. In another test, sovereign downgrades that occurred during the period of the global financial crisis (2008-10) are excluded from the analysis to mitigate concerns that our findings might be driven by large shock to the supply of capital to firms. Finally, currency crisis episodes that are not accompanied by a sovereign downgrade are included in the sample to address the concern that bound firms' liabilities might be more exposed to exchange rate movements than of unbound firms (due to possibly greater access to international capital markets). We find no statistical differences between bound and unbound firms in these tests. These results mitigate the concerns that the difference between bound and nonbound firms is stemming from other factors beyond the sovereign downgrade.[27]

Indirect Impact of Sovereign Downgrade on Banks through Firms. The negative effects of sovereign stress on firms' borrowing costs and activity may weaken the soundness of firms' balance sheets. Consequently, banks' loan portfolio quality may be adversely affected, leading banks to curtail lending. This would further reduce consumption and investment in the domestic economy, with a consequent drop in aggregate demand and decline in the health of the corporate sector. Hence, disruptions in financial intermediation could act as an amplifier and exacerbate the damage to economic activity following a sovereign downgrade.

In line with the sovereign downgrade impact on investment and debt issuance, we investigate the impact of sovereign downgrades on country-level banking sector nonperforming loans (NPL) ratio through the importance of bound firms in the NFC sector. The sample covers 25 emerging markets countries from 1995 to 2021 (see Annex 1 for more details on the sample). For this purpose, we estimate the following equation:

$$\begin{aligned}\Delta_{\mathrm{h}} NPL_{c,t} = {} & \beta_{1,h} Sovereign\ Downgrade_{c,t} \\ & + \beta_{2,h}(Share)_{c,t-1} + \beta_{3,h}\, Sovereign\ Downgrade_{c,t} \times (Share)_{c,t-1} \\ & + \beta_{4,h} Controls_{c,t} + \gamma_{c,h} + \eta_{t,h} + \epsilon_{c,t,h}\end{aligned} \tag{7}$$

where $\Delta_{\mathrm{h}} NPL_{c,t}$ is the change in the aggregate banking system in country c over the next h years from the pre-downgrade period (i.e., between t-1 and t+k). *Sovereign downgrade* is the same variable as in Equation (6). *Share* is the share of bound firms' assets to total corporate sector assets as a measure of the importance of

[27] The currency crises indicator is taken from the Harvard Business School Global Crises Data by Country.

bound firms in the economy. Controls include Financial Conditions Index (FCI), banking sector aggregate equity to asset ratio, real GDP growth. The coefficient of interest is $\beta_{3,h}$.

The results show that in countries with a more dominant presence of bound firms in the corporate sector, banks' NPL ratio increase after the sovereign downgrade and the effect persists at least two years after the sovereign downgrade occurs (Table 9). Quantitatively, a one standard deviation larger share of bound firms' assets in economy-wide corporate assets is associated with an increase in banks' NPL ratio by one percentage point after two years of sovereign downgrade.

To rule out that the increase in NPL is due to a deterioration in the asset quality of smaller firms not included in the sample of rated firms, an alternative specification is tested that controls for the country-level median debt affordability (debt-to-EBITDA ratio) of small and medium-size firms.[28] The results remain broadly consistent and statistically significant.[29]

VI. Conclusions

The sovereign-bank nexus has intensified in emerging markets since the onset of the COVID-19 pandemic as banks' exposure to domestic sovereign debt has increased to historical highs. With public debt also at high levels, emerging markets are vulnerable to an adverse shock that could trigger an adverse feedback loop between sovereigns and banks, threatening macro-financial stability. This paper shows that such a loop could occur through multiple channels, including by affecting corporate sector activity, and would be stronger in countries with higher fiscal vulnerabilities and less-well-capitalized banking systems.

We find that an increase in sovereign risk can adversely affect banks' balance sheet and lending appetite. The perception of a weaker ability to support banks following sovereign distress could undermine investor confidence and banks' performance, leading to higher risk-taking for banks normally supported by larger explicit or implicit guarantees. Sovereign distress may also pose risks to non-financial firms. Finally, sovereign downgrades can reduce overall firm investment and funding. This effect is especially pronounced for firms subject to sovereign rating ceiling policies and could weaken banks' loan portfolio quality in countries where these firms are more prevalent. These findings have important policy implications and could help to inform the debate on the treatment of sovereign exposures in banking regulation and supervision.

References

Acharya, V.V., Drechsler, I. and Schnabl, P., 2014. "A pyrrhic victory? Bank bailouts and sovereign credit risk". The Journal of Finance, 69(6), pp.2689-2739.

Acharya, V.V. and Steffen, S., 2015. "The 'greatest' carry trade ever? Understanding eurozone bank risks." Journal of Financial Economics, 115(2), pp.215-236.

Acharya, V.V., Eisert, T., Eufinger, C. and Hirsch, C., 2018a. "Real effects of the sovereign debt crisis in Europe: Evidence from syndicated loans". The Review of Financial Studies, 31(8), pp.2855-2896.

[28] Small and medium-size companies are defined as firms with a number of employees equal or below 250.

[29] These findings are only suggestive—a more direct analysis showing how banks' lending behavior can be affected by their exposure to bound firms is difficult given the lack of related data.

Acharya, V.V., Berger, A.N. and Roman, R.A., 2018b. “Lending implications of US bank stress tests: Costs or benefits?”. Journal of Financial Intermediation, 34, pp.58-90.

Afonso, G., Santos, J.A. and Traina, J., 2014. “Do' Too-Big-To-Fail' Banks Take on More Risk?”. Economic Policy Review, 20(2), pp.41-58.

Almeida, H., Campello, M., Laranjeira, B. and Weisbenner, S., 2009. Corporate debt maturity and the real effects of the 2007 credit crisis (No. w14990). National Bureau of Economic Research.

Almeida, H., Cunha, I., Ferreira, M.A. and Restrepo, F., 2017. “The real effects of credit ratings: The sovereign ceiling channel.” The Journal of Finance, 72(1), pp.249-290.

Almeida, H., Fos, V. and Kronlund, M., 2016. “The real effects of share repurchases.” Journal of Financial Economics, 119(1), 168-185.

Altavilla, C., Pagano, M. and Simonelli, S., 2017. “Bank exposures and sovereign stress transmission”. Review of Finance, 21(6), pp.2103-2139.

Baker, D. and McArthur, T., 2009. “The value of the" too big to fail" big bank subsidy.” London: Center for Economic and Policy Research.

Balasubramnian, B. and Cyree, K.B., 2011. "Market discipline of banks: Why are yield spreads on bank-issued subordinated notes and debentures not sensitive to bank risks?" Journal of Banking & Finance 35, no. 1: 21-35.

Becker, B., and Ivashina, V., 2014. “Cyclicality of credit supply: Firm level evidence.” Journal of Monetary Economics, 62, 76-93.

Becker, B. and Ivashina, V., 2018. “Financial repression in the European sovereign debt crisis”. Review of Finance, 22(1), pp.83-115.

Bofondi, M., Carpinelli, L. and Sette, E., 2018. “Credit supply during a sovereign debt crisis.” Journal of the European Economic Association, 16(3), pp.696-729.

Bouis, R., 2019. “Banks’ Holdings of Government Securities and Credit to the Private Sector in Emerging Market and Developing Economies”. IMF Working Paper No. 19/224.

Chernenko, S. and Sunderam, A., 2012. “The real consequences of market segmentation.” The Review of Financial Studies, 25(7), pp.2041-2069.

Correa, R., Lee, K.H., Sapriza, H. and Suarez, G.A., 2014. “Sovereign credit risk, banks' government support, and bank stock returns around the world.” Journal of Money, Credit and Banking, 46(s1), pp.93-121.

Dell'Ariccia, M.G., Ferreira, C., Jenkinson, N., Laeven, M.L., Martin, A., Minoiu, M.C. and Popov, A., 2018. “Managing the sovereign-bank nexus”. Working Paper Series 2177, European Central Bank.

Demirgüç-Kunt, A. and Huizinga, H., 2013. “Are banks too big to fail or too big to save? International evidence from equity prices and CDS spreads.” Journal of Banking & Finance, 37(3), 875-894.

Farhi, E. and Tirole, J., 2018. “Deadly embrace: Sovereign and financial balance sheets doom loops.” The Review of Economic Studies, 85(3), pp.1781-1823.

Federal Reserve Board of Governors (2021). Dodd-Frank Act Stress Tests 2021. https://www.federalreserve.gov/supervisionreg/dfa-stress-tests-2021.htm

Feyen, E. and Zuccardi Huertas, I.E., 2019. “The Sovereign-Bank Nexus in EMDEs: What Is It, Is It Rising, and What Are the Policy Implications?” World Bank Policy Research Working Paper, (8950).

Fitch Ratings. 2013. “Definitions of Ratings and Other Forms of Opinion.” Available at http://www.fitchratings.com/web_content/ ratings/fitch_ratings_definitions_and_scales.pdf.

Gandhi, P. and Lustig, H., 2014. “Size Anomalies in U.S. Bank Stock Returns”. The Journal of Finance, 70(2), pp. 733-768.

Gennaioli, N., Martin, A. and Rossi, S., 2018. “Banks, government bonds, and default: What do the data say?”. Journal of Monetary Economics, 98, pp.98-113.

Harford, J. and Uysal, V.B., 2014. Bond market access and investment. Journal of Financial Economics, 112(2), pp.147-163.

Horvath, B.L., Huizinga, H. and Ioannidou, V., 2015. “Determinants and valuation effects of the home bias in European banks’ sovereign debt portfolios”. Available at SSRN 2624906.

International Monetary Fund. 2017. Global Financial Stability Report: Is Growth at Risk? Washington, DC, October.

International Monetary Fund, 2020. “The international architecture for resolving sovereign debt involving private-sector creditors-recent developments, challenges, and reform options” IMF Board Paper.

International Monetary Fund. 2022. Global Financial Stability Report—Shockwaves from the War in Ukraine Test the Financial System’s Resilience. Washington, DC, April.

Laeven, M.L. and Valencia, M.F., 2018. “Systemic banking crises revisited”. International Monetary Fund.

Ongena, S., Popov, A. and Van Horen, N., 2019. “The invisible hand of the government: Moral suasion during the European sovereign debt crisis”. American Economic Journal: Macroeconomics, 11(4), pp.346-79.

Panizza, U. and Presbitero, A. F., 2013. “Public debt and economic growth in advanced economies: A survey.” Swiss Journal of Economics and Statistics, 149(2), 175-204.

Pescatori, A. and Sy, A.N., 2007. “Are debt crises adequately defined?” IMF Staff Papers, 54(2), pp.306-337.

Popov, A. and Van Horen, N., 2015. “Exporting sovereign stress: Evidence from syndicated bank lending during the euro area sovereign debt crisis”. Review of Finance, 19(5), pp.1825-1866.

Reinhart, C.M. and Rogoff, K.S., 2011. “From financial crash to debt crisis”. American economic review, 101(5), pp.1676-1706.

Rigobon, R., 2003. “Identification through heteroskedasticity”. Review of Economics and Statistics, 85(4), pp.777-792.

Rigobon, R. and Sack, B., 2003. “Measuring the reaction of monetary policy to the stock market.” The Quarterly Journal of Economics, 118(2), pp.639-669.

Sufi, A., 2009. “Bank lines of credit in corporate finance: An empirical analysis”. The Review of Financial Studies, 22(3), pp.1057-1088.

Tang, T. T., 2009. “Information asymmetry and firms’ credit market access: Evidence from Moody's credit rating format refinement.” Journal of Financial Economics, 93(2), 325-351.

Tables

Table 1. Exposure Channel: The Effect of Sovereign Distress on Bank Equity at Different Distress Thresholds

	Dependent Variable: Log change in total equity							
CDS Spread Threshold:	300 bps	400 bps	500 bps	600 bps	700 bps	800 bps	900 bps	1000bps
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sovereign Exposure$_{i,c,t-1}$ x Sovereign Stress $_{c,t}$	-0.012	-0.342	-0.231	-0.329	-0.418*	-0.518**	-0.737***	-0.706***
	(0.195)	(0.241)	(0.227)	(0.221)	(0.229)	(0.238)	(0.264)	(0.267)
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country x Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3582	3582	3582	3582	3582	3582	3582	3582
Number of banks	525	525	525	525	525	525	525	525
Number of Countries	18	18	18	18	18	18	18	18
R-Squared	0.572	0.573	0.573	0.573	0.575	0.576	0.577	0.577
Log change in total equity for a bank with 10 percent higher sovereign bond holdings (evaluated at mean capital ratio)	-0.59	-2.36	-0.87	-1.85	-2.68	-3.79	-5.68	-5.44

Notes: The table reports OLS estimates of equation (2) with the dependent variable log change in (book value of) total equity. See text for the full specification and the set of bank controls. Standard errors are clustered at the bank level. ***, **, * denote significance levels at 1, 5, and 10 percent, respectively.

Table 2. Exposure Channel: Valuation Effect on Fiscal Debt and Key Bank Outcome Variables

Dependent Variable:	Change in log (Bank EDF)	Change in pre-tax profits divided by lagged total equities	Change in (log) total equity	Change in Total Loans-to-Total Assets	Change in (log) total loans
	(1)	(2)	(3)	(4)	(5)
Sovereign Exposure$_{i,c,t-1}$ x Increase in Fiscal Debt due to FX depreciation$_{c,t-1}$	46.222	-15.699**	-33.181*	-7.382***	-8.867
	(25.721)	(4.147)	(14.063)	(0.877)	(10.282)
Bank Controls	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Country x Year FE	Yes	Yes	Yes	Yes	Yes
Observations	60	216	216	216	216
Number of banks	15	66	66	66	66
Number of Countries	4	4	4	4	4
R-Squared	0.869	0.869	0.837	0.840	0.879
Economic Impact for a bank with 10% ex-ante higher sovereign exposure	4.654	-1.821	-3.849	-0.856	-1.029

Notes: Bank controls are size (log of total assets), capital ratio (total equity-to-total assets ratio), liquidity (non-cash assets-to-total assets), profitability (return on assets), exposure to the central bank (total exposure to the central bank divided by total assets); and interbank exposure (interest-earning balances with central and other banks divided by total assets), and total loans-to-total asset ratio. All bank controls are one-year lagged. All columns include loan-to-assets ratio and net open FX position in levels and in interaction with "Increase in Fiscal Debt due to FX depreciation". Standard errors are clustered at the bank level. ***, **, * denote significance levels at 1, 5 and 10 percent respectively.

Table 3. Exposure Channel: The effect of debt rollover risks on key bank outcome variables

Dependent Variable:	**Change in log (Bank EDF)**	**Change in pre-tax profits divided by lagged total equities**	**Change in (log) total equity**	**Change in Total Loans-to-Total Assets**	**Change in (log) total loans**
	(1)	(2)	(3)	(4)	(5)
Sovereign Exposure$_{i,c,t-1}$ x I(Maturing Debt$^{e}_{c,t-1}$) x Change in log(VIX)$_t$	11.443	-1.125**	-5.192**	-0.666**	-0.716
	(10.671)	(0.368)	(1.577)	(0.190)	(0.757)
Sovereign Exposure$_{i,c,t-1}$ x I(Maturing Debt$^{e}_{c,t-1}$)	0.922	-0.145	-0.556	0.043	0.490*
	(0.677)	(0.144)	(0.399)	(0.056)	(0.216)
Sovereign Exposure$_{i,c,t-1}$ x Change in log(VIX)$_t$	-0.232	0.391	0.507	0.066	0.648**
	(1.957)	(0.260)	(0.562)	(0.089)	(0.186)
Bank Controls	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes
Country x Year FE	Yes	Yes	Yes	Yes	Yes
Observations	80	261	261	261	261
Number of banks	21	80	80	80	80
Number of Countries	5	5	5	5	5
R-Squared	0.897	0.867	0.814	0.823	0.888
Economic Impact for a bank with 10% ex-ante higher sovereign exposure (When VIX is higher by 1 std and sovereign has a high degree of maturing debt)	28.81	-3.036	-14.01	-1.796	-1.933

Notes: Bank controls are size (log of total assets), capital ratio (total equity-to-total assets ratio), liquidity (non-cash assets-to-total assets), profitability (return on assets), exposure to the central bank (total exposure to the central bank divided by total assets); and interbank exposure (interest-earning balances with central and other banks divided by total assets), and total loans-to-total asset ratio. All bank controls are one-year lagged. All columns include loan-to-assets ratio and net open FX position in levels, in double interaction and triple interaction with maturing debt dummy and change in VIX. Standard errors are clustered at the bank level. ***, **, * denote significance levels at 1, 5 and 10 percent respectively.

Table 4. Safety Net Channel: The Effect on Banks' Equity Abnormal Returns

A: Baseline with sovereign distress defined as sovereign CDS spreads > 500 bps													
	Months after sovereign stress												
VARIABLES	0	1	2	3	4	5	6	7	8	9	10	11	12
SRF purge $_{i,c,t-1}$	0.065	0.195	0.189	0.243	0.300	0.356	0.356	0.461	0.496	0.444	0.199	-0.317	-0.924
	(0.284)	(0.577)	(0.832)	(1.083)	(1.322)	(1.444)	(1.539)	(1.686)	(1.773)	(1.837)	(1.753)	(1.591)	(1.489)
SRF purge $_{i,c,t-1}$ x Sovereign distress $_{c,t}$	4.162**	6.900***	5.288*	3.976	1.416	-0.341	-1.992	-4.130	-7.280	-13.727**	-13.240**	-16.088**	-15.938**
	(1.667)	(1.707)	(2.538)	(3.201)	(4.013)	(4.492)	(5.451)	(5.951)	(5.558)	(5.537)	(5.139)	(5.046)	(5.052)
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,276	4,276	4,276	4,276	4,276	4,276	4,276	4,276	4,276	4,276	4,276	4,276	4,276
R-squared	0.767	0.785	0.780	0.774	0.772	0.776	0.781	0.788	0.792	0.792	0.792	0.794	0.798
B: Robustness checks with alternative sovereign CDS spreads thresholds													
Sovereign CDS spreads > 400 bps													
	Months after sovereign stress												
VARIABLES	0	1	2	3	4	5	6	7	8	9	10	11	12
SRF purge $_{i,c,t-1}$	0.043	0.114	0.102	0.145	0.232	0.312	0.328	0.421	0.463	0.386	0.201	-0.268	-0.808
	(0.277)	(0.547)	(0.798)	(1.038)	(1.281)	(1.419)	(1.530)	(1.672)	(1.760)	(1.809)	(1.755)	(1.605)	(1.525)
SRF purge $_{i,c,t-1}$ x Sovereign distress $_{c,t}$	3.569***	7.614***	6.822***	6.344**	3.561	1.473	-0.227	-1.144	-3.477	-6.729*	-8.717**	-12.386***	-14.875***
	(0.514)	(0.691)	(1.576)	(2.041)	(2.301)	(2.656)	(3.296)	(3.563)	(3.460)	(3.508)	(3.298)	(3.108)	(3.190)
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,276	4,276	4,276	4,276	4,276	4,276	4,276	4,276	4,276	4,276	4,276	4,276	4,276
R-squared	0.767	0.785	0.780	0.774	0.772	0.776	0.781	0.788	0.792	0.792	0.792	0.794	0.798

Sovereign CDS spreads > 700 bps													
	Months after sovereign stress												
VARIABLES	0	1	2	3	4	5	6	7	8	9	10	11	12
SRF purge $_{i,c,t-1}$	0.128	0.306	0.280	0.313	0.327	0.354	0.333	0.404	0.386	0.226	-0.017	-0.581	-1.187
	(0.290)	(0.604)	(0.856)	(1.086)	(1.298)	(1.400)	(1.491)	(1.623)	(1.674)	(1.680)	(1.595)	(1.436)	(1.357)
SRF purge $_{i,c,t-1}$ x Sovereign distress $_{c,t}$	28.338***	23.079***	-5.006*	-14.507***	-11.337***	-15.269***	-46.625***	-52.898***	-55.152***	-56.789***	-34.662***	-35.260***	-28.635***
	(0.790)	(1.669)	(2.385)	(2.986)	(3.450)	(3.846)	(4.147)	(4.473)	(4.686)	(5.014)	(5.417)	(5.639)	(5.922)
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,276	4,276	4,276	4,276	4,276	4,276	4,276	4,276	4,276	4,276	4,276	4,276	4,276
R-squared	0.767	0.785	0.780	0.774	0.772	0.776	0.781	0.788	0.792	0.792	0.792	0.794	0.798
C: Additional interaction with high sovereign debt ratio dummy													
	Months after sovereign stress												
VARIABLES	0	1	2	3	4	5	6	7	8	9	10	11	12
SRF purge $_{i,c,t-1}$	0.349	0.591	0.837	0.961	1.150	1.302	1.529	1.762	1.881	1.857	1.556	0.955	0.337
	(0.198)	(0.402)	(0.611)	(0.761)	(1.041)	(1.074)	(1.156)	(1.231)	(1.371)	(1.481)	(1.374)	(1.185)	(1.082)
SRF purge $_{i,c,t-1}$ x Sovereign distress $_{c,t}$	4.048*	6.956***	5.180*	3.882	1.215	-0.336	-2.297	-4.650	-7.476	-13.719**	-13.373**	-16.395**	-16.323**
	(1.821)	(1.907)	(2.796)	(3.452)	(4.216)	(4.561)	(5.605)	(6.030)	(5.575)	(5.513)	(5.117)	(5.096)	(5.180)
SRF purge $_{i,c,t-1}$ x Sovereign distress $_{c,t}$ x High debt$_{c,t-1}$	-2.830***	-5.467***	-8.033***	-10.117***	-11.505***	-12.961***	-15.056***	-17.120***	-18.353***	-18.784***	-18.110***	-17.282***	-16.924***
	(0.316)	(0.873)	(1.499)	(2.403)	(3.112)	(3.918)	(4.189)	(4.198)	(4.195)	(4.678)	(5.038)	(5.177)	(5.012)
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country-Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,252	4,252	4,252	4,252	4,252	4,252	4,252	4,252	4,252	4,252	4,252	4,252	4,252
R-squared	0.767	0.785	0.781	0.776	0.773	0.776	0.785	0.793	0.796	0.795	0.794	0.798	0.801

Notes: In the fixed-effect panel regressions, the dependent variable $CAR_{i,c,t-1,h}$ is the cumulative abnormal returns of bank i's stock from month $t-1$ to $t+h$, and the abnormal returns are derived from a capital asset pricing model (CAPM). Among the explanatory variables, $SRF\_purge_{i,c,t-1}$ is the one-month lagged Support Rating Floor (in numerical values) that is purged of domestic financial conditions, and $Sovereign\_Stress_{c,t}$ is a dummy variable that is equal to 1 if country c is in sovereign distress in month t (with 500 bps sovereign CDS spreads as the threshold in panel A, and 400 and 700 bps as the threshold in panel B) The control variables are as of the end of the previous calendar year (T-1) and include the same set of variables as in the exposure channel analysis (equation 6). In addition, banks' government-bond-holdings-to-total-assets ratio is added to control for the impact of the exposure channel. In panel C, only key coefficients are reported. The econometric model also includes country-month and bank fixed effects The standard errors are clustered at the bank level. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Safety Net Channel: The Effect on Banks' Risk-Taking Activity

A: Effect on bank gross loan growth

	Years after the sovereign stress					
VARIABLES	1	2	3	4	5	6
$SRF_{i,c,t-1}$	0.755	3.594***	3.459**	4.186***	2.924**	1.854
	(1.533)	(1.091)	(1.374)	(0.809)	(1.065)	(1.302)
$SRF_{i,c,t-1}$ x Sovereign distress $_{c,t}$	-2.779	-5.512***	-4.366	-2.891	-8.224***	-15.326***
	(2.749)	(1.517)	(2.481)	(3.179)	(2.168)	(1.208)
$SRF_{i,c,t-1}$ x Sovereign distress $_{c,t}$ x Capital Ratio $_{c,t-1}$	-2.890	-4.576	-13.608***	-15.021*	-6.558	-5.395
	(3.577)	(3.091)	(3.416)	(7.499)	(5.022)	(4.456)
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Country-Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	224	224	224	224	224	224
R-squared	0.823	0.912	0.939	0.926	0.948	0.953

B: Effect on bank nonperforming loan growth

	Years after the sovereign stress					
VARIABLES	1	2	3	4	5	6
$SRF_{i,c,t-1}$	0.143	-0.253*	-0.244**	-0.670***	0.029	-0.152
	(0.346)	(0.132)	(0.102)	(0.147)	(0.131)	(0.124)
$SRF_{i,c,t-1}$ x Sovereign distress $_{c,t}$	-0.510	-1.420***	-0.645	-0.155	0.685	-0.307
	(0.314)	(0.225)	(0.612)	(0.771)	(0.706)	(0.681)
$SRF_{i,c,t-1}$ x Sovereign distress $_{c,t}$ x Capital Ratio $_{i,c,t-1}$	-1.121	-0.746	-0.358	-2.049**	-2.015**	-1.704*
	(0.637)	(0.831)	(0.833)	(0.798)	(0.623)	(0.849)
Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Country-Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	224	224	224	224	224	224
R-squared	0.823	0.912	0.939	0.926	0.948	0.953

Notes: In the fixed-effect panel regressions, the dependent variable in panel A is cumulative growth in bank i's gross loans from year T-1 to year T+H and in panel B is the cumulative change in the nonperforming loan ratio over the same period. $Capital\ Ratio_{i,c,T-1}$ represents bank i's capital-to-asset ratio, lagged by one year. The model is estimated using annual frequency data. Only key coefficients are reported in the tables. In all models estimated in this section, ordinary least squares are used, and standard errors are clustered at the bank level. *** p<0.01, ** p<0.05, * p<0.1.

Table 6. Macroeconomic Channel: Baseline Regressions. Change in investment ratio and debt issuance two years after a sovereign downgrade (relative to the year of downgrade)

	Investment ratio	Debt issuance
$Bound_{j,s,c,t-1} \times Sovereign\ downgrade_{c,t}$	16.729**	16.085*
	(-8.451)	(-8.442)
Firm Controls	Yes	Yes
Industry FE	Yes	Yes
Country FE	Yes	Yes
Year FE	Yes	Yes
Observations	4,368	3,950
Number of unique firms	717	710
Number of countries	34	34
R-squared	0.105	0.03

Notes: The table shows the direct impact of sovereign downgrades on the real economy to measure the direct impact of sovereign downgrades on the real economy. Dependent variables are changes in annual firm investment ratio and net debt issuance between bound and non-bound firms around the time of a sovereign downgrade. The coefficient of the interaction term between bound and sovereign downgrade dummies is of interest. The control variables are firms' size, Tobin's Q, cash flow, cash holdings, leverage, and government ownership. The regressions also include sovereign downgrade, bound firms dummy, sector, country and year fixed effects. The banking crisis indicator used for this purpose is taken from Laeven and Valencia (2018). ***, **, * denote significance levels at 1, 5 and 10 percent respectively.

Table 7. Macroeconomic Channel: Corporate Investment Following a Sovereign Downgrade at Different Levels of Sovereign Distress and Sovereign Debt

	Sovereign distress	High debt countries
$Bound_{j,s,c,t-1} \times Sovereign\ Downgrade_{c,t} \times Low\ Sovereign\ Stress_{c,t}$	17.18	
	(-15.133)	
$Bound_{j,s,c,t-1} \times Sovereign\ Downgrade_{c,t} \times High\ Sovereign\ Stress_{c,t}$	-81.411*	
	(-42.322)	
$Bound_{j,s,c,t-1} \times Sovereign\ Downgrade_{c,t} \times High\ Debt_{c,t}$		-38.046***
		(-13.917)
Firm Controls	Yes	Yes
Industry FE	Yes	Yes
Country FE	Yes	Yes
Year FE	Yes	Yes
Observations	3,390	4,284
Number of unique firms	675	675
Number of countries	32	32
R-squared	0.12	0.11

Notes: The coefficient of the interaction term between bound, sovereign downgrade dummies is of interest. Low Sovereign Stress is a dummy variable which takes the value 1 when the sovereign CDS is between 250 and 500 bp. High Sovereign stress is a dummy variable equal to 1 for sovereign CDS bigger than 500 bp. High debt is a dummy variable that takes value 1 for countries with a debt-to-GDP ratio higher than the median value of this variable across countries in a given year. The control variables are firms' size, Tobin's Q, cash flow, cash holdings, leverage, and government ownership. The regressions also include sovereign downgrade, bound firms dummy, sector, country and year fixed effects. ***, **, * denote significance levels at 1, 5 and 10 percent respectively.

Table 8. Macroeconomic Channel: Placebo Tests Baseline Regressions

	(1) Removing Recession	(2) Replace Recession	(3) Great Financial Crisis	(4) Currency Crises
$Bound_{j,s,c,t-1} \times Sovereign\ Downgrade_{c,t}$	-7.412			
	(7.111)			
$Bound_{j,s,c,t-1} \times Recession_{c,t}$		-7.521		
		(9.031)		
$Bound_{j,s,c,t-1}$			-6.321	
			(4.873)	
$Bound_{j,s,c,t-1} \times Currency\ Crisis_{c,t}$				2.528
				(6.907)
Firm Controls	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	4,567	4,570	791	3,992
Number of unique firms	713	717	492	712
Number of countries	34	34	30	34
R-squared	0.106	0.108	0.061	0.112

Notes: This table provides the results for placebo tests to ensure that results are driven by sovereign downgrades and not by other macroeconomic factors. In column (1), the recession episodes which occur at the same time as downgrades are removed from the analysis. Column (2) shows the results for the exercise in which recession episodes are used instead of sovereign downgrades (sovereign episodes are also dropped). In column (3) presents the results for the global financial crisis period only (excluding sovereign downgrades episodes overlap) and finally in column (4), results for the currency crisis episodes that are not accompanied by a sovereign downgrade are presented. The coefficient of the interaction term between bound and sovereign downgrade dummies is of interest. The control variables are firms' size, Tobin's Q, cash flow, cash holdings, leverage, and government ownership. The regressions also include sovereign downgrade, bound firms dummy, sector, country and year fixed effects. ***, **, * denote significance levels at 1, 5 and 10 percent respectively.

Table 9: Macroeconomic Channel: Indirect Impact of Sovereign Downgrade on Banks through Firms

	Change in NPL Ratio					
	No control for smaller firm			With control for smaller firm		
	T	T+1	T+2	T	T+1	T+2
Sovereign Downgrade $_{c,t}$ × Share $_{c,t-1}$	1.649**	2.757**	3.951*	1.037*	1.762***	2.684***
	(0.742)	(1.331)	(2.062)	(0.534)	-0.643	-1.015
Macro and Bank Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	171	162	148	170	161	147
R-squared	0.376	0.315	0.239	0.521	0.576	0.596

Notes: The table shows the results for the change in the NPL ratio of the banking sector following a sovereign downgrade. The first three columns present the results without controls for the smaller firms and the last three columns control for the small and mid-size firms. "Share" is share of bound firms' assets to total corporate sector assets as a measure of the importance of bound firms in the macroeconomy. ***, **, * denote significance levels at 1, 5 and 10 percent respectively.

Annex I. Data Description and Summary Statistics

Because of the variety of exercises conducted in the paper and data limitations, samples vary across sections and subsections as described below. Stylized facts in Section III draw on a sample of 54 emerging market economies identified as emerging market by the IMF's Vulnerability Exercise for Emerging Market Economies.

The SVAR analysis in Section IV uses daily data for 11 major emerging markets over 2006/01/01-2020/12/31. The expected default frequency (EDF) for sovereigns is CDS-implied, while for the banking and corporate sectors, it is computed as a simple average of the EDFs for individual banks and nonfinancial corporations, respectively, in a given country.

The bank-level analysis in Section V.A uses detailed annual unconsolidated financial statements for 525 banks from 18 EMs from 1998 to 2020. The list of countries is reported in Table A.I.I. The data are complemented with various bank-level variables, including expected default frequency from Moody's, detailed ownership data from Orbis and yearly country-level information.

In Section V.B, the sample covers 54 banks from 11 EMs, with monthly data available for monthly stock returns, bank-level Support Rating Floor and balance sheet data over the period September 2007-December 2020. The bank-level Support Rating Floor is downloaded from Fitch, with the ratings converted to discrete numerical values from 1 to 17 (higher values represent higher ratings).

The data for the analysis of the macroeconomic channel in Section V.C relies on firms' annual consolidated data from S&P Capital IQ. The sample is based on 717 rated firms with available data in 29 EMs over the period 1990-2020. The set of sovereign downgrades used in the analysis comprises 84 unique sovereign downgrades.

Table A.I.1 reports the list of countries for each section. Table A.I.2-Table A.I.4 report details on data sources and summary statistics.

Table A.I.1 List of Countries in the Emerging Markets Sample

Economy	Section III	Section IV	Section V			Economy	Section III	Section IV	Section V		
			Section V.A	Section V.B	Section V.C				Section V.A	Section V.B	Section V.C
Albania	■					Indonesia	■	■	■	■	■
Algeria	■					Jamaica	■				
Angola	■					Jordan	■				
Argentina	■	■	■		■	Kazakhstan	■				■
Armenia	■					Lebanon	■				
Azerbaijan	■				■	Malaysia	■	■	■	■	■
Bahamas, The	■					Mauritius	■				
Barbados	■					Mexico	■				■
Belarus	■					Morocco	■				■
Bolivia	■					North Macedonia	■				
Bosnia and Herzegovina	■					Pakistan	■		■		
Brazil	■	■	■	■	■	Panama	■				■
Bulgaria	■					Peru	■		■		■
Chile	■	■			■	Philippines	■		■	■	■
China	■	■	■	■	■	Poland	■	■	■		■
Colombia	■	■	■		■	Romania	■		■		■
Costa Rica	■					Russia Federation	■		■	■	■
Croatia	■				■	Serbia	■				
Dominican Republic	■					South Africa	■	■	■	■	
Ecuador	■					Sri Lanka	■				■
Egypt	■	■	■	■		Thailand	■	■	■	■	■
El Salvador	■					Tunisia	■				
Georgia	■				■	Turkey	■	■	■	■	■
Ghana	■					Ukraine	■				■
Guatemala	■				■	Uruguay	■				■
Hungary	■				■	Venezuela	■				■
India	■	■	■	■	■	Vietnam	■		■		■

Note: The table includes economies identified as emerging market by the IMF's Vulnerability Exercise for Emerging Market Economies. Each column indicates the country coverage in the corresponding section of the paper. Shaded areas indicate the presence of a given economy in the sample considered for the Section empirical analysis.

Table A.I.2. Sovereign Stress/Default Episodes Coverage

Country	Sample Period	Stress Episodes Sovereign CDS spread		
		> 300 bps	> 500 bps	> 1000 bps
ARGENTINA	2002-2020	2002-2020	2002-2005,2008-2016,2018-2020	2002-2005,2008-2010,2012-2016,2019,2020
BRAZIL	2006-2020	2008-2009,2015-2016,2020	--	--
CHINA	2002-2020	--	--	--
COLOMBIA	2002-2008	2002-2005, 2008	2002-2004	2002
EGYPT	2003-2006,2012-2020	2003,2012-2020	2012-2014,2020	--
INDIA	2004-2020	2008-2009,2011-2013	--	--
INDONESIA	2005-2020	2008, 2009	2008, 2009	--
MALAYSIA	2011-2020	--	--	--
PAKISTAN	2010-2020	2010-2020	2010-2016,2020	2011-2012
PERU	2013-2019	1998-2001	1998-2001	--
PHILIPPINES	2007-2020	2008-2009	--	--
POLAND	2011-2020	--	--	--
ROMANIA	2003-2020	2003, 2008-2012	2008-2009	--
RUSSIAN FEDERATION	1998-2020	1998-2003,2008-2009,2014-2016	1998-2002,2008-2009,2015	1998-2000
SOUTH AFRICA	2013-2020	2014-2016, 2020	--	--
THAILAND	2013-2020	--	--	--
TURKEY	2002-2020	2002-2005, 2009, 2012, 2018-2020	2002-2004, 2020	2002-2003
VIETNAM	2004-2020	2004,2008,2011-2012	2008	--

Note: A year is labeled as a stress episode if the monthly average of sovereign CDS spread breaches a given threshold at least once in a given year or the sovereign is in outright default following Reinhart-Rogoff (2011) or S&P long-term foreign-currency rating of "CCC-" or lower. For India, the CDS is of the State Bank of India.

Table A.I.3. Data Description and Sources

Variable	Description	Source
Macroeconomic and Financial Variables [Country-Level]		
Banking crisis	A banking crisis as an event that meets two conditions: i) Significant signs of financial distress in the banking system (as indicated by significant bank runs, losses in the banking system, and/or bank liquidations); ii) significant banking policy intervention measures in response to significant losses in the banking system.	Laeven and Valencia (2018); Harvard Business School Global Crises Data by Country
Credit to GDP	Private sector credit as a share of GDP	World Bank, World Development Indicators
Currency crisis	A currency crisis is defined as an annual depreciation versus the relevant anchor currency (e.g., the US dollar) of 15% or more. An inflation crisis is defined as an annual rate of inflation of 20 percent or more.	Harvard Business School Global Crises Data by Country
Exchange rate depreciation	Change in local currency per US dollar (nominal)	IMF, World Economic Outlook
Expected Default Frequency (EDF)	CDS-implied Expected Default Frequency over a one-year horizon	Moody's analytics
Fiscal shock	Dummy variable equal to one for sovereign CDS greater than 500 basis points	IHS Markit and staff calculation
GDP per capita	Real GDP per capita	IMF, World Economic Outlook
Global financial conditions index	For methodology and variables included in the financial condition index, refer to Annex 3.2 of the October 2017 Global Financial Stability Report. Positive values of the index indicate tighter-than-average financial conditions	IMF staff estimates
Inflation	CPI growth	IMF, World Economic Outlook
Interest payment	General government interest expense in percent of GDP	IMF, World Economic Outlook
Interest rate	Short-term interest rate	IMF, World Economic Outlook
Policy rate	The rate used by central banks to implement or signal its monetary policy stance	IMF, World Economic Outlook
Public debt	General government gross debt (all or in foreign currency)	IMF, World Economic Outlook, Institute of International Finance
Recession	Dummy variable equal to one for two consecutive negative quarter-over-quarter real growth rates	IMF, World Economic Outlook and staff calculation
Short-term external debt-to-reserves	Short-term external debt to international reserves (including Fund position)	IMF, World Economic Outlook
Sovereign CDS Spreads	Markit 5-year sovereign CDS spreads (monthly) with coupon rate of 100 bps	IHS Markit
Sovereign default event	Domestic sovereign debt default or external sovereign debt restructuring based on Reinhart and Rogoff (2011). The dataset is updated by the Harvard Business School	Harvard Business School, Global Crises Data by Country
Sovereign default rating	Standard & Poor's foreign currency long-term sovereign default rating	Standard & Poor's
Stock market capitalization	Stock market capitalization as a share of GDP	World Bank, World Development Indicators
Tax revenue	General government tax revenue in percent of GDP	IMF, World Economic Outlook
Term spread	10-year government bond yield minus 3-months government bond yield	Datastream, and staff calculation
US dollar index	Nominal broad U.S. dollar index	FRED
VIX	CBOE's options-implied volatility index for S&P 500	Chicago Board Options Exchange
Yields of JP Morgan Global Bond index	Spreads correspond to the difference between a bond's yield and the linearly interpolated yield of the two base curve bonds that bracket the maturity of this bond	Bloomberg
WEO GDP forecast	Historical forecasts vintages of one year-ahead change in GDP	IMF, World Economic Outlook vintage
Financial Variables [Bank-Level]		
Borrowing cost	Banks' Interest Expense to Interest-Bearing Liabilities	Fitch Connect
Bank size	Log of bank total assets	Fitch Connect
Capital ratio	Book value of total equity divided by total assets	Fitch Connect
Central bank exposure	Total exposure to central bank divided by total assets	Fitch Connect
Deposits to assets	Book value of deposits divided by total assets	Fitch Connect
Expected Default Frequency (EDF)	CDS-implied Expected Default Frequency over a one-year horizon	Moody's analytics
Government bonds' exposure	Total book value of government bond holdings divided by total assets	Fitch Connect
Government bonds holdings	Total book value of government bond holdings	Fitch Connect
Government ownership	Government ultimate ownership dummy (equals one if government ownership is greater than 50 percent)	Orbis

Table A.I.3. Data Description and Sources (Concluded)

Variable	Description	Source
Interbank ratio	Interbank balance divided by total assets	Fitch Connect
Loans to deposits	Total outstanding gross loans divided by total deposits	Fitch Connect
Net purchases	Log change in banks' holding of sovereign debt	Fitch Connect
Net open position	Bank foreign-currency net open position divided by total equity	Fitch Connect
Nonperforming loans		
Noncash ratio	total assets minus cash and due from banks, divided by total assets	Fitch Connect
Profits	Pre-tax profits (operating profits + net non-recurring income + other non-operating income and expenses + equity-accounted Profit/Loss non-operating + change in fair value of own debt)	Fitch Connect
Return on assets	Bank operating income divided by total assets	Fitch Connect
Stock market return	First log difference of the stock market index	Datastream, and staff calculation
Support rating floor	Fitch's rating on a potential supporter's propensity to support a bank and of its ability to support it. Support Rating Floors do not assess the intrinsic credit quality of a bank. Rather they communicate the agency's judgment on whether the bank would receive support should this become necessary.	Fitch Connect
Total capital	Book value of total equity ratio	Fitch Connect
Total loans	Total principal amount of all loan facilities extended by the bank to its customers (excluding loans to financial institutions), before the deduction of any loan loss reserves	Fitch Connect
Total stock return index	Equity index that tracks both the capital gains as well as other cash distributions, such as dividends or interest, attributed to the index constituents	Refinitiv Datastream
Additional bank-level data		
Holdings of domestic sovereign bonds and additional breakdowns	The database contains bank-level holdings of domestic sovereign bonds (DSB) across 13 emerging markets. The data was gathered from accounting statements and Pillar III disclosures of individual banks. Whenever disclosed, the sovereign bond holdings were further broken down into the nationality and currency of issuance, the level of the issuing governmental body (central government, regional/municipal governments, government agencies, central bank) as well as type of ownership (proprietary VS retained collateral of REPO counterparties). This granularity allows to extract the precise exposure of banks to DSB, while external data providers usually report gross positions, which in some cases exceed the correct exposure by over 3 times.	Accounting statements and Pillar III banks' disclosures.
Nonfinancial-Corporates-level Variables		
Bound	Dummy indicating whether S&P score of a firm is equal or above its country's S&P sovereign score	S&P Capital IQ and staff calculation
Capex	Capital Expenditure, millions of US dollars	S&P Capital IQ
Investment ratio	The ratio of capital expenditures to lagged net property, plant, and equipment	S&P Capital IQ
Debt issuance ratio	Net debt issuance to lagged total assets ratio	S&P Capital IQ
Cash flow	Cash flow from financing, millions of US dollars	S&P Capital IQ
Cash holding	Cash and short-term investments, millions of US dollars	S&P Capital IQ
Leverage	Companies' total liabilities to total equity ratio	S&P Capital IQ and staff calculation
Government ownership dummy	Dummy indicating whether a company is "Public Company" or a "Government Institution", or a "Public Investment Company"	S&P Capital IQ and staff calculation
S&P outlook	S&P outlook converted to numerical valuesas	S&P Capital IQ and staff calculation
S&P score	S&P rating for companies converted to numerical values	S&P Capital IQ
Tobin's Q	The ratio of (total asset plus total market capitalization minus common equity) to total assets	S&P Capital IQ and staff calculation

Table A.I.4 Summary Statistics

Country-Level Analysis	Mean	SD	p25	p50	p75	min	max
Banking crisis	0.2	0.4	0	0	0	0	1
Credit to GDP	71.9	40.7	39.6	66.6	98.6	11.1	222.4
Currency crisis	0.3	0.5	0	0	1	0	2
Exchange rate depreciation	4.8	17.2	-3.3	1.5	9.1	-28.1	210.8
Expected Default Frequency (EDF), banks	1.1	0.9	0.5	0.9	1.4	0.1	9.3
Expected Default Frequency (EDF), corporates	1.5	1.4	0.3	1	2.3	0	9.5
Expected Default Frequency (EDF), sovereign	0.3	1.6	0	0	0.1	0	50
GDP per capita	3.4	8	0	0.1	0.6	0	41
Inflation	5.9	7.2	2.5	4	6.5	-2	56.2
Interest payment	2.7	2.2	1.2	2.2	3.4	0	17.7
Interest rate	7.1	6.5	3.3	5.4	8.4	0	48.5
Policy rate	6.7	6.2	3.3	5.5	8	0	53.7
Public debt	49.9	26.8	32.5	45.8	63.6	3.2	171.1
Public Revenue	26.4	9.2	19.9	25.4	32.6	8.5	49.1
Stock market capitalization	40.9	29.6	18.3	34.5	60	0.3	125.7
Stock market return	0	0.1	0	0	0.1	-0.4	0.4
WEO GDP forecast	5.1	2.3	3.5	5.4	6.7	-1.6	10
Yields of JP Morgan Global Bond index	6.4	2.1	4.3	8.3	6.3	2.6	12
Sovereign Exposure Channel Analysis [Bank-Level]	**Mean**	**SD**	**p25**	**p50**	**p75**	**min**	**max**
Banks' sovereign debt exposure	12.6	9.9	5.3	9.8	18.1	0.0	52.3
Borrowing cost	5.2	3.5	2.6	4.5	6.4	0.6	34.8
Capital ratio	0.1	0.1	0.1	0.1	0.1	0.0	0.9
Central bank exposure	7.9	7.4	2.9	5.8	11.3	0.0	60.7
Deposits to assets	64.7	19.3	56.4	69.2	78.8	1.4	93.4
Fiscal shock	0.1	0.3	0.0	0.0	0.0	0.0	1.0
Government bonds' exposure	0.1	0.1	0.1	0.1	0.2	0.0	0.9
Interbank ratio	9.1	9.9	2.0	5.7	12.9	0.0	71.5
Loans to deposits	112.1	267.3	66.0	82.7	103.5	4.3	5395.6
Net open positions (percent of equity)	-0.1	1.7	0.0	0.0	0.1	-30.2	3.9
Net purchases	0.2	0.9	0.0	0.1	0.4	-7.7	8.6
Noncash ratio	92.3	6.9	89.2	94.0	96.9	39.9	100.0
Profits, change	1.2	2.5	0.6	1.2	2.0	-31.1	13.7
Return on assets	14.8	24.1	7.6	15.2	24.7	-353.7	408.7
Sovereign CDS Spreads	365.4	1008.0	91.0	143.1	255.8	13.5	9717.2
Sovereign default event	0.2	0.4	0.0	0.0	0.0	0.0	1.0
Sovereign default rating	11.7	3.1	10.0	12.0	14.0	4.0	20.0
Support rating floor	3.5	2.4	1.9	3.1	4.8	0.0	8.9
Total capital	0.1	0.1	0.1	0.1	0.1	0.0	0.9
Total loans	0.5	0.2	0.4	0.6	0.6	0.0	1.0
Safety Net Channel [Bank-Level]	**Mean**	**SD**	**p25**	**p50**	**p75**	**min**	**max**
Abnormal stock returns	-0.8	11.5	-7.1	-1.3	4.8	-50.2	88.0
Bank size	21.5	1.8	20.7	22.2	23.0	14.9	23.0
Central bank exposure	8.0	5.0	3.9	7.2	11.3	0.0	32.4
Government bond exposure	14.8	7.4	9.2	14.7	20.3	0.0	47.3
GUO_50_dummy	0.4	0.5	0.0	0.0	1.0	0.0	1.0
Interbank asset ratio	5.6	6.4	1.4	3.3	7.0	0.0	39.1
Leverage	91.0	3.2	88.5	91.5	93.8	74.8	95.4
Loan-to-asset ratio	60.4	9.6	55.2	61.8	66.1	28.5	91.1
Noncash asset ratio	91.2	5.1	88.3	92.3	94.8	64.7	99.9

Return on assets (ROA)	17.2	14.0	12.7	17.6	26.4	-71.9	67.9
Support rating floor (purged)	0.1	0.7	0.0	0.0	0.3	-3.0	3.7

Table A.I.4 Summary Statistics (Concluded)

Macroeconomic Channel [Firm-Level]	Mean	SD	p25	p50	p75	min	max
Bound	0.2	0.4	0.0	0.0	0.0	0.0	1.0
Capex	806.1	2648.0	53.6	179.6	609.1	0.0	50209.1
Cash flow	-1001.7	3130.3	-809.8	-246.9	-63.6	-67566.5	5362.8
Cash holding	-50.9	1569.1	-242.2	-26.0	104.8	-20504.0	32388.2
Debt issuance ratio, change	0.0	0.7	-0.4	0.0	0.4	-3.0	3.0
Investment ratio, change	-0.1	0.7	-0.5	-0.1	0.3	-3.4	3.4
Leverage	0.9	17.9	0.4	0.7	1.2	-1116.0	400.3
Nonperforming loans (NPL) ratio	7.8	15.8	2.6	3.9	8.0	0.5	218.1
Public company dummy	0.9	0.2	1.0	1.0	1.0	0.0	1.0
S&P score	13.5	3.2	12.0	13.0	16.0	2.0	19.0
Tobin's Q	1.5	1.0	1.0	1.2	1.6	0.2	17.5

Annex II. Structural Model Estimation and Model Extensions

Structural Model Identification. Our baseline model is a system of five endogenous variables specified as follows:

$$Ay_t = \tilde{a} + \tilde{A}_1 y_{t-1} + \cdots + \tilde{A}_p y_{t-p} + \tilde{\Gamma}_0 x_t + \cdots + \tilde{\Gamma}_q x_{t-q} + \epsilon_t \qquad \text{(A. II. I)}$$

The endogenous variables correspond to the sovereign EDF, bank EDF, nonfinancial corporates EDF, term spread and stock prices growth. Exogenous variables include a measure of global financial conditions (global financial condition index or vix), USD dollar broad index and the US corporate bonds spread. To estimate the structural parameters, we pre-multiply equation (A. II. 1) by A^{-1} and define $c \equiv A^{-1}\tilde{c}, A_i \equiv A^{-1}\tilde{A}_i, \tilde{\Gamma}_j \equiv A^{-1}\tilde{\Gamma}_j$, which yields:

$$y_t = c + \mathrm{A}_1 y_{t-1} + \cdots + \mathrm{A}_\mathrm{p} y_{t-p} + \Gamma_0 x_t + \cdots + \Gamma_q x_{t-q} + \mathrm{u}_\mathrm{t} \qquad \text{(A. II. 2)}$$

Here, u_t is a vector of reduce-form residuals. It is related to the structural shocks according to $\mathrm{u}_\mathrm{t} = A^{-1}\epsilon_t$. The matrices c, A_i, Γ_j and $\sum_u$ of model (A. II. 2) can be estimated consistently by ordinary least squares. To recover the structural parameters, the impact matrix is first estimated. From (A. II. 1) and (A. II. 2), $\sum_u = \mathrm{A}^{-1} \sum_\epsilon \left(A^{-1}\right)'$. In this system, the number of unknowns is larger than the number of independent equations. As additional information, the heteroskedasticity in the data is hence exploited.

For illustration of the approach, consider a bivariate system without constants, lags or exogenous variables. If there are two regimes in the variances of the structural shocks, e.g., low (L) and high (H), the system would be:

$$\begin{pmatrix} \omega_{11}^{L} & \omega_{12}^{L} \\ . & \omega_{22}^{L} \end{pmatrix} = \begin{pmatrix} a_{11}^{L} & a_{12}^{L} \\ . & a_{22}^{L} \end{pmatrix}^{-1} \begin{pmatrix} \sigma_{11}^{L} & \sigma_{12}^{L} \\ . & \sigma_{22}^{L} \end{pmatrix} \begin{pmatrix} 1 & -a_{12} \\ -a_{12} & \sigma_{22} \end{pmatrix}^{-1} \quad \text{(A. II. 3)}$$

$$\begin{pmatrix} \omega_{11}^{H} & \omega_{12}^{H} \\ . & \omega_{22}^{H} \end{pmatrix} = \begin{pmatrix} 1 & -a_{12} \\ -a_{21} & 1 \end{pmatrix}^{-1} \begin{pmatrix} \sigma_{11}^{H} & 0 \\ 0 & \sigma_{22}^{H} \end{pmatrix} \begin{pmatrix} 1 & -a_{12} \\ -a_{21} & \sigma_{22} \end{pmatrix}^{-1} \quad \text{(A. II. 4)}$$

While an additional volatility regime adds two new parameters to be estimated, the variances of the structural shocks, it also provides three new moments. It follows then that the system can be estimated as there as many independent equations as unknowns and the system can be solved. Table A.II.1 reports the number of days with changes in volatility for each endogenous variable.

Identification relies on a few relevant assumptions. First, the different types of structural shocks are uncorrelated. Second, the structural shocks are uncorrelated over time. Third, the ratio of the shock variances changes significantly across regimes. Fourth, A is constant across regimes.

Identification relies on a few relevant assumptions. First, the different types of structural shocks are uncorrelated. Second, the structural shocks are uncorrelated over time. Third, the ratio of the shock variances changes significantly across regimes. Fourth, A is constant across regimes.

Table A.II.1. Number of daily changes in volatility regimes

Country	Sovereign EDF	Bank EDF	NFCs EDF	Term spread	Equity prices	No volatility change
ARG	22	99	75	0	146	2,814
BRA	67	136	230	0	294	2,957
CHL	55	62	27	0	328	2,368
CHN	13	10	13	0	32	4,019
COL	81	20	24	64	65	3,275
IND	5	70	21	87	87	2,789
MYS	22	40	53	11	14	3,579
POL	23	164	87	224	179	3,445
THA	38	77	5	0	465	3,536
TUR	55	53	223	15	64	3,712
ZAF	0	65	54	365	243	3,395

Sources: Datastream, Haver, Moody's; Datastream; and authors' calculations.
Note: columns in the table report the number of days with unique changes in volatility for each endogenous variables described in the baseline model. The classification of the regimes follows the approach described in Rigobon (2003). Country labels use International Organization for Standardization (ISO) country codes. EDF = expected default frequency.

The first assumption is standard in structural vector autoregressions. Moreover, it is likely to hold in our setup as we control for common effects through macroeconomic news and other exogenous variables which can affect the endogenous variables simultaneously. To make the second assumption likely to hold, five lags of the endogenous variables are included although information criteria suggest less lags. This relatively high number of lags ensures that the reduced-form residuals are largely free of autocorrelation. For all variables except for stock returns, Portmanteau tests for lags 1 to 1–5 do not reject the null hypothesis of no autocorrelation at the 10% level.

The third assumption can be tested after estimation by formally evaluating the inferred relative changes in volatility. While theoretically two regimes can be enough for just identification, in practice larger systems tend to require more regimes as there are more shocks to be disentangled. More regimes enhance the likelihood of finding a regime for each shock where that shock changes significantly in volatility vis-a` -vis the other shocks. For this reason, five volatility regimes are used in the estimations. While four regimes are sufficient for identification, having one additional regime has the advantage that the fourth identifying assumption, the constancy of A, becomes overidentifying.

For robustness, the main results of the analysis are tested against the use of a different number of volatility regimes (four instead of five) and different lag structures (from two to five lags of the endogenous variables). Results remain broadly consistent. Note that the identification through heteroskedasticity yields consistent estimates even if the regimes are misspecified (see Rigobon, 2003).

Assessing the impact of global shocks. The analysis is then extended to examine the effect of global shocks and potential amplification effect through fiscal as well as financial vulnerabilities. To this aim, the model specified in equation A.II.1 is estimated using local projections at quarterly frequency to maintain consistency between the observable frequency of macroeconomic and financial variables. The model takes the following form:

$$y_{t+h} = \tilde{a} + \tilde{A}_1 y_{t-1} + \cdots + \tilde{A}_p y_{t-p} + \left(\tilde{\Gamma}_0 x_t + \cdots + \tilde{\Gamma}_q x_{t-q}\right) \text{x Vulnerability}_{\text{t-q}} + \cdots + \tilde{\gamma}_1 \text{Vulnerability}_{\text{t-1}} \ \ldots \ + \tilde{\gamma}_p \text{Vulnerability}_{\text{t-q}} + X_{t-q}\, \epsilon_t \,, \quad \text{(A. II. 5)}$$

Where y_{t+h} is the projection of endogenous variables at different time horizon h; and $\text{Vulnerability}_{t-1}$ is a pre-existing financial or fiscal vulnerability. Control variables are the same ones used in equation A.II.1. The following vulnerability measures are considered: total public debt and banks' government exposure (i.e., banks' government bond holdings to total assets). High level of vulnerability corresponds to a value of the metric one standard deviation higher than the average of its sample distribution. Results from this model are shown in Figure A.II.1.

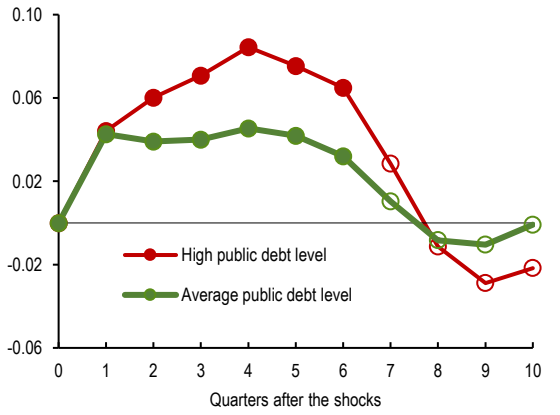
We find that following a tightening in global financial conditions, banks and corporates are the most affected. For example, a tightening in global financial conditions corresponding to half of the magnitude observed during the March 2020 financial market turmoil is associated with, on average, a 0.1 percentage point increase in sovereign default risk for emerging market with high public debt. Furthermore, the effect is persistent, lasting at least six quarters after the shock. Similarly, a strong and persistent effects are found for default risk of banks with larger exposure to sovereign debt. The effect of a tightening in global financial conditions on sovereign and bank EDFs are economically significant given that the median EDF is equal to 0.1 and 0.7 (respectively) across the sample.

For robustness, the main results of the analysis are tested against the use of a different number of volatility regimes and different lag structures. Results remain broadly consistent across these alternative specifications. It should be noted also that identification through heteroskedasticity yields consistent estimates even if the regimes are misspecified (see Rigobon, 2003). To test the sensitivity of the analysis on the choice of the global shock, VIX is used instead of the global financial condition index.

Figure A.II.1 The Impact of a Tightening of Global Financial Conditions on Sovereign and Bank Default Risk in Emerging Markets

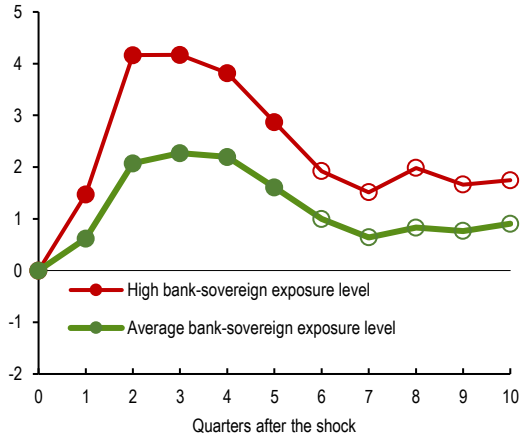
1. Cumulative Change in Sovereign Default Risk Following a Global Financial Conditions Shock

(Percentage points)



2. Cumulative Change in Bank Default Risks Following a Global Financial Conditions Shock

(Percentage points)



Sources: Haver Analytics; Moody's; Refinitiv Datastream; and authors' calculations.
Note: Panels 1 and 2 show results from local projection models in which the sovereign and banking default risks at quarterly frequency are regressed on lagged values of each other, controlling for other domestic and external factors, including a global financial conditions index and its interaction with an indicator variable identifying countries with high public debt or high bank-sovereign exposure (with high vulnerability identified as values of public debt to GDP or a ratio of banks' holdings of government debt to total banking sector assets that is one standard deviation above the sample average). Solid dots indicate statistical significance at 10 percent or lower.

Annex III. Examining the Presence of Moral Suasion and Risk-Shifting

Moral suasion and risk shifting have been identified as two key reasons for banks to hold sovereign debt besides their liquidity management motives. Moral suasion refers to government pressure on banks to purchase public debt; risk shifting can occur during times of sovereign distress when banks—in particular, those that are less capitalized— increase their sovereign debt exposure to take advantage of higher sovereign yields and thus potentially improve their positions. In effect, with risk-shifting banks take a bet on the ability and willingness of the sovereign to service its debt. While risk-shifting is initiated by the banks, moral suasion to hold public debt can be involuntary on the part of banks and due to governmental pressure. Acharya et al. (2015) and Ongena et al. (2019) provide evidence of these two motives in the context of the euro area sovereign debt crisis. We use bank-level data to show that moral suasion and risk-shifting are key reasons why emerging market banks hold sovereign debt.

To identify moral suasion and risk shifting, we exploit the variation in the types of banks that are more likely to be induced to hold more government debt during exogenous variations in fiscal need—such as domestic state-owned banks—with a particular focus on less-capitalized banks.

The baseline empirical specification that is estimated is thus as follows:

$$\begin{aligned} Net\ Purchases_{i,c,t} &= \beta_1 High\ Fiscal\ Need_{c,t-1} \times State\ Owned_{i,c,t-1} \\ &+ \beta_2 Capital\ Ratio_{i,c,t-1} \times State\ Owned_{i,c,t-1} + \beta_3 State\ Owned_{i,c,t-1} \\ &+ \beta_4 Capital\ Ratio_{i,c,t-1} + \Gamma X_{i,c,t-1} + \gamma_{c,t} + \gamma_i + \varepsilon_{i,c,t}\ , \end{aligned} \tag{A. III. 1}$$

Where $Net\ Purchases_{i,c,t}$ denotes the log change in total government debt holdings (normalized by total assets) of domestic bank i in country c from year t-1 to t, $High\ Fiscal\ Need_{c,t}$ is a binary variable that equals 1 if the expected maturing debt to total public debt ratio is above the country-specific 75th percentile over the sample period, $State\ Owned_{i,c,t}$ is a binary variable that equals 1 if a particular bank has more than 25 percent government ownership, $Capital\ Ratio_{i,c,t}$ is measured as the total equity-to-total assets ratio, and $X_{i,c,t}$ is a vector of bank controls that includes deposits-to-total assets ratio, total loans-to-deposits ratio and (log of) total assets. All independent variables are lagged one period. The baseline model includes country-time fixed effects ($\gamma_{c,t}$), which absorb any time-varying country characteristics, and bank fixed effects (γ_i), which absorb any time-invariant bank characteristics. The model is estimated for a sample of about 4,000 banks from 38 countries over 2011-2020 using ordinary least squares, and standard errors are clustered at the bank level.[1]

The model is estimated separately over the full sample and during periods of sovereign distress identified by the sovereign CDS spread higher than a given threshold. The key coefficients of interest are β_1 (moral suasion) and β_2(risk shifting). To identify the presence of moral suasion for state-owned banks, we would expect β_1 to be larger during sovereign distress, as the government pressures state-owned banks to purchase more debt. To identify the presence of risk shifting, we would expect β_3 to be significant only during times of sovereign distress and not over the entire sample period, suggesting that weaker banks would buy riskier debt.[2]

[1] The variables in the regressions are winsorized at 1 percent in both tails of the distribution to mitigate any undue effects of outliers. In addition, to reduce outlier bias and noise in the data, banks with total assets less than $100,000, or banks with missing information on total assets, with government debt securities-to-total assets ratio greater than 1, loans-to-total assets ratio below 1 percent or above 100 percent, deposits-to-total assets less than 1 percent, and negative total equity or Tier 1 capital, are excluded from the sample. Further, to be included in the dataset, banks are required to have data for at least 5 consecutive years.

[2] Based on data availability, the final model includes 38 countries in normal times and 8 countries during times of sovereign distress. Maturing debt is available from 2011 onward, leading to a regression sample period of 2011-2020. Note also that the dataset does not allow to split sovereign bonds into domestic versus foreign bonds, or by currency. Therefore, it is not possible to analyze the relative attractiveness of foreign versus domestic bonds or the relative attractiveness of investing in foreign currency denominated bonds. While using the overall exposure to government in the analysis corresponds to assuming a strong home bias, the existence of a strong home bias has been reported in previous empirical literature (see, for example, Dell'Ariccia et al., 2018) and the share of foreign banks in government debt holdings is also generally low in emerging markets such an assumption should not imply any loss of generality in the interpretation of the results.

Table A.III.1. Regression Results for the Drivers of Bank's Sovereign Debt Holdings

Moral suasion and risk-shifting motives

	Bank-level (full)		Bank-level (sovereign distress)	
State Owned	10.06	9.99	26.80***	25.88*
	(7.10)	(6.85)	(8.85)	(14.20)
High Need x State Owned	9.81*	9.88*	26.34*	25.75*
	(5.85)	(5.85)	(14.02)	(13.09)
Capital Ratio x State Owned	-6.63	-4.95	-21.64***	-24.28***
	(5.45)	(5.34)	(8.21)	(8.93)
Capital Ratio	8.92***	5.31*	17.80**	4.35
	(2.55)	(2.72)	(7.53)	(7.73)
Deposits/Assets		-0.11		0.14
		(0.22)		(0.54)
Loans/Deposits		0.03		-0.02
		(0.02)		(0.07)
Total Assets		-14.29**		-92.33***
		(5.73)		(17.65)
Bank FE	Yes	Yes	Yes	Yes
Country FE x Year FE	Yes	Yes	Yes	Yes
Observations	4,087	4,087	529	529
R-squared	0.28	0.28	0.31	0.35
Number of banks	665	665	111	111
Number of countries	38	38	8	8

Sources: Bloomberg Finance L.P.; Fitch Connect; IHS Markit; IMF, Monetary and Financial Statistics and World Economic Outlook databases; Standard & Poor's Capital IQ; and authors' calculations.

Note: The table reports results from bank-level panel regressions based on a sample period from 2011-20. The dependent variable is bank net purchases of soveriegn debt, measured as the log change in bank holdings. Sovereign distress is a dummy variable equal to 1 when the sovereign CDS is higher than 500 bpts, or S&P long-term rating for sovereign FX debt is CCC- or lower, or the government is in external/domestic default according to the Harvard Business School Global Crises Data by Country; 0 otherwise. The capital ratio is reported in terms of its standard deviation. All independent variables are lagged and all regressions include bank and country-year fixed effects. Standard errors are clustered at the bank level. ***, **, * denote significance levels at 1, 5 and 10 percent respectively

Table A.III.1 reports the regression results. We find that state-owned bank's net purchases of domestic sovereign bonds are around 10 percentage points higher than private banks during times of high fiscal need. During periods of high fiscal need when the sovereign is in distress, state-owned banks are more than twice as likely to purchase sovereign bonds, as their net purchases are 26 percentage points higher. Furthermore, during times of sovereign distress the net purchases of sovereign bonds of less-capitalized state-owned banks are over 20 percentage points higher. While it is possible that governments in emerging markets put more pressure on weaker state-owned banks in general, this coefficient is significant only during episodes of sovereign distress and not over the full sample, pointing toward the existence of some risk-shifting activities by more vulnerable banks when sovereign yields spike.

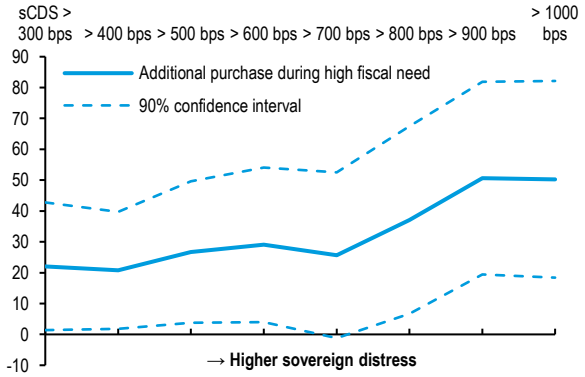
Notably, moral suasion and risk shifting are amplified at higher levels of sovereign distress. To analyze the non-linear effects, equation A.III.1 is estimated for different levels of sovereign distress. Figure A.III.1 reports the estimation results of β1 and β2 in periods when the sovereign CDS is higher than a threshold (300 bps, 400

bps, ..., or 1000 bps), or S&P long-term rating for sovereign FX debt is CCC- or lower, or the government is in external or domestic default.

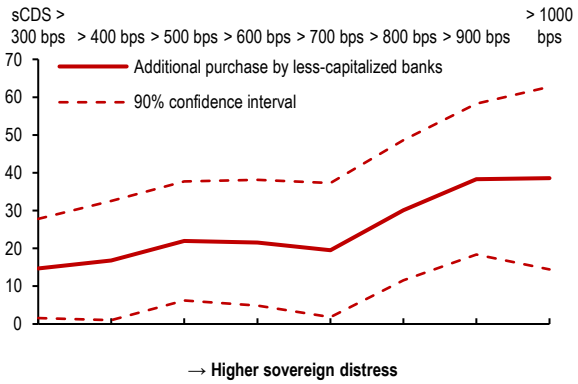
State-owned banks' additional purchases of domestic sovereign bonds during high fiscal need periods almost double from 26 to 50 percentage points when the sovereign CDS threshold increases from 500 bps to 1000 bps. Less-capitalized state-owned banks' additional purchases increase by over 1.5 times to around 40 percentage points when the threshold sovereign CDS increases from 500 bps to 1000 bps.

Figure A.III.1 Moral Suasion and Risk Shifting: Threshold Effects

1. Net Purchases of State-Owned Banks During High Need Periods (Moral Suasion)
(Percentage points, one year ahead)



2. Net Purchases of State-Owned Banks That are Less Capitalized (Risk-Shifting)
(Percentage points, one year ahead)



Sources: Bloomberg, Fitch Connect, World Economic Outlook; and authors' calculations.
Note: The figures summarize results from bank panel regressions with fixed effects. The dependent variable is net puchases of soveriegn debt (log change in bank's sovereign bank holdings). The line for "moral suasion"corresponds to the effect for state-owned banks during episodes of high fiscal need, or when expected maturing debt as a share of total debt is above the 75th percentile for the sample period. The line for "risk shifting" correspondongs to the effect for state-owned banks that have a capital ratio which is standard deviation below the mean. Sovereign distress corresponds to periods when tthe sovereign CDS is higher than a threshold (300 bpts, 400 bpts, ..., or 1000 bpts), or S&P long-term rating for sovereign FX debt is CCC- or lower, or the government is in external/domestic default according to the Harvard Business School Global Crises Data by Country. All regressions include bank controls and bank and country-year fixed effects. Standard errors are clustered at the bank level. Bands indicate 90% confidence intervals.

Overall, the results confirm that domestic state-owned banks, generally dominant in emerging markets and potentially more likely to be induced to hold government debt (Ongena, Popov, and Van Horen 2019), purchase significantly more sovereign debt in times of high fiscal need or when the sovereign is in distress. However, there is no such evidence of government pressure on private banks.

Moreover, less-capitalized state-owned banks are more likely to purchase sovereign debt during periods of sovereign distress. This pattern suggests the presence of a moral suasion motive, but there may also be a risk-shifting strategy (Acharya et al. 2018), whereby less-capitalized state-owned banks are more willing to take on additional risk and improve their capital positions by purchasing high-yield debt in emerging markets.

PUBLICATIONS

The Sovereign-Bank Nexus in Emerging Markets in the Wake of the COVID-19 Pandemic
Working Paper No. WP/2022/223