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Stress Relief? Funding Structures and Resilience to the Covid Shock

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Abstract

This paper explores whether different funding structures—including the source, instrument, currency, and counterparty location of funding—affected the extent of financial stress experienced in various countries and sectors during the Covid-19 spread in early 2020. We measure financial stress using a new dataset on changes in credit default swap spreads for sovereigns, banks, and corporates. Then we use country-sector and country-sector-time panels to assess if these different funding structures mitigated—or amplified—the impact of this risk-off shock. A higher share of funding from non-bank financial institutions (NBFI) or in US dollars was correlated with significantly greater stress, while a higher share of funding in debt instruments (instead of loans) or cross-border (instead of domestic) did not significantly impact resilience. The results suggest that macroprudential regulations should broaden their current focus to take into account exposures to NBFI and dollar funding, giving less priority to regulations focused on residency (i.e., capital controls). After the sharp increase in financial stress in early 2020, policy responses targeting these structural vulnerabilities (i.e., US$ swap lines and policies focused on NBFIs) were more effective at mitigating stress related to these funding structures than policies supporting banks, even after controlling for macroeconomic policy responses.

Topics: Coronavirus disease (COVID-19), Exchange rates, International topics, Financial institutions, Financial stability, Financial system regulation and policies

JEL codes: E44, E65, F31, F36, F42, G18, G23, G38

Résumé

Nous examinons l'influence des caractéristiques des structures de financement (la source, l'instrument et la devise de financement, ainsi que l'origine géographique de la contrepartie) sur l'ampleur des tensions financières survenues dans plusieurs pays et secteurs durant la propagation de la COVID-19 au début de 2020. Nous mesurons ces tensions à l'aide d'un nouvel ensemble de données sur les changements relatifs aux primes de risque des swaps sur défaillance pour les États, les banques et les sociétés. Nous utilisons ensuite des données de panel à effets fixes pays-secteur et pays-secteur-temps pour évaluer si ces diverses structures de financement ont contribué à l'atténuation – ou à l'amplification – des effets du choc attribuable au contexte d'aversion au risque. Une part plus importante de financement provenant d'institutions financières non bancaires ou de financement en dollars américains est corrélée à des tensions nettement plus élevées. Cependant, une part plus élevée de financement provenant de titres de dette (au lieu de prêts) ou de contreparties étrangères (plutôt que nationales) n'a pas d'impact notable sur la résilience. Les résultats portent à croire que la réglementation macroprudentielle devrait être élargie pour tenir compte de l'exposition au financement provenant d'institutions financières non bancaires et au financement en dollars américains, et qu'elle devrait accorder une importance moindre aux règlements axés sur

l'origine géographique des parties (autrement dit, axée sur le contrôle des mouvements de capitaux). Après la hausse marquée des tensions financières au début 2020, les mesures publiques ciblant ces vulnérabilités structurelles (accords de swap en dollars américains et politiques axées sur les institutions financières non bancaires) se sont avérées plus efficaces pour atténuer les tensions liées aux structures de financement comparativement à celles visant à soutenir les banques, et ce, même en tenant compte des mesures macroéconomiques mises en place.

Sujets : Maladie à coronavirus (COVID-19); Taux de change; Institutions financières; Stabilité financière; Réglementation et politiques relatives au système financier; Questions internationales

Codes JEL : E44, E65, F31, F36, F42, G18, G23, G38

I. Introduction

In March 2020, as Covid-19 evolved into a global pandemic, central banks intervened with unprecedented policy packages to stabilize financial markets and provide liquidity (English, Forbes, and Ubide, 2021). This intervention was disheartening for policymakers who had hoped that the widespread financial and regulatory reforms over the past decade had strengthened the resilience of financial systems so that they would not need another "once in a lifetime" support package just twelve years after the 2008/9 Global Financial Crisis. On a more positive note, the reforms appeared to have been successful at bolstering the resilience of banking systems to this extreme risk-off shock. But did the reforms simply shift risky exposures from banks to non-bank financial institutions (also referred to as "shadow banks") and other less regulated sectors of the economy?[1] Or, even if risky exposures declined in aggregate, did changes in financial intermediation increase vulnerabilities in unexpected ways?

We address these questions by assessing which funding structures were most vulnerable during the period of acute financial stress in 2020. We focus on banks and corporates (i.e., non-financial institutions) and evaluate the importance of the source of funding (from households, banks, or non-bank financial institutions), the instrument of funding (loans versus debt markets), the currency of funding (US dollar versus other currencies), and the geographical location of the counterparty (domestic or cross-border). Our results suggest that some funding structures were correlated with a significant increase in sensitivity to the extreme risk-off shock in early 2020: namely, dependence on non-bank financial institutions (henceforth, NBFIs) and US dollars (henceforth, US$). More specifically, banks which were more reliant on funding from NBFIs experienced significantly more stress, and those more reliant on funding from household deposits experienced significantly less stress. Banks and, in some specifications, corporates were also significantly more affected if they relied more on US$ funding. In contrast, whether funding in either sector was obtained via loans (instead of debt markets) or cross-border (instead of domestically) did not significantly affect resilience during March 2020. After financial stress spiked, policy responses targeting these specific vulnerabilities (i.e., NBFI-focused policies and US$ swap lines) were successful at significantly mitigating the increase in credit default swap (CDS) spreads. In contrast, policies that eased banking regulations more generally did not significantly reduce stress related to these vulnerabilities, and the highly targeted policies were important even after controlling for macroeconomic policies supporting the broader economy (such as fiscal and monetary stimulus and general liquidity provision).

This paper makes several contributions to the rapidly growing literature evaluating financial vulnerabilities during Covid (e.g., Falato, Goldstein, and Hortaçsu, 2021; Acharya, Engle, and Steffen, 2021; Aramonte, Schrimpf, and Shin, 2022) and evaluating the success of macroprudential reforms to date (Forbes, 2021; Chari, Dilts Stedman, and Forbes, 2022). First, it uses sectoral data to better capture the relationships between financial stress and funding structures—not just across countries, but also across different sectors within a country. This is important, as macroprudential reforms may have bolstered

[1] While the term "shadow banking" was commonly used in the years after the 2007/8 Global Financial Crisis, it is increasingly replaced by "non-bank financial institutions" or "non-bank financial intermediation." The latter terms indicate more clearly that such intermediation could occur through bank-like institutions as well as through more market-based forms. For more information on non-bank financial intermediation, please see Section II.A. Claessens et al. (2021) finds that net tightening of domestic macroprudential policies increases the activities of non-bank financial institutions and decreases bank assets, raising the share of these activities in total financial assets.

certain segments of the economy (such as banks) but simultaneously increased the vulnerability of other sectors. This is a broader focus than most other work, which tends to focus on just one sector. Second, the paper focuses on high-frequency data on CDS spreads by sector. This involved a substantial data compilation effort but is useful for capturing short-lived periods of financial stress, including stress for different reasons (from liquidity issues to solvency concerns) as well as for different periods across countries and sectors.[2] Third, we simultaneously focus on a broader set of vulnerabilities and changes in financial intermediation than covered by other work. This includes not only shifts in the sources of financial intermediation (such as through NBFIs, as discussed in FSB, 2020a; Chari, 2022), but also the extent of internationalization (through currency or cross-border exposures) and the instrument of funding (such as through loans versus debt markets). Although some of these characteristics are highly correlated, identifying exactly which aspects of funding are more closely correlated with resilience is important. Fourth, we focus on the extreme risk-off period in March 2020, as this is the first opportunity to evaluate how the widespread macroprudential reforms and corresponding changes in funding structures over the previous decade affected the resilience of financial systems. Finally, this episode also allows us to evaluate the effectiveness of different responses to a severe risk-off event in the post-2008 financial system. This has important implications for whether more targeted policies that focus on specific vulnerabilities could be an important complement to (or even substitute for) the broader policies that have recently been key components of the response to negative shocks (such as changes in interest rates, asset purchases, and reductions in macroprudential buffers).

This paper begins with a brief review of the large and long-standing literature on the vulnerabilities from different forms of financial intermediation that are the focus of the empirical analysis. This includes vulnerabilities associated with banking intermediation, non-bank financial intermediation, foreign exchange exposure, and cross-border borrowing. The literature review also highlights key papers in the very recent literature discussing the period that is the focus of this paper: the heightened market volatility and financial stress during the early stages of the Covid pandemic.

The paper then introduces the key measure of financial stress used throughout the analysis: a measure calculated at a daily frequency and by sector and country. This measure is constructed from a newly created database with information on 2,532 CDS series, covering 68 countries with information for three sectors: sovereigns, banks, and corporates.[3] This high-frequency, cross-sector-country measure allows us to use two different empirical frameworks for the main analysis: a *country-sector* panel that controls for country and sector fixed effects, and a *country-sector-time* panel that also incorporates the time-series dimension. We use this data to calculate measures of financial stress during the *Covid Shock*, which we define in our baseline as the log change in CDS from January 1 to March 23, 2020 (when most measures of stress peaked and before the numerous support packages from central banks and governments were announced). Focusing on the short window is important, as tests of the impact of policy changes over longer periods of time could miss important effects during periods of stress, as highlighted in Chari, Dilts Stedman, and Forbes (2022).[4] An initial comparison of these CDS series shows

[2] See Berndt et al. (2018) for a discussion of the advantages and disadvantages of using CDS to measure credit risk and Eisfeldt et al. (2022) for a discussion on pricing sensitivity in OTC markets.

[3] Funding vulnerabilities of the sovereign sector are not a direct focus of this paper, but we use the sovereign as a benchmark to better identify developments in the bank and corporate sectors.

[4] This approach is similar to that of Acharya, Engle, and Steffen (2021), which examines banks' daily excess stock returns during the same period to assess the role of balance sheet liquidity risk, including credit line commitments.

that the CDS for banks increased less than for corporates and sovereigns during the *Covid Shock*, consistent with arguments that macroprudential reforms over the last decade meaningfully improved the resilience of banking systems. There is also substantial variation in these changes in CDS spreads across countries and sectors but particularly across banking sectors.

Could these differences in resilience reflect different funding structures across countries and sectors? In order to explore any potential relationships, the paper then builds on prior literature and empirical evidence to develop a framework that decomposes different funding structures into key components that could affect the extent of financial stress experienced in different sectors and countries during the *Covid Shock*. It focuses on two forms of financial *intermediation*: the source of funding (with banks funded from deposits, other banks, or NBFIs, and corporates funded by banks or NBFIs) and the instrument of funding (loans or other instruments, which are primarily debt markets). It also focuses on two forms of financial *internationalization*: the currency of funding (either US$ or local currency) and the location of the counterparty (either cross-border or domestic). This discussion also includes more information on the diverse datasets used to compile information on these different funding structures, relying heavily on several sources from the BIS with direct or indirect information on the balance sheets of corporates and banks. An initial look at how this data on funding structures correlates to measures of sector-country stress generally supports previous literature.

Next, this paper shifts to the main focus: regression analysis of the relationship between financial stress during the *Covid Shock* and pre-pandemic funding structures. We use two empirical methodologies: one focuses on the relative resilience of different sectors within countries over the full period of the *Covid Shock* (the *country-sector* approach), and one focuses on daily changes in financial stress within each sector-country pair (the *country-sector-time* approach). We examine the role of different forms of financial *intermediation* individually, then different forms of financial *internationalization*, and finally combinations of these different funding structures simultaneously. Several patterns occur consistently across specifications. Banks with a higher share of funding from NBFIs were less resilient during the *Covid Shock*, and those that were more reliant on funding from household deposits were significantly more resilient. Banks—and, in some specification, corporates—with a higher share of funding in US$ were also significantly less resilient. In contrast, there is only weak evidence on whether funding through loans (instead of debt markets) increased resilience and no consistent evidence on whether obtaining funding domestically (instead of cross-border) affected resilience for either banks or corporates. These findings are fairly consistent across specifications, including for a series of sensitivity tests that contain different control variables (including for asset composition), exclude emerging markets, and adjust the timing of the window defined as the *Covid Shock*.

By the end of April 2020, however, the financial stress experienced in some sectors and related to certain funding structures fell significantly. Why were banks with greater exposure to NBFI funding and US$ funding no longer experiencing significantly greater stress in April—with no comparable reduction in stress for corporates with similar vulnerabilities? Were policy responses to the *Covid Shock* aimed specifically at the vulnerabilities around NBFI funding or dollar funding more important than policies aimed specifically at banks or at easing broader financial conditions? To answer these questions, the paper then tests how different policy responses in March and April of 2020 affected the stress related to certain funding structures and forms of financial intermediation. In other words, after the risk-off shock occurred, which policies were most effective at stabilizing the stresses highlighted in the earlier part of the paper? The ability to identify the impact of different policies during this period is challenging, however, as most

countries enacted multiple policies around the same time to address a range of concerns around market liquidity and other aspects of market functioning as well as to support growth, incomes, and employment and slow the spread of the virus. The *country-sector* framework used in this paper can help solve this identification challenge by isolating the differential impact on specific structures across sectors within each country. The daily data used in the *country-sector-time* framework also allows us to identify the immediate impact of key policy announcements on financial stress across sectors. Put slightly differently, our approach allows us to better test exactly which policies reduced stress related to specific structures that are linked to fragility and which policies "broke the link" between higher global volatility and country-sector stress.

Critical to this approach is the ability to integrate our analysis with a new and extremely rich high-frequency dataset on policy responses during Covid from Kirti et al. (2022). This data includes over 5,000 policy announcements classified into 28 granular policy categories for 74 countries on a daily basis during the early stage of the pandemic. The policies cover a wide range of announcements, which we divide into three broad categories. First are "structure-specific policies" (or "targeted policies"), which include granular information on policies related to NBFIs, market-based intermediation, and central bank swap lines. The first two could affect the vulnerabilities identified above related to NBFI funding, and the last could affect the vulnerabilities associated with dollar funding (or, more generally, foreign currency funding). Second are "bank-specific" policies, which include a variety of changes to prudential regulation, including changes to macroprudential buffers (which have received substantial attention recently in policy circles). Finally, there are "economy-wide" policies, such as changes to the central bank's policy interest rate, asset purchases, liquidity policy, and fiscal policy. All of these policies were used extensively during the *Covid Shock* to support the broader economy but could also have affected the relationship between funding structures and CDS spreads.

The results show that some structure-specific policies were effective at alleviating specific forms of financial stress. More specifically, policies aimed at supporting NBFIs significantly reduced the stress experienced by banks that were more reliant on NBFI funding. New US$ swap lines also significantly reduced the stress related to FX funding by banks, providing evidence on the channels through which US$ swap lines reduced strains in funding markets (see Goldberg and Ravazzolo, 2021). These structure-specific policies appeared to be more effective at reducing the forms of stress identified in banks than policies easing broader bank regulations and buffers. These very targeted policies also significantly improved resilience when controlling for policies aimed at supporting the broader economy, suggesting that economy-wide policies (such as adjusting interest rates, purchasing assets, and adopting broader liquidity programs) were not able to get "in all of the cracks" of the financial system (Stein, 2013).[5]

A number of caveats are important for interpreting this paper's results. This analysis focuses on only one episode—the period of acute financial stress during the first months of the Covid pandemic. Relationships may be different during this period than during other periods of financial stress, especially as the shock was not generated by the usual boom-bust financial cycle but instead was generated by a pandemic and the corresponding government restrictions. This focus on one period severely limits the degrees of freedom and thereby limits our ability to include as extensive a set of controls as we would like

[5] Stein (2013) makes this point for the impact of tighter monetary policy and does not specifically discuss whether the effect would be symmetric for an easing of policy and/or other broad policies (such as asset purchase or fiscal policy).

in some specifications. Also, the analysis identifies correlations between different funding structures and the extent of financial stress but not the underlying factors, which could drive the evolution of these structures and which could in turn reflect underlying vulnerabilities (i.e., endogeneity).

Overall, however, the results should contribute to the rapidly growing body of literature that helps understand the financial fragility in the spring of 2020 and sets priorities for the next phase of financial regulation. The results highlight the importance of focusing on vulnerabilities related to NBFIs and dollar exposures—especially in banks. The fragilities related to these exposures that became apparent in the spring of 2020 suggest that although the post-2008 regulatory reforms have improved the resilience of banks, there is still more work to be done. Our findings also highlight priorities for regulations related to international exposures. The evidence that the currency of the funding—rather than whether the funding is cross-border—is more important during a period of stress suggests that macroprudential regulations (which focus on the currency of the transaction) would be more effective at reducing vulnerabilities in the future than capital controls (which focus on the residency of the parties to the transaction).[6]

The results also provide guidance, and raise important questions, on how to best address certain periods of financial stress that could emerge in the future. In situations where key vulnerabilities contributing to financial stress can be identified (such as in NBFIs or from US$ exposure), policies targeting these specific vulnerabilities should be considered as part of the policy response.[7] During the *Covid Shock*, these policies appeared to complement the simultaneous support from changes in broader prudential regulations and economy-wide measures. In the future, if the vulnerability behind financial stress is specific and well identified, are there conditions under which more targeted policy responses could not only complement, but also substitute for, broader regulatory easing and monetary stimulus? For example, could these more targeted policies be used to address specific areas of financial stress without affecting efforts to achieve other macroeconomic or wider financial stability objectives? However, could relying more on targeted responses in the future generate moral hazard in the specific sectors that receive support, possibly increasing vulnerabilities in those sectors in the future? These questions will become increasingly important if financial intermediation continues to shift outside the banking system and if fragilities that emerge in specific segments of financial markets can evolve into systemic financial risks.

The remainder of the paper is as follows. Section II reviews the literature on the financial vulnerabilities that are the focus of the analysis as well as recent work describing the period of financial stress in the early stages of the Covid pandemic. Section III discusses how our new dataset of credit default swaps can capture stress in different sectors, including a descriptive analysis of key patterns over early 2020. Section IV develops the framework to analyze the relationship between different funding structures and financial stress, including the key data and some initial correlations. Section V presents the core of our empirical analysis, including the two estimation methodologies and the series of results relating financial stress to funding structures in a *country-sector* and *country-sector-time* panel analysis. Section VI estimates the impact of different policy responses (targeting specific structural vulnerabilities, banks, or the broader economy) in alleviating financial stress related to specific vulnerabilities. Finally, Section VII concludes.

[6] Also see Ahnert et al. (2021) for similar implications.

[7] See FSB (2020b) for a discussion of the FSB work program on NBFIs, including policies to reduce systemic risks.

II. Related Literature

This paper contributes to the rapidly growing body of literature that helps understand the stress in the financial system in the spring of 2020 and steers the next stage of regulatory reforms.[8] Many countries adopted widespread macroprudential reforms after the 2008/9 Global Financial Crisis, such as a tightening of capital and liquidity requirements on banks and, in some cases, limiting banks' exposure to foreign currency (FX) and access to foreign capital. Evidence from the literature suggests that these reforms have made banks more resilient to shocks, including reducing their exposure to foreign currency borrowing and exchange rate movements (Ahnert et al., 2021).

These developments, however, also generated changes in the structures and patterns of financial intermediation. Firms relied less on banks and shifted to other sources of funds, contributing to rapid growth in non-bank financial intermediation.[9] This shift in financial intermediation caused companies to obtain more financing from market-based sources, in dollars, and/or from abroad. As is well summarized in Chari (2022), we are beginning to see evidence that these changes may have shifted risks in ways that are harder to assess—especially through intermediaries and markets that are less well regulated—possibly making some sectors (and even countries) less resilient overall. Subsequently, the *Covid Shock* was the first real test for the robustness of the post-2008 financial system. Although the macroprudential reforms appear to have prevented banking systems from amplifying the *Covid Shock* to other segments of the economy, the results in this paper suggest that the stress in non-bank sectors was being transmitted back to the banking system to some extent.

To motivate our empirical tests and place our work in the context of previous studies, this section discusses the literature on different vulnerabilities of financial intermediation, including vulnerabilities associated with banking intermediation, non-bank financial intermediation, foreign exchange exposure, and cross-border borrowing. This section ends by summarizing the fast-growing literature on the period of heightened market volatility and financial stress during the early stages of Covid-19.

A. Vulnerabilities of Financial Intermediation

A long-standing literature explores the vulnerabilities to **financial intermediation via banks**. Banks conduct a maturity transformation that converts short-term liabilities into long-term assets, introducing potential vulnerabilities if funding sources are not stable (e.g., Diamond and Dybvig, 1983; Shin, 2009; Gertler, Kiyotaki, and Prestipino, 2016). To address these vulnerabilities, policymakers have introduced a wide range of regulatory reforms (updates to Basel II; Basel III). Moreover, recent advances in the measurement of macroprudential policies (e.g., Alam et al., 2019) have sparked a rich literature examining their effectiveness. The literature suggests that regulatory reforms have reduced vulnerabilities related to banking intermediation and therefore made banking systems around the world more resilient to shocks. (See surveys by Galati and Moessner, 2013; Cerutti, Claessens, and Laeven, 2017; and Forbes, 2021.)

As banks have adjusted to these stricter regulations, some financial intermediation has shifted to **non-bank financial institutions** (or **"shadow banks"**). This intermediation can take on a variety of forms,

[8] See FSB (2020b) for an overview of the factors contributing to financial stress in spring 2020.

[9] See FSB (2020a) for trends in the size and links of the NBFI sector, with the caveat that cross-country data availability for non-bank financial intermediation is limited (e.g., OECD, 2020).

ranging from small-scale relationship lending (e.g., borrowing from mortgage lenders) all the way to large scale market-based intermediation (e.g., obtaining funding from bond and stock markets).[10] What all these entities and forms of intermediation have in common is that traditional banking regulations do not apply to them. Banks are still connected to these evolving forms of intermediation, however, as banks often fund their business activities through issuing bonds and equity, and in some cases borrowing from and lending to NBFIs.[11] This increased importance of non-bank financial intermediation, including the shift away from loans to more market-based forms of financing, has raised concerns about the corresponding financial stability risks, particularly to liquidity shocks and new forms or interconnectedness (e.g., FSB, 2020a; Aramonte, Schrimpf, and Shin, 2022). This has also prompted recommendations for policymakers to better regulate this sector (Carstens, 2021). The evidence from the early stages of Covid-19 suggest that these non-bank forms of financial intermediation can be highly vulnerable to risk-off shocks, although it is unclear how exposed the traditional banking system is to risks through these non-bank forms of finance.

In addition to the source and instrument of financial intermediation, another broad area of vulnerability can emerge from exposure to **FX and currency mismatches**. This vulnerability can occur for firms, households, and banks. If the currency denomination of an entity's assets is not aligned with that of its liabilities, exchange rate fluctuations can generate sharp changes in net worth. As discussed in Ahnert et al. (2021) and Shin (2013), FX exposures and currency mismatches have been long-standing vulnerabilities in the financial system, although as some countries tightened regulations on the FX exposures of banks, risks related to currency mismatches have partially shifted to non-bank financial intermediaries, such as increased US$ bond issuance by companies. Possible tools available to mitigate this vulnerability are macroprudential FX regulations (Ahnert et al., 2021), capital controls (Keller, 2019), FX interventions (Mrkaic, Kim, and Mano, 2020), and hedging (Alfaro, Calani, and Varela, 2021).

A final vulnerability is **cross-border exposure**, which emerges when domestic residents acquire assets or liabilities from abroad. While cross-border transactions are traditionally associated with FX exposure (as discussed above), the two vulnerabilities are not necessarily identical. For example, countries can borrow cross-border in their own currencies, or currency mismatches can occur in the domestic economy (e.g., via "deposit dollarization").[12] A key feature of this cross-border vulnerability is that funding obtained abroad is more vulnerable to "sudden stops," which may occur when foreign investors reallocate their portfolios during global risk-off periods. Hofmann, Shim, and Shin (2020) and Hofmann, Patel, and Wu (2022) highlight this effect during the *Covid Shock*, showing how investors reallocated their portfolios to safe haven countries (including for cross-border funding in domestic currency), creating a feedback loop that generated even more capital outflows and higher currency depreciations for emerging markets. Cross-border exposure may have also increased in response to advances in financial regulation, which usually apply primarily to domestic banks.[13]

[10] NBFIs comprise a wide range of entities, such as mortgage lenders, insurance companies, corporate development companies, and investment companies, as well as money market funds, pension funds, mutual funds, hedge funds.
[11] See Aldasoro, Huang, and Kemp (2020) for growing cross-border links between NBFIs and banking systems.
[12] Christiano, Dalgic, and Nurbekyan (2021) provides some evidence that deposit dollarization may have served as a risk-sharing device in Peru and Armenia.
[13] A counter example is the countercyclical capital buffer (CCyB), which is equipped with an international reciprocity rule that can prevent such effects (e.g., see Chen and Friedrich, 2021).

While each of these vulnerabilities—through banks, non-bank financial intermediaries, foreign currency exposure, and cross-border borrowing—have all been explored in the academic literature, our paper is the first (to the best of our knowledge) to simultaneously measure and analyze all of these vulnerabilities. Our data allows us to compare how strongly each of these different forms of financial *intermediation* and *internationalization* contributed to financial stability risks during the *Covid Shock*. Controlling for all of the vulnerabilities at once, rather than just focusing on one form or in one sector (such as banks), is particularly important, as many of these vulnerabilities are interlinked. Examining one vulnerability that is highly correlated with another (such as increased reliance on FX borrowing and non-bank financial intermediation, or reduced reliance on banks and loans as a funding instrument) could mistake the true source of vulnerability. Likewise, focusing on only one sector could miss how vulnerabilities shifted across sectors. For example, if a reduction in one type of vulnerability shifts risks to sectors that are less able to handle a risk-off shock, this could aggravate vulnerabilities for the broader economy. This type of broader assessment is therefore important for policymakers to set priorities for their next stage of regulatory reform.

B. Financial Stress During Covid

A more recent literature assesses the impact of Covid on banks and financial markets in the early stages of the pandemic.[14] The impact on banks can be broken down into negative effects on banks' stock returns through a "credit line drawdown" channel (Acharya, Engle, and Steffen, 2021), their non-performing loans and loss provisions due to lockdown measures and Covid cases (Beck and Keil, 2021), and their international lending (Temesvary and Wei, 2021).[15] While each of these studies shows that Covid negatively impacted banks, the overall financial impact of the *Covid Shock* on the banking sector was much more benign than during the 2008/9 Global Financial Crisis. Most authors suggest that this resilience at least partly resulted from the adoption and tightening of prudential and macroprudential regulations over the last decade (see Berger and Demirgüç-Kunt, 2021; English, Forbes, and Ubide, 2021; and Giese and Haldane, 2020).

A second group of papers has focused on the impact of Covidon financial markets, highlighting the role of non-bank financial intermediaries, market-based intermediation, US$ exposure or cross-border borrowing. Haddad, Moreira, and Muir (2021) examines disruptions in debt markets; Falato, Goldstein, and Hortaçsu (2021) focuses on corporate bond markets; and Eren and Wooldridge (2021) looks at how NBFIs amplified the *Covid Shock*. Moreover, Eguren-Martin et al. (2020); Cesa-Bianchi and Eguren-Martin (2021); Czech et al. (2021); and Eren, Schrimpf, and Sushko (2020a and 2020b) highlight the role of dollar-denominated borrowing, as investors sold dollar-denominated assets to obtain dollars to repay dollar-denominated liabilities. Finally, Aldasoro, Huang, and Kemp (2020) links this literature focusing on NBFIs to that on banks and the role of the dollar by discussing how greater exposure of banks to NBFIs, especially through US$ exposures, contributed to market turmoil during the *Covid Shock*.

Our work focuses on many of the vulnerabilities highlighted in this literature (including the role of banks, NBFIs, dollar exposure, and cross-bordering borrowing) but takes a broader view than most of the studies above by simultaneously comparing the impact of different funding structures across countries and different sectors and assessing a wide range of policy options to address these vulnerabilities. We are

[14] For excellent overviews of what is a rapidly growing literature, see FSB (2020b) and Vissing-Jorgenson (2021).
[15] Moreover, Demirgüç-Kunt, Pedraza, and Ruiz-Ortega (2021) focuses on how different policy packages supported banks during Covid.

also one of the only studies (to the best of our knowledge) to use credit default swaps to measure the extent of financial stress.[16] This measure is useful, as it is available at a high frequency for a large set of countries and different sectors within countries and captures a range of factors—including concerns about short-term illiquidity as well as longer-term solvency.

III. Financial Stress: Credit Default Swap Data and the *Covid Shock*

A. Measuring Financial Stress

In order to assess which sectors and countries experienced the greatest financial stress during the *Covid Shock*, we focus on credit default swaps (CDS). This market-based measure has several advantages. First, it is available for sovereigns, banks, and non-financial companies in a broad range of countries; this allows us to compare effects across different sectors within individual countries as well as across countries. Second, it is available at a high frequency, and thereby able to capture the amount of stress in different sectors/countries at different points in time, even if the pressure was short-lived and/or occurred at different windows in different countries. Finally, this measure should capture a range of different types of "stress," from short-term liquidity/pricing pressures to longer-term solvency/valuation concerns. Focusing on CDS also has disadvantages, such as not capturing stress in companies that do not issue these securities (including small and medium enterprises), that different types of CDS can exhibit different pricing patterns (discussed in more detail below), and that trading frictions and other characteristics of CDS market structure can influence pricing. Keeping these important caveats in mind, CDS are the broadest and most timely measure to capture the various forms of sectoral financial stress that are the focus of this analysis.[17]

To compile data on CDS for a broad range of countries, sectors, and companies, we begin by downloading all available CDS from Refinitiv via Datastream for the period from January 1, 2020, through October 20, 2020. We include daily price data as well as information on seniority, term length, and entity (when available). Then we drop all CDS labelled as "Dead" or "Duplicate," that refer to indices (instead of individual entities) or central banks, that are not associated with a specific country or company, or that are not actively traded.[18] Next, we classify each of the CDS into five groups: *Sovereigns*, *Banks*, *Other Financials*, *Extended Government*, and *Corporates* (the residual). This classification is not always straightforward. To put CDS into each of these groups, we used Refinitiv information when available, outside sources for pre-specified lists (such as lists of banks, insurance companies, etc., by country), generic text searches for stubs and keywords (such as "bank" in a variety of languages), and visual inspection of the names in each category combined with web searches for hard-to-classify entities. Then

[16] The only other paper we know of that focuses on CDS during the *Covid Shock* is Daehler, Aizenman, and Jinjarak (2020). It focuses on explaining movements in sovereign CDS for emerging markets and finds an important role for macroeconomic variables (such as fiscal space, oil shocks, and monetary policies in advanced economies).

[17] Berndt et al. (2018) provides an excellent survey of the advantages and disadvantages of using CDS to measure default risk.

[18] To exclude CDS that appear to be non-traded, we use three criteria. First, we exclude any CDS with no price data. Second, we exclude CDS that have zero standard deviation over the sample period (Jan. 1–May 31, 2020). Finally, we exclude CDS with constant prices for the first 15 trading days at the start of the sample. If there is a period of more than 15 days when there is no change in the daily price (other than the start of the sample), however, the CDS can still be included in the sample but is marked as missing after the price stays constant for 15 days.

we drop all of the CDS in *Extended Government* and *Other Financials* for the remainder of this analysis. These groups include a mix of entities that vary across countries, are hard to compare and classify, and involve different degrees of government backing (especially for *Extended Government*).[19] Also, only a small subset of mostly advanced economies have information for *Other Financials*, which would severely limit the sample size for our analysis. Finally, for some entities with several CDS series (such as a country or company that has issued CDS of different currencies, maturities, or legal characteristics), we create a composite measure at the country-sector level that balances standardization with maximizing coverage.[20] Additional details on the compilation of this data are in Appendix A.

Before creating the composite measure at the country-sector level, we have information on 2,532 CDS series, covering 68 different countries.[21] When these CDS are broken down by sector, we have 127 CDS for *Sovereigns*, 396 for *Banks*, and 2009 for *Corporates*. The resulting country coverage of the composite measure at the country-sector level is 61 countries with data on *Sovereigns*, 32 with data on *Banks*, and 40 with data on *Corporates*. Coverage for *Sovereigns* and *Corporates* includes a mix of Advanced Economies (AEs) and Emerging Market Economies (EMEs), while the data for *Banks* is predominantly for AEs. Appendix Table A1 lists each of the countries in the CDS sample, with the number of CDS series for each of the sectors. It is worth noting that the coverage of EMEs is very limited for some analyses; for example, regressions which require a country to have data on each of the three sectors limits our sample of emerging markets to Brazil, India, and Russia. We therefore do not focus on a split between AEs and EMEs in the empirical analysis but do report sensitivity tests that show that excluding the EMEs has no meaningful impact on the key results**.**

B. Financial Stress during the *Covid Shock*

As a first look at our measures of financial stress, we focus on the first half of 2020. This was the rapid reassessment of the risks around Covid-19—from minimal concern at the start of the year to awareness that the virus was rapidly spreading globally, causing countries to close borders and limit economic activity. Figure 1 graphs the mean and median CDS for each of the three sectors (*Sovereigns*, *Banks*, and *Corporates*) for all countries which have data for all three sectors (to ensure results are not driven by changes in sample composition). In each graph, the CDS index is set to 100 on January 1, 2020, in order to better compare relative movements. Each of these graphs shows the sharp increase in CDS for each sector during the period of acute financial stress in March 2020. Stress moderated by the end of the month after substantial policy interventions, but each series remained elevated through June relative to

[19] The *Extended Government* group includes agency, "supranational," and municipal debt, ranging from states to provinces to prefectures to cities, as well as development banks and export-import banks. *Other Financials* includes a range of non-bank financial institutions—such as insurance companies, property companies, credit card/payment service providers, and the capital/financing arms of corporations. It has minimal coverage of the hedge funds, money market funds, mutual funds, broker dealers, etc., which are important segments of the non-bank financial sector in most countries.

[20] For the composite measure at the country-sector level, we use CDS denominated in US$ with four- to six-year maturities, and if more than one CDS is available that meets these criteria, we collapse the observations by taking the country-sector-date mean. If a country-sector combination does not have any CDS meeting these criteria, we use CDS with one- to three-year maturities instead (collapsing any CDS within this group if more than one is available).

[21] It should be noted that the CDS series themselves are composite measures of all the traded and reported CDS contracts that fall in the same category (e.g., US$ denomination, 5-year maturity). Hence, even a single CDS series can represent a large sample of individual CDS contracts.

at the start of 2020. As elaborated on below, our empirical analysis focuses on the acute period of financial stress through when the CDS series peaked on March 23, which we call the *Covid Shock*.[22]

In each of the graphs in Figure 1, *Sovereigns* experienced the greatest increase in financial stress. *Banks* were the most resilient (as assessed by the smaller increase in the CDS indices).[23] This is consistent with the thesis that macroprudential reforms since 2008 aimed at strengthening the banking system helped buffer this sector to the *Covid Shock*.

These graphs of the mean and median CDS by sector, however, mask important differences in the distribution of changes over time. Therefore, Figure 2 graphs the mean and median CDS, as well as the 25th and 75th percentiles, for the three sectors.[24] For *Corporates* and *Sovereigns*, the mean is consistently above the median, reflecting the rightward skew of the distribution (i.e., a fatter tail of sharper increases in CDS). For *Sovereigns*, countries at the 75th percentile experienced substantially more pressure on CDS relative to other sectors, while those at the 25th percentile experienced less, suggesting a set of countries that were seen as much risker (and some as more resilient). These types of patterns suggest that there is substantial variation in how the period of financial stress affected different countries and sectors.

Finally, and to further understand these different patterns, we calculate a measure of *Peak Stress* for each sector and country. More specifically, we calculate the log change in the CDS for each entity from January 1, 2020 (before Covid began to be priced into financial markets) to March 23, 2020. We use March 23 as the date of *Peak Stress* in financial markets, as this is the date in the first half of 2020 when the average CDS peaked for each of the three sectors in our analysis. It is also the date when several other broad market indices troughed or peaked—including the trough for the all-country MSCI total return index and peak in the EMBI and CEMBI indices.[25] Acharya, Engle, and Steffen (2021) also uses this window as the focus of their analysis on "the first phase of the pandemic," justifying their end-date as just before "decisive monetary and fiscal support measures were introduced."

Figure 3 shows the resulting mean measure of *Peak Stress* for each sector, for the full set of countries that have data and then for just AEs and EMEs. It confirms the results in Figure 1 that *Sovereign* CDS increased the most and that *Banks* were more resilient than *Corporates* (or *Sovereigns*). In contrast, in the much smaller subset of EMEs, *Banks* experienced more *Peak Stress* than *Corporates,* potentially reflecting less progress on macroprudential reforms targeting banks in this set of countries. The graph on the right also shows the standard deviation in these measures of *Peak Stress* for the different sectors and country groups. The greatest variation in stress occurs across countries—particularly in the EMEs. For AEs, the much smaller standard deviation for *Corporates* is noteworthy given the very different effects Covid had on different types of companies (i.e., services versus manufacturing). This may reflect confidence that

[22] We also examine different time periods, including how different measures of stress eased after the numerous policy support packages were announced in late March and early April.

[23] If this graph is replicated for just the three EMEs with data for each sector (Brazil, India, and Russia), *Banks* for these EMEs experienced a greater increase in CDS than *Corporates* early in the *Covid Shock*. This financial stress partially faded for *Banks* in EMEs later in March, however, undoubtedly reflecting the extensive support provided by AE central banks through lower interest rates, currency swaps, and other forms of liquidity support.

[24] The graphs exclude Argentina from the mean, as movements in its CDS are an outlier and so much larger than for other countries that they can affect key results.

[25] Based on the median value across all countries for the MSCI, EMBI, and CEMBI indices. The EMBI is the emerging market bond index (which is primarily sovereign bonds, with some corporate debt), and the CEMBI is the corporate emerging market bond index, both from JP Morgan. The VIX was also close to its high (peaking on Mar. 16).

governments would respond with large support packages for the corporate sector—and by more than in EMEs that may have been more fiscally constrained. The larger standard deviation for *Banks*, despite the relatively smaller effects on average, also suggest some differentiation in how different banks were expected to be affected by Covid. The empirical analysis below provides evidence of several funding structures that contributed to this variation in the resilience of banks to the *Covid Shock.*

What could explain the differences in resilience across countries and sectors during the acute period of financial stress from Covid? Can different funding structures, including changes in financial intermediation and internationalization since the 2008/9 Global Financial Crisis, explain these differences?

IV. *Intermediation* and *Internationalization* Structures: The Framework, Data, and Correlations with Financial Stress

This section develops the framework and introduces the data that will be used to test if different funding structures contributed to this substantial variation in the degree of stress experienced across countries and sectors during the *Covid Shock*. The literature review (Section II) highlighted a range of vulnerabilities in financial systems that became apparent during Covid, some of which are related to shifts in global financial intermediation over the last decade but which have not been a focus of macroprudential regulations in most countries. To analyze the role of these funding structures in contributing to these vulnerabilities, this section introduces a simple framework focusing on different forms of financial *intermediation* (the funding sources and instruments) and *internationalization* (the currency and location of the counterparty) that have been highlighted in this literature and that can be tested using our cross-country, sectoral data. Then the section discusses the data used to test these channels and reports some preliminary correlations between these different funding structures and the extent of financial stress experienced in the banking and corporate sectors during the *Covid Shock*.

A. Financial *Intermediation* and *Internationalization*: The Framework

In order to test how different funding structures performed in the initial phase of Covid, we focus on four characteristics of funding highlighted in the literature review: the source, instrument, currency, and counterparty location. We will refer to the first two characteristics as forms of *intermediation* and the last two as forms of *internationalization*. Since the analysis below not only captures the impact of each of these funding structures independently but also considers their interactions and simultaneous effects, it is useful to begin by developing a framework to evaluate the various relationships.

The first broad category, financial *intermediation*, is shown in Figure 4a and concentrates on different funding sources and instruments for banks and corporates (in blue). Banks are funded by three sources (in green): households (primarily deposits),[26] other banks, and non-bank financial institutions (NBFIs). Corporates can receive funding from banks and NBFIs.[27] For this part of the analysis, there is no differentiation between institutions located domestically or abroad, or whether the funding is in US$ or

[26] A small share of bank financing from households is in forms other than deposits (such as through equity), but since this median share of non-deposit funding is less than 1% of total bank financing from households in our sample, we do not split this out in the analysis below.

[27] We assume that households contribute only a very small share of direct funding to corporates, e.g., that purchases of corporate equity or debt primarily occur through NBFIs (such as mutual funds).

local currency (both of which are captured in the *internationalization* aspect discussed below). Each of these five funding flows are numbered in the figure; some can be further subdivided into different funding instruments (marked by letters). Funding from banks (to other banks or corporates) can occur through (a) loans or (b) debt purchases and other forms (such as equity). The NBFIs include a broad range of institutions that provide funding to banks and corporates through (a) loans and (b) market-based purchases of debt and equity.[28] This diagram is obviously a simplification, as additional forms of financing exist, as well as indirect linkages between the three sources of funding (such as households providing funds to NBFI, which can then fund banks and corporates). The main empirical analysis, however, will focus on the numbered flows capturing the source of funding in Figure 4a and/or their lettered subcomponents capturing the instrument of funding, as these are the largest direct channels highlighted in the literature and for which data is available for the sectoral analysis.

Section II provides guidance on how these different funding sources and instruments in Figure 4a would be expected to affect the resilience of the borrowing entities during a risk-off shock such as occurred in March 2020. More specifically, NBFI funding would be expected to be the least stable source of funding (for banks and corporates) during the *Covid Shock,* and households would be expected to be the most stable source of financing for banks, especially given the strength of household balance sheets during Covid. This would imply that banks with a higher share of funding from households (channel 1) should be more resilient, and those with a higher share of funding from NBFIs (channel 3) should be less resilient, with the impact of bank funding from other banks somewhere in between. Similarly, corporates with a higher share of funding from banks (channel 4) should be more resilient than those with a higher share of funding from NBFIs (channel 5). Shifting to the other aspect of *intermediation* (the funding instrument instead of the source), banks and companies with a higher share of liabilities from loans (channels 2a+3a for banks and channels 4a+5a for corporates) would be expected to be more resilient than those more reliant on more volatile debt markets.

In addition to these various forms of financial *intermediation*, the literature review also highlighted the potential vulnerabilities linked to financial *internationalization*, that is, the currency of the funding or whether the source of funding was cross-border (came from abroad instead of from domestic sources). Adjusting the mapping in Figure 4a to take these international components into account, Figure 4b shows the framework focusing on either the funding currency or the counterparty location. The funding of banks and corporates can be decomposed by currency (into either US$ or local currency, LC) or by counterparty location (into either cross-border or domestic). These divisions are captured in the arrows denoted by Roman numerals. Although there is a high correlation between the funding currency and whether the source of funds is cross-border, this relationship is weaker in some countries and for certain funding sources. For example, in some countries, households chose to keep a larger share of domestic bank deposits in US$, some companies issue a large share of domestic debt in US$, and some companies issue a large share of international debt in local currency.

The literature review in Section II suggests that banks and corporates that are more reliant on dollar funding and on “flighty” funding from abroad would be more vulnerable during periods of financial stress. This would imply that banks and corporates with a higher share of funding in local currency or from

[28] As discussed in Section II.A, these institutions comprise money market funds, pension funds, mutual funds, hedge funds, insurance companies, corporate development companies, investment companies, etc.

domestic sources (channels II and IV) should be more resilient during the *Covid Shock* than those more reliant on US$ and from cross-border sources (channels I and III).

Finally, one benefit of this framework is that it also allows us to analyze the interaction between different forms of *intermediation* and *internationalization* by evaluating the different subcomponents, shown by the capital letters and Arabic numerals inside the boxes of the relevant funding source in Figure 4b. For example, US$ funding can be broken into funding from households (primarily deposits), from banks (through loans or other channels), or NBFIs (through loans or other sources). Similarly, funding flows can be decomposed by instrument type, such as the loan share of banks' US$ bank liabilities. This more detailed decomposition can be important to better evaluate the underlying source of vulnerability. For example, if corporates with a higher share of funding in US dollars appear to be more vulnerable, but most of this funding in US dollars is from NBFIs, is it the source of funding (NBFIs) or the currency (US$) that is driving the vulnerability? To better understand which financial structures are most important, we examine combinations of vulnerabilities based on the funding source, instrument, currency, and counterparty location—with the selection of variables heavily influenced by data availability for these more disaggregated breakdowns.

To keep track of these different predictions, Table 1 lists the key forms of *intermediation* and *internationalization* discussed above, along with the corresponding identification for each channel in Figure 4, as well as the expected relationship between the given funding structure and the amount of stress experienced in the given sector during the *Covid Shock*. A "+" indicates a prediction of more stress (i.e., a larger increase in CDS spreads), and a "-" indicates less stress. For example, the "+" sign next to *Corporates* for *NBFI liabilities/total liabilities* indicates that countries in which the corporate sector has a higher share of liabilities from NBFIs are expected to experience a larger increase in CDS spreads during the window defined as the *Covid Shock*. When the sign of effect is uncertain based on the previous literature, we use a question mark in the table.[29]

B. Financial *Intermediation* and *Internationalization*: The Data and Correlations with Financial Stress

In order to measure these different funding structures capturing *intermediation* and *internationalization* across sectors, it is necessary to draw on a number of different data sources. The data we rely on to measure the funding profile of banks and corporates is generally quarterly, and in order to capture funding structures before the *Covid Shock*, we use statistics for 2019 Q4. The majority of the data for the funding profile of banks is taken from the BIS International Banking Statistics. They provide rich information on the claims and liabilities of banks for the key aspects of our analysis: from different sectors (including households, other banks, and NBFIs); in different currencies (including US$ and all currencies); in different instruments (including loans/deposits, debt securities, and other), and by location of the counterparty (domestic and cross-border). These data provide not only information on the liabilities of the banks but also the claims of banks on corporates (i.e., the liabilities of corporates vis-à-vis BIS reporting banks).

[29] An example when the effect is expected to be uncertain is the share of bank financing from other banks; this form of bank financing is expected to be correlated with less stress than financing from NBFIs but more stress than financing from deposits.

The second key data source relevant for both corporates and banks is the BIS International Debt Statistics. They record information on the amount of debt securities outstanding (valued in US$) by issuer residence and issuer nationality as well as issuing sector and issuing currency. For the data on US$ exposures, we focus on debt calculated on a nationality basis to capture the global exposures for banks and corporates, including via the issuance of affiliates located abroad. The importance of the latter source of US$ funding is frequently highlighted by the BIS, such as Shin (2013) and BIS (2021). For the data on cross-border exposures, we focus on debt statistics calculated on residency basis—which is standard for these variables.

Finally, we use BIS data on domestic credit to measure total credit from all sources extended to non-financial corporations. More detailed definitions, sources, and summary statistics for all of these variables on funding structures (as well as other variables) are in Appendix B. In some cases, these measures are not identical to those in the figures (or theory) but are the best available proxy available for a cross-section of countries.

As a first look at whether the funding structures measuring different forms of *intermediation* and *internationalization* are related to the resilience of the banking and corporate sectors, we calculate simple correlations between these different structures and the extent of stress in the relevant sector during the *Covid Shock* (defined in Section III.A). More specifically, we estimate equation (1) for either the banking or corporate sector (*s*):

$$Stress_i^s = \alpha + \delta Structure_i^s + \varepsilon_i, \quad (1)$$

where *Stress* is measured as the log change in the CDS from January 1 through March 23, 2020, for each country *i* in each sector *s*. *Structure* is measured using the different variables discussed above, capturing various aspects of financial market *intermediation* and *internationalization*. To estimate raw correlations, we include only one structure variable per regression. The resulting correlations for each of the measures are listed in the far-right column of Table 1, with ***, **, and * indicating significance at the 1%, 5%, and 10% levels, respectively.

The results—albeit only showing raw correlations and not controlling for other variables that could affect these relationships—generally support our priors and existing evidence (as summarized in Section II). Starting with the results for *intermediation* on the different sources of funding, banks that had a higher share of funding from households (primarily through household deposits) experienced significantly less stress during the *Covid Shock* (i.e., smaller percent increases in CDS spreads), and banks with a higher share of funding from NBFIs experienced significantly more stress. Similarly, corporates with a higher share of funding from NBFIs experienced more stress, and those more reliant on banks experienced less, although these effects were not significant. Shifting to the funding instruments, when banks had a higher share of their overall liabilities in the form of loans, and when either banks or corporates had a higher share of their bank liabilities in the form of loans, they experienced less stress. This increased resilience from loans, however, is only significant for banks when measured as the overall share of liabilities. Shifting to the results for the role of *internationalization*, when banks or corporates have a higher share of borrowing in dollars or cross-border, they experienced larger increases in CDS spreads (as expected)—although in most cases, these correlations are insignificant when ignoring the form of *intermediation*. The regression analysis below shows, however, that when controlling for both the funding source as well as if the financing is in dollars, these relationships are usually highly significant for both banks and corporates. This highlights the importance of simultaneously focusing on various funding

characteristics (as modelled in Figure 4) rather than examining only one aspect of funding *intermediation* or *internationalization*, as previously done in this literature.[30]

To summarize, this first look at the data suggests that the different forms of financial *intermediation* and *internationalization* were related to the resilience of banks and companies during the *Covid Shock* in directions that agree with the existing literature. But which funding structures were most important in contributing to this period of acute financial stress?

V. Financial Stress and Funding Structures: Regression Analysis

In order to better understand the relationships between different funding structures and the extent of financial stress during the acute phase of Covid, this section moves beyond the correlations of the last section to estimate these relationships while taking into account additional factors that could simultaneously affect each country and sector. More specifically, we take advantage of the country-sector-time variation in this data to estimate two models. The first approach tests if funding structures determined the variation in stress *across sectors* within countries over the full period of the *Covid Shock*. The second uses higher-frequency data to capture the variation in stress *across time for each country-sector* in order to better incorporate the size of the financial shock at different dates. These tests build on the various channels of financial *intermediation* and *internationalization* (capturing the funding source, instrument, currency, and counterparty location) as developed above in Section IV, Table 1 and Figure 4.

A. Financial Stress and Funding Structures: Empirical Methodology

Our first estimation methodology, which we will refer to as the "c*ountry-sector approach*," focuses on how funding structures were correlated with stress in the banking and corporate sectors relative to stress experienced by the sovereigns within the same country during the *Covid Shock*. We estimate:

$$Stress_{i,s} = \alpha_i + \alpha_s + \delta \boldsymbol{Structure_i^s} * \alpha_s + \gamma \boldsymbol{Controls_i} * \alpha_s + \varepsilon_{i,s}, \quad (2)$$

where *Stress*$_{i,s}$ is the measure of financial stress for each country *i* for the *Bank, Corporate* or *Sovereign* sector *s*, measured as the log change in CDS (between January 1 and March 23), as discussed in Section III. The α_i and α_s are country and sector fixed effects, respectively (with *Sovereign* being the excluded category). The $Structure_i^s$ variables are vectors of different combinations of the measures of financial *intermediation* and/or *internationalization* in the relevant sector, all measured before the *Covid Shock* (throughout the paper, variable matrices in equations are shown in bold).[31] These variables are interacted with a sectoral dummy, so that the δ captures how the structural variables correlate to stress in that sector

[30] Forbes, Friedrich, and Reinhardt (2022) include additional information on the predications for and correlations between *Covid stress* and different funding structures, with the funding structures decomposed into more granular categories incorporating multiple forms of financial intermediation and internationalization simultaneously.

[31] We do not code structure measures as *Structure*$_{i,s}$ because differences in the average values between the corporate and bank sectors would drive the results, rather than differences across countries within each sector. For example, the average share of NBFI funding for banks is about 13%, and for corporates about 50%. By controlling for differences in these averages across sectors, we can better capture if NBFI funding for banks that is above the 13% average is correlated with greater stress for banks, even if it is a lower share of NBFI funding than for corporates in that country.

relative to those of the other sectors in the same country. These δ coefficients would be expected to have the signs in Table 1. Given the limited degrees of freedom for this cross-country analysis, in our baseline we include only one additional variable for *Controls*: the number of new Covid cases per 100k population averaged over the two weeks prior to the March 23 date of *Peak Stress* (as discussed in Section III.B). For our baseline, we interact this control with the sector dummy to capture different effects of the incidence of Covid across sectors. (The sensitivity tests show the impact of not controlling for the spread of Covid.) The country fixed effect absorbs any time-invariant heterogeneity across countries so that it is not necessary to include controls for country characteristics that do not change over this window and do not have different effects across sectors.

Our second estimation approach, which we will refer to as the "*country-sector-time* approach," focuses on the time-series dimension of how changes in financial stress relate to the funding structures within each country and sector. This has the advantage of using the higher frequency daily (or weekly) CDS data to better capture the magnitudes of stress experienced by different sectors at different times over the full *Covid Shock* window. This could be important, as Covid spread more quickly in some countries than others and thereby affected some variables at different times in different countries. More specifically, we estimate:

$$Stress_{i,s,t} = \alpha_{i,t} + \alpha_{s,t} + \delta \boldsymbol{Structure_i^s} * \alpha_s + \emptyset vix_{t-1} \boldsymbol{Structure_i^s} * \alpha_s + \gamma \boldsymbol{Controls_{i,t}} * \alpha_s + \varepsilon_{i,s,t} \qquad (3)$$

where $Stress_{i,s,t}$ is now measured as the day-to-day log change in CDS by sector for each country over the *Covid Shock*; vix_{t-1} is the day-to-day growth in the VIX (measured as a growth rate to be consistent with the *Stress* variable), lagged by 1 day to avoid endogeneity. The $\alpha_{i,t}$ is a country-time fixed effect, and the $\alpha_{s,t}$ measure sector-time fixed effects (for *Banks* and *Corporates*, with *Sovereign* being the excluded category). The $Structure_i^s$ variables continue to be vectors of different combinations of the *intermediation* and *internationalization* variables for *Banks* and *Corporates*, now interacted with the VIX as well as the sector dummies. The φ coefficients on this interaction are the key focus and should capture whether, on days after the VIX spiked, there is a relatively larger response in CDS spreads in the banking and corporate sectors (relative to the country as a whole) for countries with certain structural characteristics. We also control for the number of Covid cases per 100k reported each day in $Controls_{i,t}$.[32] In our baseline analysis below, we focus on results based on daily data, but the key results are unchanged when the analysis is based on weekly data (as shown in the Sensitivity Analysis).[33]

The *country-sector* and *country-sector-time* approaches each have distinct advantages and disadvantages. The *country-sector* approach has very limited degrees of freedom (which constrains our ability to include multiple controls simultaneously), while the *country-sector-time* approach assumes that movements in our high-frequency measure of the financial shock (the VIX) quickly affect the country-sector relationship between structures and stress. More specifically, the latter approach assumes that the VIX interacts with the sector-country funding structures to generate different degrees of financial stress over the next day (or week). In contrast, the *country-sector* approach assumes that these relationships

[32] Results are qualitatively and quantitatively the same for lagged Covid cases.

[33] We calculate weekly changes from Wednesday to Tuesday and include all full weeks in our baseline period.

are more protracted and better captured over the full window of the *Covid Shock*. There is no strong evidence to justify one approach over the other.

Also important, both approaches capture correlations and could miss important omitted variables that could impact estimated coefficients and drive underlying relationships. For example, institutions in countries with higher political risk may have more difficulty obtaining funding in local currency, with a greater relative disadvantage for the banking sector relative to the corporate sector. Regression results which find that banking sectors more reliant on dollar funding experienced greater financial stress during the *Covid Shock* (relative to other sectors in the country in the *country-sector* approach, or across time in the *country-sector-time* approach) could reflect concerns about political risk during the *Covid Shock* (which also could be greater for the banking sector) rather than the direct impact of differences in the funding currency.

Finally, in both regression approaches, we control for the possible impact of outliers by winsorizing key variables. Specifically, we winsorize the dependent variable and the number of Covid cases at the 1% level.[34] The *Structure* variables are defined as shares, ranging between 0 and 1, and are not winsorized. Also, to lessen sample effects, we focus on a sample of 25 countries which report the key structure variables on *internationalization* for banks (cross-border and US$) as well as at least two of the three *intermediation* variables.[35] Summary statistics for all the variables are reported in Appendix Tables B1 and B2.

B. Financial Stress and Funding Structures: Regression Results

To begin, and before focusing on the relationship between funding structures and stress during the *Covid Shock*, it is worth highlighting several coefficient estimates from unconditional regressions that do not include the full set of controls in equations (2) and (3). Appendix Table C1 shows estimates in columns (1) to (3) using the *country-sector* approach with only controls for the respective sectoral dummies. The coefficients on the banking sector dummy are negative and significant, whereas those on the corporate sector dummy fluctuate in sign and are not significant. The -0.37 coefficient on the banking dummy in columns (3) and (6) implies that the growth rate of CDS spreads is on average 30.9 percentage points lower for banks relative to other sectors of the economy.[36] These patterns agree with Figures 1 and 3, showing that *Banks* experienced less financial stress than *Corporates* or *Sovereigns* during the *Covid Shock*. Also, columns (4) through (6) show results when the interactions between Covid cases and the sectoral dummies are added. In these regressions, the interaction with the corporate sector dummy is positive and significant (at least at the 10% level), while the interactions with the banking dummy are not significant. This indicates that countries with a higher incidence of Covid experienced greater stress in the corporate sector (but not in the banking sector). This may not come as a surprise; in countries where the virus was more prevalent, businesses were expected to be more directly affected than banks. The relative resilience of banks may also reflect confidence that the banking system was well positioned to handle this

[34] Results are qualitatively and quantitatively robust to other winsorization choices, including winsorizing at the 2.5% level.

[35] The variable for banks' deposits from households is available for only 21 countries. We do not use this variable for all the specifications and therefore do not constrain the sample based on just this variable.

[36] This is calculated as the log change in CDS = 1*dummy coefficient = -0.37. Taking the exponential and subtracting 1 on both sides yields: exp(1*-0.37) - 1 = -0.309, which corresponds to 30.9 percentage points lower growth rate in CDS spreads.

shock, possibly due to stronger macroprudential regulations and/or expectations of a rapid central bank response.

Next, we shift to the main analysis and estimate the role of financial *intermediation* through the funding source (households, banks, or NBFIs), as shown in the green boxes at the top of Figure 4a and specified in equations (2) and (3). Table 2 shows results using the *country-sector* approach and Table 3 the comparable results using the *country-sector-time* approach. Columns (1) through (4) control for one source of funding at a time, then columns (5) and (6) control for multiple sources for banks and corporates simultaneously, and column (7) focuses on just the role of funding from NBFIs (for both banks and corporates). In each case, it is necessary to exclude at least one funding source to avoid collinearity. This series of coefficient estimates supports the predictions in Table 1. Banks with a greater share of funding from households experienced a smaller increase in CDS during the *Covid Shock*, and banks and corporates with a greater share of funding from NBFIs experienced a greater increase in CDS. These effects are always significant for banks but usually insignificant for corporates (with mixed signs for the *country-sector-time results*). To put these estimates in context, the coefficient of 2.67 in column (7) of Table 2 implies that if a banking system had a 10pp higher share of funding from NBFIs, CDS spreads in the banking sector would have been correlated with an additional increase of 30.6 percentage points relative to the other sectors in the same economy during the *Covid Shock*.[37] Funding from other banks also appears to have improved resilience for banks relative to funding from NBFIs but provided less resilience for banks than funding from households (as also expected).

We also test for the other characteristic of financial *intermediation*, the funding instrument, as shown by the numbered subcomponents in the green boxes at the top of Figure 4a. Due to data limitations, we focus on the role of loans versus other instruments, measured by the share of loans in total funding for banks or the share of loans in corporates' funding from banks. It is worth highlighting that the data available for the corporate sector does not capture the overall share of loans in funding—only the share of bank funding in the form of loans—and thereby does not fully capture the vulnerability introduced by the instrument type for the corporate sector. With this important caveat, the right side of Tables 2 and 3 shows the results, with the loan shares estimated separately in columns (8) and (9) and then simultaneously for banks and corporates (in column (10)). A higher share of loans (or a lower share of other debt instruments) corresponds to a smaller rise in CDS spreads during the *Covid Shock* for banks and corporates, but the relationship is significant only for banks in the *country-sector* results. These results are consistent with arguments that relying on loans instead of debt markets increased the resilience of firms—and especially of banks—during the period of acute financial stress.

Next, we test for the two aspects of financial *internationalization* shown in Figure 4b, the currency and location of the counterparty. For the currency of funding, we control for the share of funding in US$, and for the counterparty location, we control for the share of funding from abroad (i.e., cross-border). Tables 4 and 5 show the results for the *country-sector* and *country-sector-time* estimates, respectively. Columns (1) through (4) control for one aspect of exposure at a time, and column (5) controls for all

[37] Calculated as the log change in CDS = change in funding share * coefficient = 0.1*2.67. Taking the exponential and subtracting 1 on both sides yields: exp(2.67*0.1) - 1 = 0.3060, which corresponds to a growth rate in CDS spreads of 30.6 percentage points. To put the 0.10 increase in the share of funding from NBFIs in context, Table B1 shows this is less than the cross-country mean of the level of the share of NFBI funding (of 0.13) and slightly larger than one standard deviation (0.08).

simultaneously. In most cases, the relevant coefficient estimates are positive, suggesting that banks and companies more reliant on US$ and cross-border funding experienced a significantly larger increase in CDS during the *Covid Shock*. The significance of the coefficients varies across specifications, however, with the relationship more often significant for banks and more often for funding in dollars.

One possible explanation for the mixed significance in many of these results is that we do not simultaneously control for different forms of financial *intermediation* and *internationalization*. These omitted variables capturing different funding characteristics could work in different directions to mitigate—or aggravate—any relationships. For example, if companies in a country were more reliant on loans for funding (the more stable instrument for financing), but these loans were largely in US$ (the less stable currency for funding), then the relationship between the loan share of financing and stress during Covid could be estimated to be insignificant, even though the underlying relationship is positive and significant (when controlling for the omitted variable of the funding currency). To better understand these relationships, we estimate regressions which simultaneously control for *intermediation* and *internationalization.* Due to the limited number of countries in our sample and corresponding limited degrees of freedom, however, we can only control for a subset of different channels in any regression.

The results for the *country-sector* approach are shown in Table 6. Columns (1) and (2) include controls for the funding source as well as the funding currency and counterparty location, with NBFI funding for each sector as the excluded category in column (1) and then including just NBFI as a funding source for each sector in column (2). Columns (3) through (6) include more detailed breakdowns of NBFI funding by currency and counterparty location that is only available for banks; for corporates, a detailed breakdown into currency and counterparty location is available only for funding from banks (columns (5) and (6)). The share of funding from NBFIs continues to be correlated with a larger increase in CDS spreads, with this relationship consistently significant for banks. The estimates show that a higher share of funding in US$ is positively and significantly correlated with the increase in CDS spreads for both banks and corporates, and even the narrow measure of the share of bank funding in US$ from NBFIs is significantly and positively correlated with higher CDS spreads. To put these estimates in context, the coefficient of 2.25 in column (1) implies that if the corporate sectors' share of US$ liabilities was 10pp higher, CDS spreads in the corporate sector would have been correlated with an increase of an additional 25.2 percentage points relative to the other sectors in the economy. In contrast, the share of funding cross-border for both banks and corporates is not significant—and is even often negative.

Finally, columns (7) to (9) use more detailed data that controls for the loan share in US$ funding and cross-border for each sector. These results also support the earlier estimates that a greater reliance on loans may have reduced sensitivity to financial stress during the *Covid Shock*, especially for banks (as found above) and for loans in US$ (supporting the more general results on the vulnerability of US$ funding). These results are less robust across specifications and usually insignificant, however, suggesting that the instrument of funding does not play a crucial role in this case.

Two important patterns in this series of results are worth highlighting. First, for financial *intermediation*, the source of funding appears to be more important than the instrument of funding. More specifically, when banks had a higher share of funding from household deposits, they experienced significantly less financial stress during the *Covid Shock*, and when banks or corporates had a higher share of funding from NBFIs, they experienced more stress (with the effects more often significant for banks). In contrast, banks and corporates with a higher share of funding from loans generally experienced less

stress, but the effect was usually not significant (albeit with data limitations for corporates). Second, for financial *internationalization*, the currency of the funding appears to be more important than the nationality of the funding source. More specifically, when corporates and banks had a higher share of funding in dollars, they generally experienced significantly more financial stress during the *Covid Shock*. In contrast, there is less consistent evidence on whether a higher share of funding from abroad affected vulnerability, with the estimates for cross-border borrowing not only being insignificant in most cases but having varying signs.

The corresponding results for simultaneously controlling for different forms of *intermediation* and *internationalization* in the *country-sector-time* approach yield coefficient estimates that vary across specifications—both in terms of significance as well as sign.[38] This suggests that the vulnerabilities may be more difficult to capture in daily relationships than over longer periods of time (as captured by the *country-sector* approach).

C. Financial Stress and Funding Structures: Sensitivity Analysis

In order to assess if the key results cited above are robust to different samples and model assumptions, we estimate several sensitivity tests. These are reported in Table 7 for the *country-sector* approach and Table 8 for the *country-sector-time* approach. Each of these tests focuses on the main set of significant results that simultaneously control for the role of financial *intermediation* and *internationalization* (i.e., columns (1) and (2) of Table 6 for the *country-sector* approach). We do not focus on the results on the role of the instrument of funding due to more severe data limitations and the insignificance of these results (which also occurs in the unreported sensitivity tests).

More specifically, in each table, columns (1) and (2) replicate the baseline results for ease of comparison, and columns (3) and (4) drop the Covid controls interacted with sectoral dummies. When interactions controlling for the incidence of Covid are dropped, the key results are basically unchanged for banks, but some become insignificant for corporates (such as the impact of the share of liabilities in US$). This is not surprising given the greater sensitivity of the corporate sector to the incidence of Covid, as shown in Appendix Table C1 and discussed in Section V.B. Next, we drop emerging market economies from the sample.[39] Results for the *country-sector* results are reported in columns (5) and (6) of Table 7 and are basically unchanged from the baseline. The degrees of freedom are too limited to estimate the comparable *country-sector-time* results.[40]

In columns (7) and (8) of Table 7 and (5) and (6) of Table 8, we add controls for the asset side of banks' balance sheets in order to assess if the key results on the fragilities related to banking systems' dependence on NBFIs and US$ is driven by the funding side rather than the asset side (which may be correlated).[41] Specifically, we include banks' NBFI and US$ assets as a share of total assets. Each of these

[38] The full set of results is not reported to save space, but key columns are in the sensitivity analysis in Table 8. The full set of results is available in Table 7 in Forbes, Friedrich, and Reinhardt (2022).

[39] We define EMEs based on the classifications in the BIS International Banking Statistics, which causes South Korea, South Africa, Saudi Arabia, and Malaysia to be dropped from the sample. Further countries listed in Table A1 are not included in the baseline intermediation and internationalization regressions due to data limitations with regard to the main bank and corporate funding measures.

[40] The degrees of freedom become too limited to calculate our clustered standard errors due to the larger number of variables compared to the number of countries in the *country-sector-time* setup when dropping EMEs.

[41] For example, banks which have a higher share of assets in US$ may be more likely to obtain funding in US$.

asset-side measures has a negative but insignificant coefficient, suggesting that it is the funding source (rather than the asset exposure) driving vulnerabilities related to NBFI and US$ exposures. Column (7) of Table 7 also suggests that a higher share of US$ in banks' assets led to a significant reduction in financial stress during the *Covid Shock*; these results, however, are not significant when also controlling for banks' NBFI liabilities or using the *country-sector-time* approach.

Next, we explore the impact of using different timing conventions and dates to define the *Covid Shock*. Table 8 explores the use of weekly data in columns (7) to (10), where the dependent variable is the weekly (instead of daily) log change in CDS spreads. In columns (7) and (8), we include only full weeks running from Wednesday to Tuesday (i.e., to March 17), and in columns (9) and (10) we lag the VIX by a week (instead of being simultaneous).[42] The key results are robust: banks and (to a lesser extent) corporates more reliant on NBFI funding were more vulnerable, and banks more reliant on household funding were less vulnerable, during the *Covid Shock*.

Finally, we test for the impact of using different windows for the *Covid Shock* in the *country-sector* results. In Table 7, columns (9) and (10) use a shorter window, moving the start date to February 24 (rather than January 1), so that we focus more narrowly on the one-month window before the date of *Peak Stress* on March 23. The key results are unchanged. More noteworthy, columns (11) through (14) extend the window of the *Covid Shock* to the end of April 2020 with these two start dates (the beginning of 2020 and starting on February 24). This is a type of counterfactual experiment to see if the patterns of financial stress survived after the significant policy interventions at the end of March and early April, interventions which meaningfully reduced the aggregate measures of financial stress (as shown in Figure 1). Several of the key results change significantly in this counterfactual. Specifically, more bank exposure to NBFI funding is no longer correlated with significantly greater financial stress, and more bank exposure to deposit funding is no longer correlated with significantly less stress. Instead, a greater share of bank funding from other banks is correlated with significantly less stress. Also, banks are no longer significantly impacted by the currency of their funding.

These extensions suggest that banking sectors more reliant on NBFI and dollar funding benefited meaningfully from the policy actions taken in late March/early April. More vulnerabilities may have emerged in the banking sector over time if policy support mitigating these vulnerabilities had not been provided. Also noteworthy, the policy support did not appear to alleviate the significant vulnerability of the corporate sector to dollar funding but did meaningfully reduce the stress experienced by corporates that were more reliant on cross-border funding. What policy responses can explain this reduction in stress for certain sectors and structures? This is an important question that is the focus of the next section.

VI. Which Policy Responses Reduced Financial Stress?

After the pandemic began, what alleviated the financial stress experienced by certain countries and sectors at the end of March and early April 2020? Why was the exposure of banks to NBFI funding and US$ funding no longer correlated with significantly greater stress in April? Did banks experience greater reductions in stress because of the adjustments in prudential policy that focused on alleviating

[42] Results are similar if we extend the sample by a few extra days so that it is the exact same window as for the cross-section results (even though the last period is shorter than a week).

constraints on banks—or because of the reforms targeting the specific vulnerabilities? Were policies aimed specifically at the vulnerabilities around NBFI funding or dollar funding more important to deal with the impact of these vulnerabilities than policies aimed at easing broader financial conditions?

This section attempts to answer these questions by testing how different policies enacted in March and April of 2020 (i.e., after CDS spreads spiked) affected the stress related to the funding structures and forms of financial intermediation that were highlighted as increasing vulnerability in the last section. Identifying the impact of different policy responses during the *Covid Shock* is challenging, as most countries enacted multiple policies around the same time to address a range of concerns around market liquidity and functioning, as well as to support growth, incomes and employment and slow the spread of the virus. The country-sector framework used in this paper can help solve this identification challenge, however, by isolating the differential impact on specific structures within each sector and country—both over the March–April 2020 window as well as at the high frequency in our daily data. Put slightly differently, our approach allows us to test exactly (1) which policies reduced stress related to specific structures in each sector and (2) which policies "broke the link" between higher global volatility and country-sector stress.

This section begins by discussing the new, high-frequency dataset on policy responses to Covid from Kirti et al. (2022). Then it builds on our earlier framework to test for the impact of policies related to NBFIs, market-based intermediation, swap lines, banking sector regulations, and "economy-wide" policies (such as interest rates, asset purchases, market liquidity policy, and fiscal policy). Finally, the section reports an extensive series of results and summarizes the implications for policy responses to reduce periods of financial stress in the future.

A. Policy Responses to Covid: The Data

Critical to our analysis of how different policies alleviated the financial stress in different countries and sectors in the spring of 2020 is our ability to integrate our analysis with a new and rich high-frequency dataset from Kirti et al. (2022). This data includes over 5,000 policy announcements classified into 28 granular policy categories for 74 countries on a daily basis during the early stage of the pandemic. The policies cover a wide range of announcements, which we divide into three broad categories: "structure-specific policies," "bank-specific policies," and "economy-wide policies."

Our first group of policy responses, the structure-specific policies, are three types of policies which would be most likely to affect the vulnerabilities identified in the last section: NBFI policies, market-based measures, and US$ swap lines.[43] The first two could affect the vulnerabilities identified above related to NBFI funding of banks and corporates, and the last could affect the vulnerabilities identified above associated with dollar funding (or, more generally, foreign currency funding). More specifically, the ***NBFI Policies*** are "all prudential measures applied to non-bank financial institutions." These include policies such as modifying reporting requirements, supervisory flexibility, regulatory and capital relief, providing instructions on how to handle customer claims during the pandemic, and placing restrictions on share buybacks and dividend payouts for insurance companies. The ***Market-Based Measures*** are "regulations on financial market participants or recommended actions in response to Covid." These include policies

[43] These are from a subset of the policies which Kirti et al. (2022) lumps into their group of "other" policies. We also looked at announced changes in FX-related macroprudential regulations as a policy that could affect vulnerabilities related to foreign currency exposure, but there were no changes in these policies in our sample.

such as rules on short selling, security issuance, and reporting. Since Kirti et al. (2022) does not distinguish tightening and loosening actions for each of these policies, we code each of the responses for these two variables in a directional way. (For details, see Appendix D.) Finally, the ***US$ Swap Lines*** are US$ swap lines between central banks, which Kirti et al. (2022) record only for the counterparty with a relatively greater need for foreign exchange.[44]

Our second group of policy responses, the "bank-specific policies," target the overall banking sector rather than specific vulnerabilities within the bank (or corporate) sector: changes in prudential regulations and macroprudential buffers. These policies could explain why banks experienced a significant reduction in vulnerability (related to NBFI funding shares and dollar exposures) after the period of *Peak Stress*, while corporates did not experience a similar decrease in vulnerability (Table 7). More specifically, ***Prudential Regulations*** are any changes in overall prudential policy, including changes in macroprudential buffers, changes in prudential measures related to borrowers, capital requirements, liquidity requirements, and buffer usability, and any adjustments to dividend restrictions, lending standards, reporting requirements, special provisioning rules, and supervisory expectations. This is measured as a dummy variable equal to one if any loosening occurred on a given day (or equal to negative one for any tightening).[45] ***Macroprudential Buffers*** is one subset of these regulations, a dummy variable which records any cuts in the countercyclical capital buffer (CCyB), the capital conservation buffer (CCoB), or the systemic risk buffer (SyRB).

Our final group of policy responses, the "economy-wide policies," are those which would be more likely to affect the broader economy (albeit could still have differential effects by sector) and include a range of announcements related to monetary policy, fiscal policy, liquidity policy, and regulatory policy.[46] These policies were used by many countries during the *Covid Shock* to support the broader economy but could also have affected the relationship between funding structures and CDS spreads. More specifically, monetary policy is captured by ***Policy Rate Changes*** (reductions in the main policy rate, with cuts expressed as a positive number) and ***Asset Purchases*** (measured as purchases of securities, such as bonds, stocks, and commercial paper in the secondary market by the central bank,[47] all as a share of 2019 GDP). ***Fiscal Policy*** is the sum of all fiscal policy measures (as a share of 2019 GDP), and ***Market Liquidity Policy*** is "short-term lending or interventions in asset markets, with the explicit and sole intention of improving short-term market liquidity." For specifications focusing on structure-specific vulnerabilities instead of bank vulnerabilities, we also include ***Prudential Regulations*** as an economy-wide policy, defined as above.

Before testing if these different policies affected the degree of stress experienced in different countries and sectors during the *Covid Shock*, it is useful to understand the timing and use of these policies

[44] If relative need cannot be determined between the two countries, they record the measure for both. All swap lines for the countries in our main sample are for US$, so we are not able to extend the results to swap lines in any currency.

[45] We do not attempt to measure the magnitude of any adjustments in prudential regulations, as it is impossible to sum across different measures. We also use a dummy variable instead of summing the number of changes in prudential regulation each day, as often multiple changes are adopted simultaneously on related buffers as part of one policy change (i.e., adjusting liquidity/cyclical and capital buffers).

[46] We repeat estimates both with and without controls for changes in prudential policy as one of the "economy-wide" policies, with no meaningful change in the key results. Changes in prudential policy are measured using the variable for *Prudential Regulations* defined above.

[47] Purchases made only with the intention to improve market liquidity are not included.

for our sample of countries. We focus on the announcements for each policy, which may differ from the implementation date. Figure 5 shows each of the sector-specific policies (in panels A through C), bank-specific policies (in panels D and E), and economy-wide policies (in panels F through I). For each policy, the left-hand side shows the distribution of individual policy actions from January through July 31, 2020, and the right-hand side shows the cumulated policy actions for gross loosenings, gross tightenings, and net loosenings. In other words, the left panel shows policy changes, while the right panel shows policy levels.

The figures show that the majority of policy changes were announced in late March, consistent with our use of March 23, 2020, as the date of peak stress that prompted a policy response. Moreover, the period in late March and April is dominated by loosening announcements for most policies (i.e., positive bars in the panels on the left-hand side), reflecting the objective of policymakers to ease financial and economic stress (rather than tighten policies with the intention of guarding against additional, unmaterialized risks). The one exception is for the *Market-Based Measures*, which includes several tightening announcements, such as increases in reporting requirements or a decrease in the notification threshold for net short positions.

The duration and timing over which each of the policies was used varies significantly. *NBFI Policies*, *Market-Based Measures*, *and Macroprudential Buffers* were primarily announced in late March and throughout April, and then rarely after May. *US$ Swap Lines* were announced immediately after the *Covid Shock* and over an even shorter period—primarily on two dates: March 15 and 20, 2020. In contrast, most economy-wide policies were enacted in late-March/early April, before a pause, and then used again in July (such as for *Asset Purchases* and *Market Liquidity Policy*), and in some cases used more continuously over several months. These patterns suggest that some policies were part of a "first line of defence" (the *US$ Swap Lines*, *NBFI Policies*, *Market-Based Measures*, *Macroprudential Buffers*, *Market Liquidity Policy*, and *Asset Purchases*), while others were relied on more heavily to support the economy after the initial period of extreme financial stress had diminished (such as fiscal, monetary, and other prudential policies).

In our empirical specification, we focus on the effects on specific structures and intermediaries that are likely to be more affected by specific policies and utilize the daily frequency available in the data to better identify the impact of individual policies announced on different dates.[48]

B. Policy Response to Covid and Financial Stress: Specification

In order to test if the sector-specific, bank-specific, and economy-wide policies affected the degree of stress experienced in different countries and sectors during the *Covid Shock*, and to identify the effects when many of these policies were announced around the same time, we extend the *country-sector* and *country-sector-time* specifications used in the last section. This section outlines the methodology in some detail, as the large number of specifications can be difficult to follow, but each captures somewhat different aspects of the potential relationships. Section C then estimates these different specifications and discusses the results.

[48] Table D1 contains summary statistics for our baseline sample employing daily data (e.g., column (1) of Table 10). Table D2 in Forbes, Friedrich, and Reinhardt (2022) shows that the time-series correlation between most of the policy variables we consider is high at the weekly frequency.

More specifically, we estimate the following specifications for each of the five sector- and bank-specific policies (using both the *country-sector* and the *country-sector-time* approach) and then a similar set of specifications for the five economy-wide policies (discussed at the end). Tables (9) and (10) report the full set of results for NBFI policies in order to show the range of specifications. Then, Tables (11) and (12) summarize a subset of the key results for the different sector- and bank-specific policies simultaneously in order to facilitate a comparison.[49]

First, column (1) in Table 9 estimates if the policy change was correlated with a reduction in country-level stress:

$$Stress_{i,s} = \alpha + \alpha_s + \beta \boldsymbol{Policy_i} + \gamma \boldsymbol{Controls_i} + \varepsilon_{i,s} , \quad (4)$$

where $Stress_{i,s}$ is the log change in stress (for the sovereign or sector) from March 10 until April 30 (the window used for the tests showing the reduction in stress in Table 7); α_s are the sector dummies (for banks or corporates); $Policy_i$ is one of the policies discussed in Section A for each country *i*; and $Controls_i$ is the number of Covid cases over the same window. For the regressions for *US$ Swap Lines*, we use a shorter window of March 10 until March 30 to capture the much shorter period (of just a few days) when all the swap lines were announced. If the *Policy* reduces stress in each country on average, we expect β<0.

Next, column (2) estimates if the policy change was correlated with a reduction in sector-level stress and add controls for the country dummies[50]:

$$Stress_{i,s} = \alpha_i + \alpha_s + \beta \boldsymbol{Policy_i} * \alpha_s + \gamma \boldsymbol{Controls_i} * \alpha_s + \varepsilon_{i,s} . \quad (5)$$

If the policy reduces stress in the banking or corporate sector, we expect β<0 for the given sector.

Then, columns (3) through (5) test if the policy change is correlated with a reduction in stress from the structural vulnerabilities or in the banking sector as a whole:

$$Stress_{i,s} = \alpha_i + \alpha_s + \delta \boldsymbol{Structure_i^s} * \alpha_s + \beta \boldsymbol{Policy_i} * \alpha_s + \mu \boldsymbol{Policy_i} * \boldsymbol{Structure_i^s} * \alpha_s + \gamma \boldsymbol{Controls_i} * \alpha_s + \varepsilon_{i,s} . \quad (6)$$

If the policy reduces stress from the specific structure, we expect μ<0 for the given sector, while δ<0 suggests that the policy reduced stress in the sector overall but not necessarily linked to the specific structure. We estimate equation (6) focusing on vulnerabilities for just banks, just corporates, and then for both sectors simultaneously (continuing to include the sovereign in each specification).

Finally, columns (6) through (8) in Table 9 add controls for the economy-wide policies in order to assess if the reduction in stress corresponded to the economy-wide policies. Column (6) simply adds controls for the economy-wide policies to equation (4), while columns (7) and (8) add the same controls to equation (6) interacted with banking or corporate sector dummies, respectively, allowing the impact of each policy (including the economy-wide policies) to vary by sector.[51] If any of the economy-wide policies reduce stress in each country on average, we would expect the corresponding coefficient to be

[49] The full set of results for the other structure- and bank-specific policies are in Forbes, Friedrich, and Reinhardt (2022).

[50] In most cases, these results do not change significantly with the country dummies, so we include them to be consistent with the following specifications.

[51] We do not include banks and corporates simultaneously in this specification due to limited degrees of freedom.

negative. Equally important, if any significant effects of the structure-specific (or bank-specific) policies remain significant (in the μ and δ coefficients), this suggests that the estimated effects were not driven by the economy-wide policies.

These specifications in equations (4) through (6) correspond to the *country-sector* results in equation (2). As discussed in Section V, however, the daily frequency of our data also allows us to estimate and identify relationships based on the time-series dimension. Therefore, we also estimate a corresponding series of *country-sector-time* results, building on equation (3), to better capture how specific policies affected the relationship between stress and the different structures and sector in our sample.

An example of these results is shown in Table 10 for NBFI policies. Column (1) begins by estimating if the policy change was correlated with a reduction in country-level stress at the higher daily frequency *t*, including controls for country and sector effects over the full period (as done above):

$$Stress_{i,s,t} = \alpha_i + \alpha_s + \beta \boldsymbol{Policy_{i,t}} + \gamma \boldsymbol{Controls_{i,t}} * \alpha_s + \varepsilon_{i,s,t} \quad (7)$$

We estimate these relationships over the window from March 23 through April 30, including the early period in order to estimate relationships before the period of active policy responses. If the *Policy* reduces stress in countries on average immediately after being announced, we expect β<0.

Next, column (2) tests if the policy change was correlated with a reduction in sector-level stress, while including country-time and sector-time dummies:

$$Stress_{i,s,t} = \alpha_{i,t} + \alpha_{s,t} + \beta \boldsymbol{Policy_{i,t}} * \alpha_s + \gamma \boldsymbol{Controls_{i,t}} * \alpha_s + \varepsilon_{i,s,t} \quad (8)$$

If the policy reduces stress in the banking or corporate sector immediately after it was announced, we would expect β<0 for the given sector.

Then columns (3) through (5) test if the policy change is correlated with a reduction in stress from the structural vulnerabilities or in the banking sector at this higher frequency and while controlling for changes in overall risk:

$$Stress_{i,s,t} = \alpha_{i,t} + \alpha_{s,t} + \delta \boldsymbol{Structure_i^s} * \alpha_s + \beta \boldsymbol{Policy_{i,t}} * \alpha_s + \mu \boldsymbol{Policy_{i,t}} * \boldsymbol{Structure_i^s} * \alpha_s + \emptyset VIX_{t-1} \boldsymbol{Structure_i^s} * \alpha_s + \gamma \boldsymbol{Controls_{i,t}} * \alpha_s + \varepsilon_{i,s,t}\ , \quad (9)$$

where VIX_{t-1} is the lagged percent change in the VIX. We estimate equation (9) for just banks, just corporates, and then both sectors simultaneously. If the policy reduces stress from the specific structure at this high frequency, we expect μ<0 for the given sector, while β<0 suggests that the policy reduced stress in the sector overall, but not necessarily linked to the specific structure.

Finally, columns (6) through (8) repeat these results with additional controls for the economy-wide policies in order to assess if the reduction in stress corresponded to the economy-wide policies, as well as if any earlier results were driven by economy-wide policies adopted around the same time. If any of the economy-wide policies reduce stress in the bank or corporate sector after controlling for the other structure- or bank-specific policies, we would expect the corresponding coefficient to be negative. Equally important, if any significant effects of the structure-specific (or bank-specific) policies from equation (9) remain significant (in the μ and β coefficients), this suggests that the estimated effects were not driven by the economy-wide policies.

C. Policy Responses to Covid: Results

Tables 9 through 12 report the results of this extensive series of tests of whether different policy responses to the *Covid Shock* significantly mitigated stress in different sectors and related to certain exposures in March and April of 2020. We focus on estimates of the impact of the three structure-specific policies (*NBFI Policies*, *Market-Based Measures*, and *US$ Swap Lines*) that would be more likely to impact the two key vulnerabilities related to NBFI and dollar funding, and then on the impact of two bank-specific policies (*Prudential Regulations* and *Macroprudential Buffers*) that would be more likely to affect the sector which experienced the significant reduction in vulnerability during April 2020. For each of these five policies, we also include controls for changes in economy-wide policies, and there is one table with the *country-sector* results (equations (4) to (6)) and a second table with the *country-sector-time* results (equations (7) to (9)).

We begin with policies focused on supporting NBFIs, with key results in Tables 9 and 10. The estimates based on the *country-sector* results (Table 9) indicate that a loosening in *NBFI Policies* was correlated with a significant reduction in country-level spreads (column (1)) over March 10 to April 30. Estimates of the impact on different sectors that do not control for the exposure to NBFIs suggest that this reduction in country-level stress may reflect an impact of *NBFI Policies* on the corporate sector (column (2)), but when also controlling for the exposure of each sector to NBFIs, the estimates show that *NBFI Policies* worked by significantly lowering the spreads of banks that were more reliant on NBFI funding (columns (3) to (5)). There was some corresponding benefit to all corporates (independent of NBFI exposure), but the reduction in corporate spreads becomes insignificant. Also important is that all of these results are robust to controlling for a range of economy-wide policies (*Policy Rate Changes*, *Asset Purchases*, *Fiscal Policy*, *Market Liquidity Policy*, and *Prudential Regulations*) in columns (6) to (8). It is noteworthy that none of the economy-wide policies correspond to a significant reduction in spreads across all of the specifications, while the *NBFI Policies* consistently correspond to a significant reduction in spreads for the country as a whole, driven by banks with more NBFI exposure, in each of the specifications.

Table 10 repeats the corresponding tests for the impact of *NBFI Policies* while incorporating the time-series dimension available in our daily data plus controls for changes in global risk interacted with NBFI funding vulnerabilities in some specifications. The results are very similar, although there is now evidence that *NBFI Policies* reduced spreads for corporates, as well as banks, with greater NBFI exposure. More specifically, a loosening in *NBFI Policies* is correlated with a significant reduction in country-level spreads (column (1)) when controlling only for country and sector effects and the interaction of Covid cases with each sector. When allowing the effects to vary by sector, *NBFI Policies* cause a larger reduction in corporate spreads than banking spreads (although both effects are now significant in column (2)) and work by significantly reducing the spreads of both banks and corporates with greater NBFI exposure (columns (3) to (5)). These results continue to be significant when controlling for the economy-wide policies, with no consistent effects of the economy-wide policies on spreads in the economy overall or on just the bank or corporate sectors (columns (6) to (8)).

Next, Tables 11 and 12 report a subset of these results for other policies using the *country-sector* and *country-sector-time* approach, respectively. For reasons of brevity, we report the key columns (5), (7),

and (8) of Tables 9 and 10 for each policy.[52] Results for *Market-Based Measures* (instead of *NBFI Policies*) are shown in columns (4) to (6) of each table. These policies could not only reduce stress for the economy overall but also have more impact on institutions with more exposure to NBFIs, as more NBFI transactions occurred through the markets that are affected by these policies. The estimated impact of these *Market-Based Measures* on spreads, however, varies across estimation approaches. The *country-sector* results in Table 11 suggest that the impact of *Market-Based Measures* is smaller and less consistently significant than for the *NBFI* policies, although usually still negative. More specifically, the *Market-Based Measures* are not correlated with a significant reduction in spreads in banks or corporates more exposed to NBFIs. In contrast, however, the *country-sector-time* results in Table 12 find somewhat stronger effects of these *Market-Based Measures* on spreads, especially through banks more exposed to NBFIs (as found for all the results focusing on *NBFI Policies*). The stronger results for the estimates that incorporate the time-series dimension (as found for the corresponding results assessing the impact of *NBFI Policies*) supports our hypothesis that the higher-frequency data is useful to help identify the impact of different policies during this volatile period.

As a final analysis of structure-specific policies, we assess the impact of the *US$ Swap Lines*. Since these policies were enacted over a much narrower window (mostly on March 15 and 20, 2020, instead of over several weeks), we modify our framework slightly. For the *country-sector* results, we focus on changes in spreads from March 10 to 30 (with changes in the *country-sector-time* approach discussed below). Also, instead of focusing on whether the policies differentially affected banks and corporates which were more reliant on NBFI funding (a characteristic that was most relevant when assessing the impact of the other *structure-based measures*), we focus on whether the policies differentially affected institutions which were more reliant on FX funding. The results from the *country-sector* analysis are shown in columns (7) to (9) of Table 11. Column (8) shows that the announcement of swap lines is correlated with a significant reduction in the spreads of banks more reliant on US$ funding when simultaneously controlling for the economy-wide policies. This is consistent with the swaps working as expected and having a greater effect on banks.

Perhaps more informative given the narrow window over which the US$ swap lines were announced is the *country-sector-time* approach. We modify our standard approach slightly to add additional terms to test if the US$ swap lines "broke-the link" between changes in the VIX and country-spreads when controlling for the FX exposure of the given country-sector. For this purpose, we code US$ swap lines as a policy level dummy which takes the value of 1 from the day swap lines were enacted, and 0 otherwise. This is a clean test that is possible due to the high frequency of our data and the expectation that the US$ swap lines would have an immediate impact on the spreads of the most exposed sectors. The results are shown in columns (7) to (9) of Table 12. The results suggest that swap lines worked primarily through reducing stress in banks with greater US$ exposures, with less impact for corporates with greater US$ exposure (this corresponds to the results in columns (11) to (14) of Table 7, which show a reduction in spreads for banks with US$ exposure, but not corporates, when including the period over which swap lines may have had an effect on CDS spreads).

Our next set of results shifts from assessing the impact of structure-specific policies to focusing on bank-based policies. This builds on the results in the last section that banks with certain exposures (to NBFI funding and dollar funding) tended to be more vulnerable during the *Covid Shock*, with more mixed

[52] The full set of results can be found in an earlier working paper version (see Forbes, Friedrich, and Reinhardt, 2022).

results on whether corporates with similar exposures were more vulnerable. This focus on bank-based policies is also useful as it can be easier to implement policies targeting banks—which are already highly regulated—rather than broader policies which cover sectors and institutions that are less regulated or subject to regulatory oversight by different institutions. We focus on two types of bank-specific regulations (defined above): the broad category of *Prudential Regulations* and the narrower policy of changes in *Macroprudential Buffers.* We also use the same time period and methodology as used to analyze the *NBFI Policies* and *Market-Based Measures* (instead of the shorter window used for the US$ swap lines).

The results for changes in *Prudential Regulations* using the *country-sector* and *country-sector-time* approach are reported in columns (10) to (12) of Tables 11 and 12, respectively. Results for the *Macroprudential Buffers* are very similar, so we do not include the additional results. Changes in *Prudential Regulations* (and *Macroprudential Buffers*) appear to reduce the CDS spreads for banks and corporates—as would be expected—but this effect is rarely significant. This lack of a significant relationship between *Prudential Regulations* (and *Macroprudential Buffers*) and the resilience of banks or corporates during the *Covid Shock* is a sharp contrast to the consistently significant relationship with *NBFI Policies* (and, to a lesser extent, some *market-based policies* and *US$ swaps*). This suggests that these policies targeting banks were less effective than the structure-specific policies at reducing stress related to the vulnerabilities that are a focus of this analysis.

As a final set of tests, we have replicated the analysis in Tables 11 and 12, but instead of testing for the impact of sector-specific or bank-focused policies, we have tested for the impact of the five economy-wide policies. In each case, we tested for the impact of these policies on each sector overall and then for each sector based on the exposure to NBFIs or US dollars (as done above). The resulting estimates (not reported) show no consistent patterns and do not provide notable evidence that the economy-wide policies significantly reduced stress specifically related to NBFI or US dollar exposures. This does not imply that these economy-wide policies had no impact, as they likely supported the economy in other important ways. Instead, the results suggest that these economy-wide policies did not appear to have reduced the specific forms of stress as captured by CDS markets related to exposure to NBFIs or US dollar funding during the *Covid Shock*.

To summarize, the results in this section show that some structure-specific policies were effective at alleviating the specific forms of financial stress identified earlier in the paper. More specifically, policies aimed at supporting NBFIs significantly reduced the stress experienced by banks (and for corporates in some specifications) that were more reliant on NBFI funding. New US$ swap lines also significantly reduced the stress related to FX funding by banks. Moreover, policies aimed at supporting market-based financial intermediation reduced the stress experienced by banks that were more reliant on NBFI funding in some specifications (namely those utilizing the time-series dimension), but with more mixed results. These structure-specific policies appeared to be more effective at reducing the forms of stress identified in this paper than policies easing general regulations on banks or that focused on supporting the broader economy. These structure-specific policies also had significant effects even after controlling for a range of economy-wide policies (such as reducing interest rates, asset-purchase programs, liquidity support policies, and fiscal policy), suggesting that the economy-wide policies may not have mitigated the specific forms of stress related to NBFI and US$ exposures in the banking sector, even if they supported the economy through other channels.

VII. Conclusions

Financial market volatility increased sharply in March 2020, with many measures of financial stress jumping to their highest levels since the 2008/9 Global Financial Crisis (or even worse, in some cases). This paper focuses on one aspect of this stress: changes in CDS spreads for sovereigns, corporates, and banks. While these measures jumped sharply at the end of March 2020, there was a large variation in the vulnerability of different countries and sectors. The paper provides evidence on how different funding structures may have contributed to this variation and which policy responses to the risk-off shock helped mitigate these structural vulnerabilities.

We find that the source and currency of funding were important for explaining resilience during the *Covid Shock* in March 2020, with more mixed evidence on the role of the instrument and counterparty location of funding. More specifically, banks with a higher share of funding from household deposits were significantly more resilient, and banks that relied more on non-bank financial institutions (NBFIs) were less resilient. Banks, and to some extent corporates, with a higher share of funding in US$ were also significantly less resilient. In contrast, there is only weak evidence on whether funding through loans (instead of debt markets) increased resilience, and no consistent evidence that funding domestically (instead of cross-border) increased resilience for either banks or corporates.

These results generally support previous literature on the potential vulnerabilities from different funding structures, but they provide the first evidence of how these vulnerabilities may matter across sectors. They also provide new granularity on the relative importance of different vulnerabilities—such as whether borrowing in dollars is more or less risky than borrowing from abroad. These results are also one of the first tests of whether the substantial macroprudential reforms adopted over the last decade improved resilience in different sectors to a severe risk-off shock and whether the corresponding changes in funding structures and forms of intermediation (such as the growth of "shadow" banking) may have increased vulnerabilities in unexpected ways.

The key findings have important implications for the priorities for future policy reforms. While many of the macroprudential reforms adopted since the 2008/9 Global Financial Crisis increased the resilience of banks, they also shifted more financial intermediation from banks to the NBFI sector, and the results in this paper suggest that entities which received a larger share of funding from NBFIs (and especially dollar funding from NBFIs) were less resilient to the *Covid Shock*. This supports policy efforts to widen the perimeter for macroprudential regulation to include not just banks but segments of the NBFI sector which contributed to these vulnerabilities. The results also support efforts in some countries to reduce reliance on foreign currency funding, as this appears to have strengthened resilience in both the banking and corporate sectors.

Closely related, the results provide some evidence that the currency of the funding was more important than the nationality of the counterparty (even though they are highly correlated) for the resilience of corporates—and especially banks—to the *Covid Shock*. More specifically, when banks (and, to some extent, corporates) had a higher share of funding in dollars, they generally experienced significantly more financial stress. In contrast, there is less evidence on whether a higher share of funding from abroad affected vulnerability (when controlling simultaneously for the currency exposures). This has important implications when evaluating how to reduce vulnerabilities in the future. The results suggest

that regulations such as capital controls (that focus on the residency of the parties to the transaction) would be less effective than macroprudential regulations (which focus on the currency of the transaction) for increasing resilience in the future.

The paper also goes a step further to analyze which policy responses were most effective after CDS spreads spiked in mitigating the financial stress around these two key vulnerabilities: funding from NBFIs and in foreign currency. The results suggest that structure-specific policies (especially those targeting the NBFI sector and US$ swap lines) were most effective at alleviating these specific forms of financial stress in banks. These targeted policies had significant effects even after controlling for a range of macroeconomic policies aimed at supporting the broader economy—such as lower interest rates, announcements of asset purchases, measures to support market liquidity, and fiscal stimulus. These structure-specific policies also appeared to be more effective at reducing these specific forms of stress than policies focused on supporting the banking sector more broadly—such as adjusting prudential regulations or macroprudential buffers. This raises an important question for the future: when key vulnerabilities contributing to financial stress can be identified and there are not yet strong spillovers to the broader economy, could authorities rely on policies addressing these specific vulnerabilities in lieu of adjusting broader prudential regulations, releasing macroprudential buffers, or other forms of support?

The establishment of more targeted policies will take time and require answering a number of important questions. How should these policies be aligned with existing macroprudential regulations to create a level playing field for different forms of intermediation? If the growth of the NBFI sector is partly driven by tighter prudential and macroprudential regulations on the banking sector, would these policies targeting other financial intermediaries generate their own leakages? And lastly, what is the right balance for policymakers between costly *ex ante* interventions (such as more targeted prudential frameworks), whose benefits may be uncertain at the time of implementation, and *ex post* interventions, which could prove even more distortionary by generating moral hazard and a greater buildup of risks in vulnerable sectors? The answers to these questions could provide policymakers with a richer toolset to tackle complex crisis situations, such as when the economy is repeatedly hit by adverse shocks or when financial and macroeconomic objectives appear in conflict.

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Table 1
Financial Intermediation and Internationalization: Variables, Channels and Correlations

Sector	Variable	Channel in Figure 4	Expected relation with Covid stress[1]	Correlation and Significance[2]
Intermediation				
Banks	*Household liabilities/total liabilities*	1/(1+2+3)	-	-1.389**
Source				
	Bank liabilities/total liabilities	2/(1+2+3)	?	0.460
	NBFI liabilities / total liabilities	3/(1+2+3)	+	2.573**
Instrument	*Loans / total liabilities*	(1+2a+3a)/ (1+2+3)	-	-1.85***
	NBFI loans / total liabilities to NBFIs	3a/3	-	0.47
Corporates	*Bank liabilities / total liabilities*	4/(4+5)	-	-0.582
Source				
	NBFI liabilities[3] / total liabilities	5/(4+5)	+	0.582
Instrument	*Bank loans / total liabilities to banks*	4a/4	-	-0.694
Internationalization				
Banks	*US$ liabilities / total liabilities[4]*	I/(I+II)	+	0.719
Currency				
Counterparty location	*Cross-border liabilities / total liabilities*	I/(I+II)	+	0.92
Corporates	*US$ liabilities / total liabilities[4]*	III/(III+IV)	+	1.02*
Currency				
Counterparty location	*Cross-border liabilities / total liabilities*	III/(III+IV)	+	0.197

Notes: See Appendix B for detailed definitions, sources and sample statistics for each variable. (1) A "+" sign indicates more stress, i.e., a greater increase in CDS spreads. A "?" signifies that theory suggests channels so that the relationship could go in either direction or is neutral relative to the other variables. (2) *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively. (3) Data on NBFI liabilities of corporates is not available, so this is calculated as total liabilities less claims from banks and therefore is perfectly correlated with bank liabilities/total liabilities. (4) This is international debt issuance by countries' nationals (and not just residents) and therefore includes issuance by offshore affiliates.

Table 2 – Financial *Intermediation* and Stress: *Country-Sector* Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Banks' HH Liabilities*sector_bank	-1.56***				-2.35***					
	(0.48)				(0.74)					
Banks' Bank Liabilities*sector_bank		1.90**			-0.67	0.29				
		(0.77)			(0.88)	(1.01)				
Banks' NBFI Liabilities*sector_bank			2.72***			2.47*	2.67**			
			(0.91)			(1.35)	(0.96)			
Corporates' NBFI Liabilities*sector_corp				0.36	0.57	0.37	0.36			
				(0.51)	(0.47)	(0.45)	(0.44)			
Loan Share of Banks' All Sector Liabilities*sector_bank								-2.04**		-1.44*
								(0.74)		(0.82)
Loan Share of Corporates' Bank Liabilities*sector_corp									-0.36	-0.37
									(2.58)	(2.48)
sector_bank	0.10	-0.79***	-0.69***	-0.40***	0.50	-0.80***	-0.76***	1.38*	-0.48***	0.73
	(0.20)	(0.19)	(0.24)	(0.13)	(0.47)	(0.19)	(0.19)	(0.68)	(0.14)	(0.68)
sector_corp	-0.33**	-0.31*	-0.32*	-0.47	-0.57**	-0.48*	-0.47*	-0.32*	-0.16	-0.16
	(0.13)	(0.18)	(0.18)	(0.27)	(0.22)	(0.24)	(0.24)	(0.18)	(2.23)	(2.14)
New Covid Cases per 100k*sector_bank	0.02	-0.02	0.01	0.02	0.03	0.03	0.03	-0.01	0.05	0.04
	(0.03)	(0.06)	(0.06)	(0.04)	(0.02)	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)
New Covid Cases per 100k*sector_corp	0.13**	0.12*	0.13*	0.11*	0.11	0.12*	0.12*	0.12*	0.17**	0.17**
	(0.06)	(0.07)	(0.07)	(0.06)	(0.07)	(0.06)	(0.06)	(0.07)	(0.08)	(0.07)
Observations	*56*	*66*	*66*	*56*	*54*	*56*	*56*	*66*	*55*	*55*
R-squared	*0.77*	*0.65*	*0.65*	*0.69*	*0.76*	*0.74*	*0.74*	*0.64*	*0.69*	*0.71*
Number Countries	*21*	*25*	*25*	*21*	*20*	*21*	*21*	*25*	*21*	*21*
Adjusted R-squared	*0.585*	*0.366*	*0.361*	*0.424*	*0.521*	*0.482*	*0.499*	*0.356*	*0.429*	*0.443*

Notes: The table shows the estimated parameter values from a panel regression of equation (2) testing the relationship between different forms of financial *intermediation* (the funding source or instrument) and financial stress. All columns include country and sector fixed effects (in the form of bank and corporate sectoral dummies *sector_bank* and *sector_corp*, respectively). Standard errors are clustered at the country level. The dependent variable measuring financial stress is the log change in sector-specific CDS during the *Covid Shock* (Jan. 1 to Mar. 23, 2020). See Appendix B for detailed definitions, sources, and sample statistics for each variable.

Table 3 - Financial *Intermediation* and Stress: *Country-Sector-Time* Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Banks' HH Liabilities*sector_bank*Δvix	-0.28**				-0.43***					
	(0.10)				(0.14)					
Banks' Bank Liabilities*sector_bank*Δvix		0.17			-0.22	-0.06				
		(0.13)			(0.19)	(0.17)				
Banks' NBFI Liabilities*sector_bank*Δvix			0.45**			0.48**	0.44**			
			(0.18)			(0.23)	(0.20)			
Corporates' NBFI Liabilities*sector_corp*Δvix				-0.03	0.00	-0.03	-0.02			
				(0.08)	(0.10)	(0.08)	(0.07)			
Banks' HH Liabilities*sector_bank	-0.02**				-0.04***					
	(0.01)				(0.01)					
Banks' Bank Liabilities*sector_bank		0.02			-0.01	0.00				
		(0.01)			(0.01)	(0.01)				
Banks' NBFI Liabilities*sector_bank			0.03*			0.03	0.03*			
			(0.02)			(0.02)	(0.02)			
Corporates' NBFI Liabilities*sector_corp				0.01	0.02**	0.01*	0.01*			
				(0.01)	(0.01)	(0.01)	(0.01)			
Loan Share of Banks' All Sector Liabilities*sector_bank*Δvix								-0.11		-0.03
								(0.14)		(0.18)
Loan Share of Corporates' Bank Liabilities*sector_bank*Δvix									-0.07	-0.07
									(0.41)	(0.41)
Loan Share of Banks' All Sector Liabilities*sector_bank								-0.04***		-0.03***
								(0.01)		(0.01)
Loan Share of Corporates' Bank Liabilities*sector_bank									0.00	0.00
									(0.03)	(0.03)
New Covid Cases per 100k (daily)*sector_bank	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
New Covid Cases per 100k (daily)*sector_corp	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.00	0.01	0.01
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Fixed effects					Country-time, Sector-time					
Observations	*3,136*	*3,696*	*3,696*	*3,136*	*3,024*	*3,136*	*3,136*	*3,696*	*3,080*	*3,080*
R-squared	*0.74*	*0.71*	*0.71*	*0.73*	*0.74*	*0.74*	*0.74*	*0.71*	*0.72*	*0.72*
Number	*21*	*25*	*25*	*21*	*20*	*21*	*21*	*25*	*21*	*21*
Adjusted R-squared	*0.538*	*0.498*	*0.501*	*0.532*	*0.542*	*0.535*	*0.536*	*0.499*	*0.510*	*0.511*

Notes: The table shows the estimated parameter values from a panel regression of equation (3) testing the relationship between different forms of financial *intermediation* (the funding source or instrument) and financial stress. All columns include country-time and sector-time fixed effects; *sector_bank* and *sector_corp* are bank and corporate sectoral dummies, respectively. Standard errors are clustered at the country level. The dependent variable measuring financial stress is the daily log change in CDS. The sample period is Jan. 1 to Mar. 23, 2020. See Appendix B for detailed definitions, sources, and sample statistics for each variable. VIX interactions are shown in bold.

Table 4 - *Internationalization* and Stress: *Country-Sector* Results

	(1)	(2)	(3)	(4)	(5)
Banks' US$ Liabilities*sector_bank	2.18**				2.40***
	(0.80)				(0.63)
Banks' Cross-border Liabilities*sector_bank		1.80***			0.97
		(0.61)			(0.63)
Corporates' US$ Liabilities*sector_corp			0.37		2.16**
			(1.02)		(0.77)
Corporates' Cross-border Liabilities*sector_corp				-0.00	-0.28
				(0.37)	(0.35)
sector_bank	-0.72***	-0.79***	-0.37*	-0.31	-0.93***
	(0.15)	(0.16)	(0.19)	(0.19)	(0.13)
sector_corp	-0.30*	-0.32*	-0.37*	-0.18	-0.43**
	(0.18)	(0.18)	(0.20)	(0.16)	(0.17)
Fixed effects	Country, Sector				
New Covid Cases per 100k *Sector Dummies	Included				
Observations	*66*	*66*	*66*	*62*	*62*
R-squared	*0.66*	*0.66*	*0.61*	*0.60*	*0.73*
Number	*25*	*25*	*25*	*23*	*23*
Adjusted R-squared	*0.392*	*0.377*	*0.295*	*0.284*	*0.477*

Notes: The table shows the estimated parameter values from a panel regression of equation (2) testing the relationship between different forms of financial *internationalization* (the funding currency and counterparty location, i.e., whether the funding is cross-border or domestic) and financial stress. All columns include country and sector fixed effects (in the form of bank and corporate sectoral dummies *sector_bank* and *sector_corp*, respectively). Standard errors are clustered at the country level. The dependent variable measuring financial stress is the log change in sector-specific CDS over the *Covid Shock* (Jan. 1 to Mar. 23, 2020). See Appendix B for detailed definitions, sources, and sample statistics for each variable.

Table 5 - *Internationalization* and Stress: *Country-Sector-Time* Results

	(1)	(2)	(3)	(4)	(5)
Banks' US$ Liabilities*sector_bank*Δvix	0.30***				0.16
	(0.08)				(0.13)
Banks' Cross-border Liabilities*sector_bank*Δvix		0.30**			0.26
		(0.11)			(0.17)
Corporates' US$ Liabilities*sector_corp*Δvix			-0.18		-0.06
			(0.13)		(0.14)
Corporates' Cross-border Liabilities*sector_corp*Δvix				0.01	0.10
				(0.06)	(0.08)
Banks' US$ Liabilities*sector_bank	0.03*				0.03**
	(0.01)				(0.01)
Banks' Cross-border Liabilities*sector_bank		0.02			0.00
		(0.01)			(0.01)
Corporates' US$ Liabilities*sector_corp			0.00		0.02*
			(0.01)		(0.01)
Corporates' Cross-border Liabilities*sector_corp				0.00	-0.00
				(0.00)	(0.01)
Fixed effects	Country-time, Sector-time				
New Covid Cases per 100k *Sector Dummies	Included				
Observations	*3,696*	*3,696*	*3,696*	*3,472*	*3,472*
R-squared	*0.71*	*0.71*	*0.71*	*0.72*	*0.72*
Number	*25*	*25*	*25*	*23*	*23*
Adjusted R-squared	*0.502*	*0.502*	*0.497*	*0.514*	*0.521*

Notes: The table shows the estimated parameter values from a panel regression of equation (3) testing the relationship between different forms of financial *internationalization* (the funding currency and counterparty location, i.e., whether the funding is cross-border or domestic) and financial stress. All columns include country-time and sector-time fixed effects; *sector_bank* and *sector_corp* are bank and corporate sectoral dummies, respectively. Standard errors are clustered at the country level. The dependent variable measuring financial stress is the daily log change in CDS. The sample period is Jan. 1 to Mar. 23, 2020. See Appendix B for detailed definitions, sources, and sample statistics for each variable. VIX interactions are shown in bold.

Table 6 – *Intermediation, Internationalization* and Stress: *Country-Sector* Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Intermediation and Internationalization		Sectoral US$ and cross-border splits				Internationalization Loan Shares		
Banks' US$ Liabilities*sector_bank	1.05	2.67***							
	(1.19)	(0.88)							
Banks' Cross-border Liabilities*sector_bank	0.70	-0.18	0.04						
	(0.77)	(0.74)	(0.90)						
Corporates' US$ Liabilities*sector_corp	2.25***	2.28***	2.22***	2.43***					
	(0.77)	(0.60)	(0.60)	(0.64)					
Corporates' Cross-border Liabilities*sector_corp	-0.18	-0.41	-0.19	-0.22	0.23				
	(0.32)	(0.26)	(0.31)	(0.35)	(0.37)				
Banks' HH Liabilities*sector_bank	-2.19***								
	(0.59)								
Banks' Bank Liabilities*sector_bank	-1.46*								
	(0.82)								
Banks' NBFI Liabilities*sector_bank		2.21**							
		(1.00)							
Corporates' NBFI Liabilities*sector_corp	0.40	0.44	0.39	0.39					
	(0.46)	(0.43)	(0.47)	(0.47)					
Banks' NBFI US$ Liabilities*sector_bank			14.16**	17.21***	13.77*	12.32*			
			(6.31)	(5.16)	(6.64)	(6.82)			
Banks' NBFI XB Liabilities*sector_bank				-2.18	-1.81	-1.41			
				(1.75)	(1.90)	(1.82)			
Corps' Bank US$ Liabilities*sector_corp					8.31***	5.34			
					(2.42)	(3.32)			
Corps' Bank XB Liabilities*sector_corp						2.98			
						(2.54)			
Loan Share of Banks' US$ Liabilities*sector_bank							-0.87*		-0.49
							(0.43)		(0.63)
Loan Share of Corporates' US$ Liabilities*sector_corp							0.75		0.62
							(0.51)		(0.59)
Loan Share of Banks' Cross-border Liabilities*sector_bank								-0.33	-0.45
								(0.45)	(0.51)
Loan Share of Corps' Cross-border Liabilities*sector_corp								0.52	0.14
								(0.32)	(0.47)
sector_bank	0.30	-1.00***	-0.65***	-0.59***	-0.63***	-0.62***	0.19	-0.14	0.20
	(0.35)	(0.17)	(0.16)	(0.14)	(0.13)	(0.14)	(0.39)	(0.35)	(0.42)
sector_corp	-0.82***	-0.77***	-0.77***	-0.80***	-0.77***	-0.76***	-0.83***	-0.47**	-0.82***
	(0.23)	(0.23)	(0.25)	(0.25)	(0.20)	(0.18)	(0.27)	(0.21)	(0.25)
Fixed effects					Country, Sector				
New Covid Cases per 100k *Sector Dummies					Included				
Observations	*54*	*56*	*53*	*53*	*48*	*48*	*49*	*66*	*49*
R-squared	*0.80*	*0.79*	*0.77*	*0.78*	*0.77*	*0.78*	*0.74*	*0.63*	*0.75*
Number	*20*	*21*	*20*	*20*	*18*	*18*	*19*	*25*	*19*
Adjusted R-squared	*0.541*	*0.528*	*0.506*	*0.520*	*0.512*	*0.530*	*0.479*	*0.309*	*0.447*

Notes: The table shows the estimated parameter values from a panel regression of equation (2) testing the relationship between different forms of financial *intermediation* (the funding source or instrument) and/or financial *internationalization* (the funding currency and counterparty location, i.e., whether the funding is cross-border or domestic) and financial stress. All columns include country and sector fixed effects (in the form of bank and corporate sectoral dummies *sector_bank* and *sector_corp*, respectively). Standard errors are clustered at the country level. The dependent variable measuring financial stress is the log change in sector-specific CDS during the *Covid Shock* (Jan. 1 to Mar. 23, 2020). See Appendix B for detailed definitions, sources, and sample statistics for each variable.

Table 7 – Sensitivity Tests: *Country-Sector* Panel

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	Baseline		No Covid Controls		Drop EMEs		Incl. NBFI+USD Assets		24 Feb to 23 March		1 Jan to 30 April		24 Feb to 30 April	
Banks' US$ Liabilities*sector_bank	1.05	2.67***	-0.47	1.88*	1.18	2.84**	6.88**	5.68	0.05	1.86*	1.12	3.48	0.59	2.09
	(1.19)	(0.88)	(1.26)	(0.91)	(1.41)	(0.99)	(3.01)	(3.92)	(1.35)	(0.98)	(2.17)	(2.16)	(1.94)	(1.58)
Banks' Cross-border Liabilities*sector_bank	0.70	-0.18	1.03	-0.03	0.35	-1.08	0.71	0.01	0.09	-1.06	-0.05	-0.67	-0.31	-1.34
	(0.77)	(0.74)	(0.75)	(0.68)	(1.00)	(1.00)	(0.88)	(1.06)	(0.79)	(0.82)	(0.96)	(1.49)	(0.65)	(0.96)
Corporates' US$ Liabilities*sector_corp	2.25***	2.28***	0.98	1.39	2.47**	2.50***	2.49***	2.35***	1.81*	1.99***	2.80***	2.90***	2.81***	3.05***
	(0.77)	(0.60)	(1.08)	(0.90)	(0.93)	(0.71)	(0.74)	(0.56)	(0.89)	(0.62)	(0.79)	(0.86)	(0.88)	(0.82)
Corporates' Cross-border Liabilities*sector_corp	-0.18	-0.41	0.04	-0.25	-0.32	-0.57*	-0.33	-0.56*	-0.18	-0.44	-0.64	-0.99**	-0.80*	-1.12**
	(0.32)	(0.26)	(0.45)	(0.41)	(0.42)	(0.31)	(0.37)	(0.32)	(0.38)	(0.30)	(0.42)	(0.47)	(0.40)	(0.40)
Banks' HH Liabilities*sector_bank	-2.19***		-2.85***		-2.19*		-3.42***		-2.53***		-3.40		-2.42	
	(0.59)		(0.76)		(1.03)		(1.01)		(0.48)		(2.12)		(1.43)	
Banks' Bank Liabilities*sector_bank	-1.46*		-1.93**		-1.46		-3.36***		-1.29		-3.00**		-2.00**	
	(0.82)		(0.78)		(1.06)		(1.15)		(0.94)		(1.37)		(0.94)	
Banks' NBFI Liabilities*sector_bank		2.21**		2.18**		3.25***		2.10**		3.57***		-0.04		1.77
		(1.00)		(1.00)		(0.97)		(0.82)		(0.91)		(2.00)		(1.35)
Corporates' NBFI Liabilities*sector_corp	0.40	0.44	0.74	0.64	-0.02	-0.07	0.45	0.51	0.20	0.16	-0.30	-0.10	-0.13	-0.08
	(0.46)	(0.43)	(0.44)	(0.45)	(0.62)	(0.47)	(0.48)	(0.42)	(0.50)	(0.44)	(0.69)	(0.50)	(0.72)	(0.50)
Banks' NBFI Assets*sector_bank							1.41	-1.03						
							(1.55)	(1.12)						
Banks' USD Assets*sector_bank							-8.06**	-3.52						
							(3.36)	(4.22)						
sector_bank	0.30	-1.00***	0.83*	-0.86***	0.46	-0.82***	1.02*	-0.92***	0.73**	-0.80***	1.11	-0.60**	0.95	-0.44*
	(0.35)	(0.17)	(0.41)	(0.16)	(0.70)	(0.24)	(0.56)	(0.18)	(0.33)	(0.18)	(1.05)	(0.29)	(0.68)	(0.22)
sector_corp	-0.82***	-0.77***	-0.58*	-0.51	-0.48	-0.36	-0.83***	-0.79***	-0.64**	-0.59**	-0.32	-0.32	-0.27	-0.25
	(0.23)	(0.23)	(0.29)	(0.30)	(0.35)	(0.31)	(0.24)	(0.23)	(0.24)	(0.24)	(0.22)	(0.21)	(0.25)	(0.25)
Fixed effects	Country, Sector													
New Covid Cases per 100k *Sector Dummies	Included (except columns 3 + 4)													
Observations	*54*	*56*	*54*	*56*	*45*	*47*	*54*	*56*	*54*	*56*	*51*	*53*	*51*	*53*
R-squared	*0.80*	*0.79*	*0.73*	*0.71*	*0.75*	*0.75*	*0.82*	*0.79*	*0.74*	*0.76*	*0.79*	*0.75*	*0.76*	*0.75*
Number	*20*	*21*	*20*	*21*	*16*	*17*	*20*	*21*	*20*	*21*	*19*	*20*	*19*	*20*
Adjusted R-squared	*0.541*	*0.528*	*0.430*	*0.400*	*0.401*	*0.423*	*0.548*	*0.506*	*0.408*	*0.467*	*0.495*	*0.444*	*0.428*	*0.444*

Notes: The table shows the estimated parameter values from panel regressions of equation (2) testing the relationship between financial stress and different forms of financial *intermediation* and *internationalization* using a country-sector approach. All columns include country and sector fixed effects (in the form of bank and corporate sectoral dummies, *sector_bank* and *sector_corp*, respectively). All columns except columns (3) and (4) also include interactions of the sector dummies and Covid cases. Standard errors are clustered at the country level. The dependent variable measuring financial stress is the log change in sector-specific CDS during the *Covid Shock* (Jan. 1 to Mar. 23, 2020), except in columns (9) through (14), which use the dates specified at the top. See Appendix B for detailed definitions, sources, and sample statistics for each variable.

Table 8 – Sensitivity Tests: *Country-Sector-Time* Panel

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Baseline		No Covid controls		Incl. NBFI+USD Assets		Weekly data (to 17 March)		Weekly data (to 17 March, lagged VIX)	
Banks' US$ Liabilities*sector_bank*Δvix	-0.09	0.26	-0.10	0.25	-0.09	-0.17	-0.71	0.30	0.27	0.87*
	(0.31)	(0.27)	(0.31)	(0.27)	(0.66)	(0.61)	(0.44)	(0.46)	(0.39)	(0.42)
Banks' Cross-border Liabilities*sector_bank*Δvix	0.31	0.10	0.30	0.10	0.35	0.23	0.62**	0.15	-0.26	-0.49*
	(0.21)	(0.22)	(0.21)	(0.22)	(0.21)	(0.23)	(0.27)	(0.32)	(0.29)	(0.26)
Corporates' US$ Liabilities*sector_corp*Δvix	-0.11	-0.08	-0.11	-0.09	-0.12	-0.11	-0.04	0.13	-0.08	0.10
	(0.22)	(0.17)	(0.22)	(0.18)	(0.22)	(0.16)	(0.32)	(0.29)	(0.30)	(0.23)
Corporates' Cross-border Liabilities*sector_corp*Δvix	0.13	0.08	0.13	0.08	0.12	0.10	0.17	0.04	0.02	-0.05
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.13)	(0.17)	(0.12)	(0.12)
Banks' HH Liabilities*sector_bank*Δvix	-0.38**		-0.37**		-0.33**		-1.24***		-1.08***	
	(0.13)		(0.13)		(0.16)		(0.19)		(0.26)	
Banks' Bank Liabilities*sector_bank*Δvix	-0.34*		-0.34*		-0.31		-0.83**		-0.21	
	(0.18)		(0.19)		(0.23)		(0.35)		(0.36)	
Banks' NBFI Liabilities*sector_bank*Δvix		0.29*		0.29*		0.29*		1.02***		1.54***
		(0.14)		(0.15)		(0.16)		(0.30)		(0.29)
Corporates' NBFI Liabilities*sector_corp*Δvix	0.00	0.00	-0.00	-0.00	0.00	0.01	0.20*	0.17*	0.19	0.11
	(0.11)	(0.09)	(0.11)	(0.09)	(0.12)	(0.10)	(0.11)	(0.09)	(0.14)	(0.11)
Banks' NBFI Assets*sector_bank*Δvix					-0.13	-0.32				
					(0.31)	(0.25)				
Banks' USD Assets*sector_bank*Δvix					0.02	0.46				
					(0.84)	(0.71)				
Fixed effects	Country-time, Sector-time									
Funding Structures * Sector Dummies	Included									
New Covid Cases per 100k *Sector Dummies	Included (except columns 3 + 4 + 5)									
Observations	*3,024*	*3,136*	*3,024*	*3,136*	*3,024*	*3,136*	*540*	*560*	*540*	*560*
R-squared	*0.74*	*0.74*	*0.74*	*0.74*	*0.74*	*0.74*	*0.89*	*0.89*	*0.86*	*0.86*
Number	*20*	*21*	*20*	*21*	*20*	*21*	*20*	*21*	*20*	*21*
Adjusted R-squared	*0.542*	*0.537*	*0.541*	*0.535*	*0.540*	*0.537*	*0.805*	*0.797*	*0.740*	*0.743*

Notes: The table shows the estimated parameter values from panel regressions of equation (3) testing the relationship between financial stress and different forms of financial *intermediation* and *internationalization* using a country-sector-time approach. All columns include country-time and sector-time fixed effects (with *sector_bank* and *sector_corp* the bank and corporate sectoral dummies, respectively). All columns except columns (3) to (4) also include interactions of the sector dummies and Covid cases; in column (5) we dropped Covid cases – which are insignificant in our baseline *country-sector-time results* – to allow for clustering at the country level due to constraints on the degree of freedom linked to the number of countries and variables. Standard errors are clustered at the country level. The sample period is Jan. 1 to Mar. 23, 2020, in columns (1) to (6) coupled with the daily log change in CDS spreads as the dependent variable. In columns (7) to (10), we employ weekly data up to Mar. 17 (i.e., all complete weeks during the *Covid Shock* period). In weekly specifications, the dependent variable is the weekly log change in CDS spreads. See Appendix B for detailed definitions, sources, and sample statistics for each variable.

Table 9 – NBFI Policies: *Country-Sector* Panel

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
NBFI Policies	-0.03**					-0.05**		
	(0.01)					(0.02)		
NBFI Policies*sector_bank		-0.03	0.13**		0.13*		0.26***	
		(0.02)	(0.06)		(0.06)		(0.07)	
NBFI Policies*sector_corp		-0.09***		-0.10	-0.10			-0.05
		(0.03)		(0.07)	(0.07)			(0.20)
Banks' NBFI Liabilities*sector_bank			0.63		2.15		2.78***	
			(0.65)		(1.54)		(0.75)	
NBFI Policies*Banks' NBFI Liabilities*sector_bank			-0.69**		-0.92***		-1.03***	
			(0.25)		(0.32)		(0.24)	
Corporates' NBFI Liabilities*sector_corp				-0.66	-0.67			-0.37
				(0.50)	(0.52)			(1.36)
NBFI Policies*Corporates' NBFI Liabilities*sector_corp				0.04	0.04			-0.04
				(0.13)	(0.13)			(0.30)
Policy Rate Cuts						0.08		
						(0.11)		
Asset Purchases						-1.71*		
						(0.95)		
Fiscal Policy						0.29		
						(0.58)		
Market Liquidity Policy						-0.05		
						(0.04)		
Prudential Regulations						0.03**		
						(0.01)		
Policy Rate Cuts*sector_bank (col 7)/sector_corp (col 8)							0.00	-0.05
							(0.23)	(0.29)
Asset Purchases*sector_bank (col 7)/sector_corp (col 8)							8.71***	-4.91
							(2.18)	(3.24)
Fiscal Policy*sector_bank (col 7)/sector_corp (col 8)							-2.02	-0.19
							(1.33)	(1.75)
Market Liquidity Policy*sector_bank (col 7)/sector_corp (col 8)							-0.04	-0.08
							(0.04)	(0.07)
Prudential Regulations*sector_bank (col 7)/sector_corp (col 8)							-0.09**	0.02
							(0.04)	(0.03)
sector_bank	-0.18***	-0.04	-0.13	-0.09	-0.40	-0.18***	0.10	-0.06
	(0.06)	(0.09)	(0.13)	(0.16)	(0.35)	(0.06)	(0.16)	(0.16)
sector_corp	-0.09	0.24***	0.10	0.48***	0.51***	-0.09	0.09	0.46
	(0.09)	(0.08)	(0.11)	(0.15)	(0.16)	(0.09)	(0.11)	(0.54)
New Covid Cases per 100k	0.04**					0.04*		
	(0.02)					(0.02)		
New Covid Cases per 100k*sector_bank		-0.00	-0.10*	-0.02	-0.04		-0.17***	-0.03
		(0.04)	(0.05)	(0.03)	(0.03)		(0.04)	(0.03)
New Covid Cases per 100k*sector_corp		0.01	-0.07**	0.02	0.03		-0.07**	0.02
		(0.04)	(0.03)	(0.04)	(0.04)		(0.03)	(0.04)
Constant	0.20***					0.08		
	(0.06)					(0.10)		
Fixed effects	None	Country	Country	Country	Country	None	Country	Country
Observations	*61*	*61*	*61*	*53*	*53*	*61*	*61*	*53*
R-squared	*0.14*	*0.68*	*0.61*	*0.67*	*0.73*	*0.22*	*0.68*	*0.71*
Number Countries	*23*	*23*	*23*	*20*	*20*	*23*	*23*	*20*
Adjusted R-squared	*0.0825*	*0.391*	*0.242*	*0.344*	*0.399*	*0.0837*	*0.272*	*0.283*

Notes: The table shows the estimated parameter values from a panel regression of equations (4) to (6). All columns include sector fixed effects (in the form of bank and corporate sectoral dummies *sector_bank* and *sector_corp*, respectively). The inclusion of other fixed effects is indicated at the bottom of the table. Standard errors are clustered at the country level. The dependent variable measuring financial stress is the log change in sector-specific CDS during from Mar. 10 to Apr. 30, 2020). See Appendix B for detailed definitions, sources, and sample statistics for each variable.

Table 10 – NBFI Policies: *Country-Sector-Time* Panel

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
NBFI Policies	-0.01***					-0.01***		
	(0.00)					(0.00)		
NBFI Policies*sector_bank		-0.02***	0.03***		0.02*		0.03***	
		(0.01)	(0.01)		(0.01)		(0.01)	
NBFI Policies*sector_corp		-0.03***		0.01	0.00			0.01
		(0.01)		(0.01)	(0.01)			(0.01)
Banks' NBFI Liabilities*sector_bank			0.02*		0.02*		0.02*	
			(0.01)		(0.01)		(0.01)	
NBFI Policies*Banks' NBFI Liabilities*sector_bank			-0.32***		-0.35***		-0.32***	
			(0.05)		(0.06)		(0.05)	
Corporates' NBFI Liabilities*sector_corp				0.01**	0.01**			0.01**
				(0.00)	(0.00)			(0.00)
NBFI Policies*Corporates' NBFI Liabilities*sector_corp				-0.05***	-0.05***			-0.05***
				(0.02)	(0.02)			(0.02)
Policy Rate Cuts						0.01		
						(0.01)		
Asset Purchases						0.94***		
						(0.23)		
Fiscal Policy						0.20**		
						(0.08)		
Market Liquidity Policy						0.02		
						(0.01)		
Prudential Regulations						0.00		
						(0.00)		
Policy Rate Cuts*sector_bank (col 7)/sector_corp (col 8)							0.05*	-0.01
							(0.02)	(0.03)
Asset Purchases*sector_bank (col 7)/sector_corp (col 8)							0.08	0.47*
							(0.28)	(0.27)
Fiscal Policy*sector_bank (col 7)/sector_corp (col 8)							0.32**	-0.19
							(0.14)	(0.17)
Market Liquidity Policy*sector_bank (col 7)/sector_corp (col 8)							0.03	0.00
							(0.02)	(0.01)
Prudential Regulations*sector_bank (col 7)/sector_corp (col 8)							0.00	0.00
							(0.01)	(0.01)
Banks' NBFI Liabilities*sector_bank*Δvix			0.46**		0.48**		0.49**	
			(0.19)		(0.23)		(0.19)	
Corporates' NBFI Liabilities*sector_corp*Δvix				0.02	0.03			0.02
				(0.07)	(0.07)			(0.07)
New Covid Cases per 100k(daily)*sector_bank	-0.00**	0.00*	0.00	0.00	0.00	-0.00***	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
New Covid Cases per 100k(daily)*sector_corp	-0.00***	-0.00	-0.00	-0.00	-0.00	-0.00***	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Fixed effects	Ctry, Sec	Ctry-time, Sec-time	Ctry-time, Sec-time	Ctry-time, Sec-time	Ctry-time, Sec-time	Ctry, Sec	Ctry-time, Sec-time	Ctry-time, Sec-time
Observations	*5,444*	*5,444*	*5,316*	*4,644*	*4,644*	*5,444*	*5,316*	*4,644*
R-squared	*0.01*	*0.71*	*0.71*	*0.73*	*0.74*	*0.03*	*0.71*	*0.73*
Number Countries	*24*	*24*	*24*	*21*	*21*	*24*	*24*	*21*
Adjusted R-squared	*0.00901*	*0.495*	*0.497*	*0.532*	*0.539*	*0.0268*	*0.499*	*0.532*

Notes: The table shows the estimated parameter values from a panel regression of equations (7) to (9). All columns include sector fixed effects (in the form of bank and corporate sectoral dummies *sector_bank* and *sector_corp*, respectively). The inclusion of other fixed effects is indicated at the bottom of the table. Standard errors are clustered at the country level. The dependent variable measuring financial stress is the daily log change in CDS (from Jan. 1 to Apr. 30, 2020). See Appendix B for detailed definitions, sources, and sample statistics for each variable.

Table 11 – All Policies: *Country-Sector* Panel

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Policy Variable:	NBFI Policies			Market-based Measures			USD Swap Lines			Prudential Regulations		
*Policy Variable**sector_bank	0.13*	0.26***		0.15	0.16		0.04	0.58*		0.02	0.03	
	(0.06)	(0.07)		(0.14)	(0.19)		(0.09)	(0.33)		(0.03)	(0.03)	
*Policy Variable**sector_corp	-0.10		-0.05	-0.11		0.11	-0.62		-0.18	-0.03		0.02
	(0.07)		(0.20)	(0.16)		(0.14)	(1.21)		(1.23)	(0.07)		(0.07)
Banks' NBFI (or USD cols 7-9) Liabilities*sector_bank	2.15	2.78***		-1.14	0.17		-0.33	0.13		1.38	0.50	
	(1.54)	(0.75)		(1.33)	(1.29)		(0.26)	(0.18)		(1.39)	(2.59)	
*Policy Variable**Banks' NBFI (or USD cols 7-9) Liabilities*sector_bank	-0.92***	-1.03***		-1.17	-0.95		0.60	-1.76**		-0.34	-0.14	
	(0.32)	(0.24)		(0.83)	(1.25)		(0.54)	(0.79)		(0.22)	(0.33)	
Corporates' NBFI (or USD cols 7-9) Liabilities*sector_corp	-0.67		-0.37	-0.76		-0.60	-3.86		-1.61	0.13		0.57
	(0.52)		(1.36)	(0.57)		(0.50)	(7.00)		(7.99)	(1.42)		(1.00)
*Policy Variable**Corporates' NBFI (or USD cols 7-9) Liabilities*sector_c	0.04		-0.04	0.19		-0.02	4.86		2.61	-0.07		-0.11
	(0.13)		(0.30)	(0.39)		(0.31)	(7.01)		(7.84)	(0.15)		(0.12)
Economy-wide policies * sector_bank		Included			Included			Included			Included	
Economy-wide policies * sector_corp			Included			Included			Included			Included
Fixed effects	Country	Country	Country	Country	Country	Country	Country	Country	Country	Country	Country	Country
New Covid Cases per 100k *Sector Dummies		Included			Included			Included			Included	
Observations	*53*	*61*	*53*	*53*	*61*	*53*	*64*	*64*	*64*	*53*	*61*	*53*
R-squared	*0.73*	*0.68*	*0.71*	*0.59*	*0.62*	*0.70*	*0.59*	*0.55*	*0.68*	*0.66*	*0.62*	*0.69*
Number Countries	*20*	*23*	*20*	*20*	*23*	*20*	*24*	*24*	*24*	*20*	*23*	*20*
Adjusted R-squared	*0.399*	*0.272*	*0.283*	*0.0822*	*0.123*	*0.258*	*0.142*	*-0.0217*	*0.278*	*0.232*	*0.148*	*0.270*

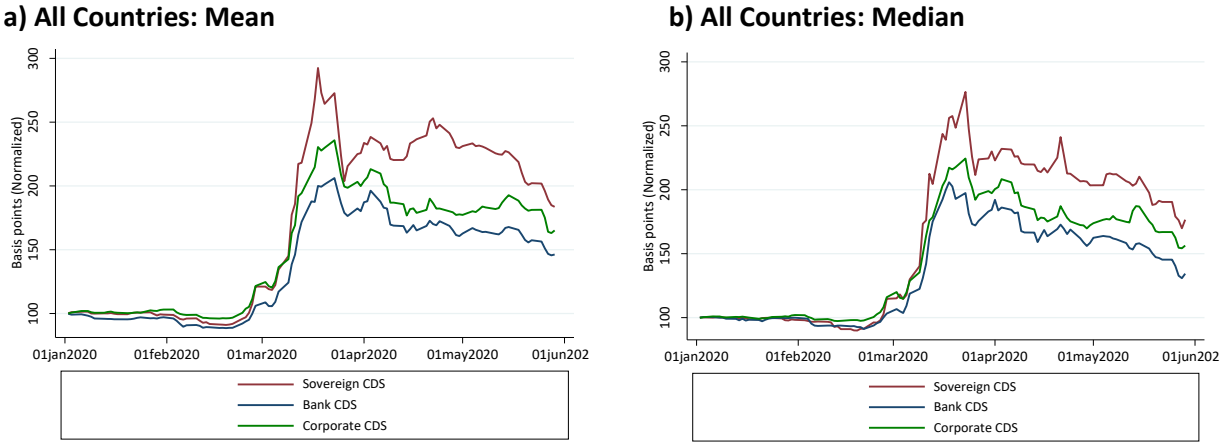
Notes: The table shows the estimated parameter values from a panel regression of equations (4) to (6). The top row indicates which Policy Variable is used in the respective interaction terms. All columns include sector fixed effects (in the form of bank and corporate sectoral dummies *sector_bank* and *sector_corp*, respectively). The inclusion of other fixed effects is indicated at the bottom of the table. Standard errors are clustered at the country level. The dependent variable measuring financial stress is the log change in sector-specific CDS during from Mar. 10 to Apr. 30, 2020. See Appendix B for detailed definitions, sources, and sample statistics for each variable.

Table 12 – All Policies: *Country-Sector-Time* Panel

Policy Variable:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	NBFI Policies			Market-based Measures			USD Swap Lines (Level)			Prudential Regulations		
Policy Variable *sector_bank	0.02*	0.03***		0.04***	0.04***		0.12	0.24***		0.01	0.02	
	(0.01)	(0.01)		(0.01)	(0.01)		(0.09)	(0.08)		(0.01)	(0.01)	
Policy Variable *sector_corp	0.00		0.01	0.00		-0.00	-0.11		-0.11	0.02		0.02
	(0.01)		(0.01)	(0.01)		(0.01)	(0.07)		(0.07)	(0.03)		(0.02)
Banks' NBFI (or USD cols 7-9) Liabilities*sector_bank	0.02*	0.02*		0.02	0.02		0.38***	0.43***		0.02	0.02*	
	(0.01)	(0.01)		(0.01)	(0.01)		(0.11)	(0.12)		(0.02)	(0.01)	
Policy Variable *Banks' NBFI (or USD cols 7-9) Liabilities*sector_bank	-0.35***	-0.32***		-0.28***	-0.28**		-0.57*	-0.77**		-0.07	-0.14*	
	(0.06)	(0.05)		(0.09)	(0.10)		(0.29)	(0.31)		(0.05)	(0.08)	
Corporates' NBFI (or USD cols 7-9) Liabilities*sector_corp	0.01**		0.01**	0.01		0.01	-0.09		-0.30	0.01		0.01
	(0.00)		(0.00)	(0.00)		(0.00)	(0.19)		(0.18)	(0.01)		(0.01)
Policy Variable *Corporates' NBFI (or USD cols 7-9) Liabilities*sector_corp	-0.05***		-0.05***	0.00		0.01	0.12		0.31	-0.03		-0.04
	(0.02)		(0.02)	(0.02)		(0.02)	(0.32)		(0.29)	(0.04)		(0.04)
Banks' NBFI (or USD cols 7-9) Liabilities*sector_bank*Δvix	0.48**	0.49**		0.45*	0.46**		Above	Above		0.45**	0.45**	
	(0.23)	(0.19)		(0.22)	(0.18)					(0.21)	(0.18)	
Corporates' NBFI (or USD cols 7-9) Liabilities*sector_corp*Δvix	0.03		0.02	0.01		0.01	Above		Above	0.01		0.01
	(0.07)		(0.07)	(0.07)		(0.07)				(0.07)		(0.07)
Economy-wide policies * sector_bank		Included			Included			Included			Included	
Economy-wide policies * sector_corp			Included			Included			Included			Included
Fixed effects	Ctry-time, Sec-time	Ctry-time, Sec-time	Ctry-time, Sec-time	Ctry-time, Sec-time	Ctry-time, Sec-time	Ctry-time, Sec-time	Ctry-time, Sec-time	Ctry-time, Sec-time	Ctry-time, Sec-time	Ctry-time, Sec-time	Ctry-time, Sec-time	Ctry-time, Sec-time
New Covid Cases per 100k *Sector Dummies		Included			Included			Included			Included	
Observations	*4,644*	*5,316*	*4,644*	*4,644*	*5,316*	*4,644*	*3,904*	*3,904*	*3,904*	*4,644*	*5,316*	*4,644*
R-squared	*0.74*	*0.71*	*0.73*	*0.73*	*0.71*	*0.73*	*0.72*	*0.72*	*0.72*	*0.73*	*0.71*	*0.73*
Number Countries	*21*	*24*	*21*	*21*	*24*	*21*	*24*	*24*	*24*	*21*	*24*	*21*
Adjusted R-squared	*0.539*	*0.499*	*0.532*	*0.534*	*0.499*	*0.530*	*0.517*	*0.520*	*0.512*	*0.532*	*0.498*	*0.531*

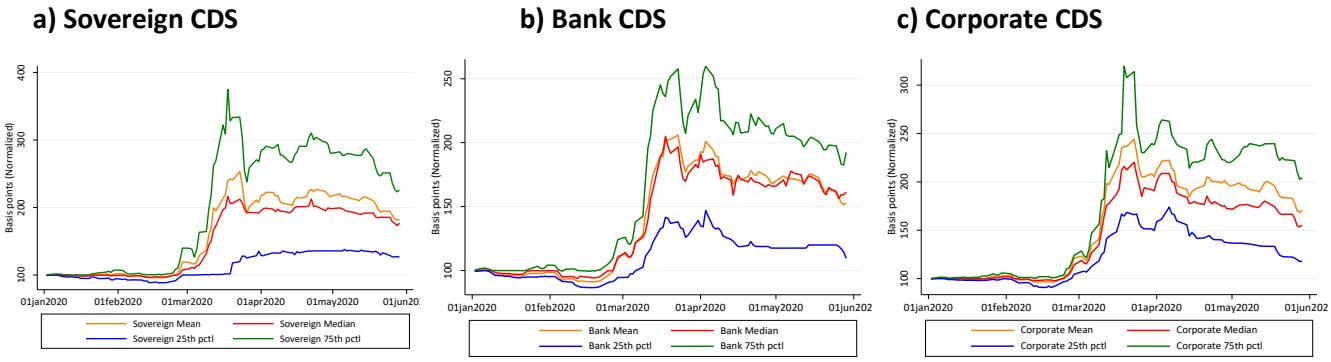
Notes: The table shows the estimated parameter values from a panel regression of equations (7) to (9). The top row indicates which Policy Variable is used in the respective interaction terms. In columns (7) to (9), all coefficients shown are interacted with Δvix; the same terms not interacted with Δvix are included in the regression, but results are not shown (please refer to Table 15 in Forbes, Friedrich, and Reinhardt, 2022 for the full results). All columns include sector fixed effects (in the form of bank and corporate sectoral dummies *sector_bank* and *sector_corp*, respectively). The inclusion of other fixed effects is indicated at the bottom of the table. Standard errors are clustered at the country level. The dependent variable measuring financial stress is the daily log change in CDS (from Jan. 1 to Apr. 30, 2020). See Appendix B for detailed definitions, sources, and sample statistics for each variable.

Figure 1
Comparing CDS across Sectors and Country Groups



Notes: Each graph shows the mean or median CDS across countries, with each series normalized to 100 on Jan. 1, 2020. The sample for "All Countries" is all countries with CDS data for each of the three sectors (*Sovereign, Bank*, and *Corporate*). Underlying data on individual CDS is from Refinitiv, compiled and collapsed as described in Section III and Appendix A. See Appendix Table A1 for country coverage and sample size for each sector.

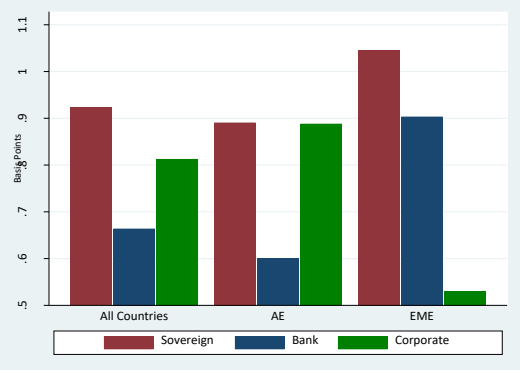
Figure 2
CDS by Sector: Means, Medians, and Distribution



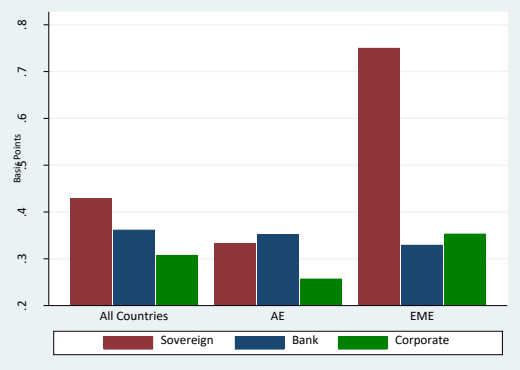
Notes: These graphs show the mean, median, and 25th and 75th values in the distribution for the CDS for three sectors: *Sovereigns*, *Banks*, and *Corporates*. Each series is normalized to 100 on Jan. 1, 2020. The sample includes countries with data for at least one of the three sectors. Underlying data on individual CDS is from Refinitiv, compiled and collapsed as described in Section III and Appendix A. See Appendix Table A1 for country coverage and sample size for each sector.

Figure 3
Peak Stress by Sector and Country

a) Mean of *Peak Stress*

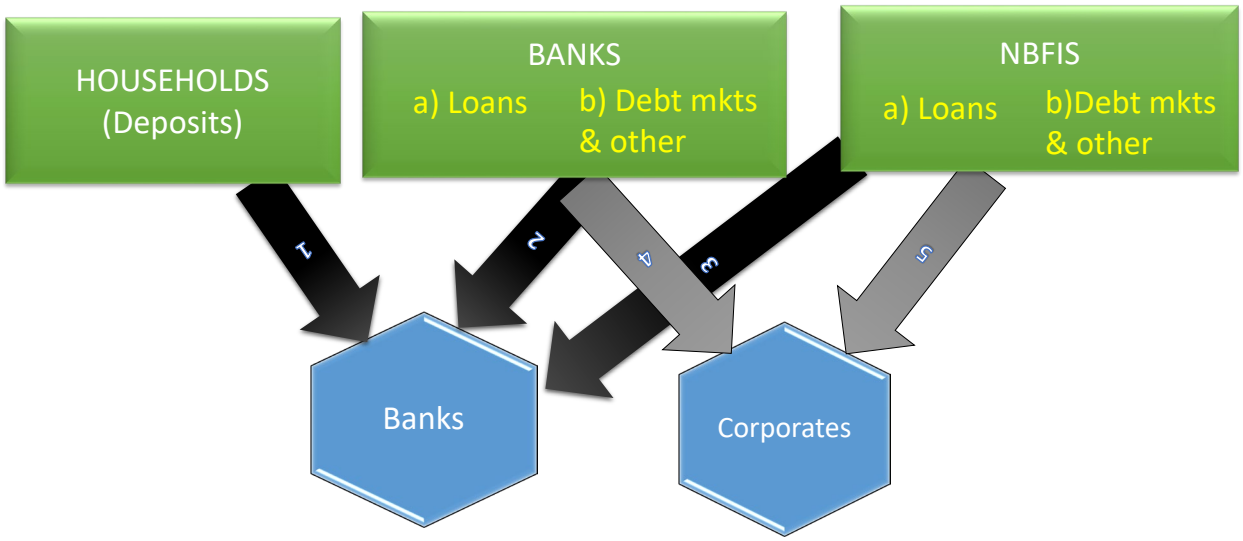


b) Standard Deviation of *Peak Stress*



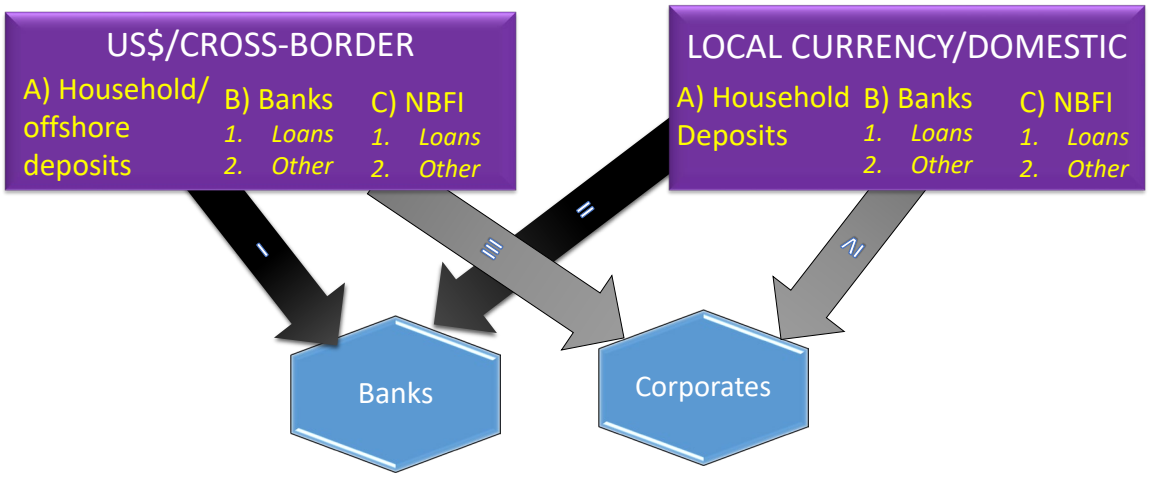
Notes: These graphs show the mean and standard deviation of *Peak Stress* experienced by each sector, with *Peak Stress* defined as the log change in CDS from Jan. 1 through Mar. 23, 2020. The sample includes only countries with data for all three sectors. Underlying data on individual CDS is from Refinitiv, compiled and collapsed as described in Section III and Appendix A. See Appendix Table A1 for country coverage and sample size for each sector.

Figure 4a: Forms of Financial Intermediation



Note: Figure shows the various forms of financial intermediation for the bank and corporate sectors (at the bottom). Funding can come from three sources: households, banks and non-bank financial institutions (NBFIs). Funding from these sources is via different instrument types: deposits, loans, or debt markets and other. The numbers indicate the flows from the different funding sources, and these can be combined with the letters to classify different instrument types from different sources.

Figure 4b: Forms of Financial Internationalization

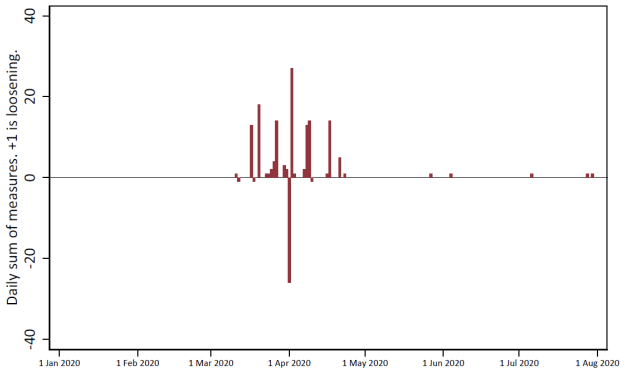


Note: Figure shows the various forms of financial internationalization for the bank and corporate sectors (at the bottom). Funding can be divided into that from US dollars (US$) versus local currency, or differentiated as cross-border versus domestic sources. Funding from these sources is via different instrument types: deposits, loans, or debt markets and other. The Roman numerals indicate the flows from the different funding sources, and these can be combined with the letters and numbers to classify different instrument types from different sources.

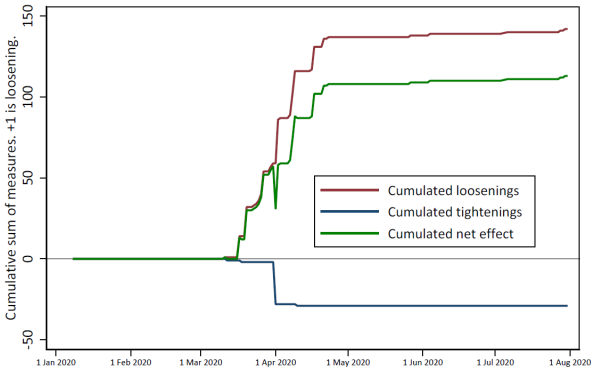
Figure 5: Policy Responses during the Covid Shock: Daily and Cumulative Actions

Panel A: NBFI Policies (Structure-Specific policy)

a) Daily Actions

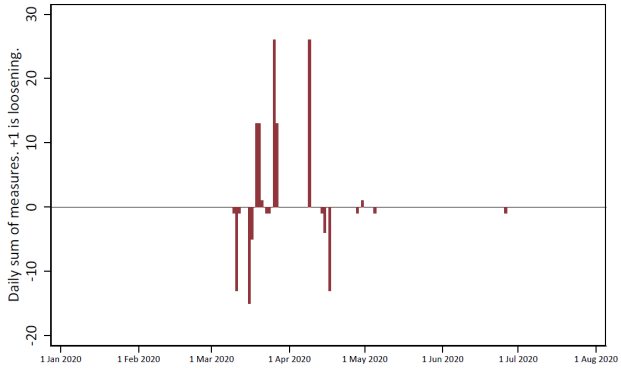


b) Cumulative Actions

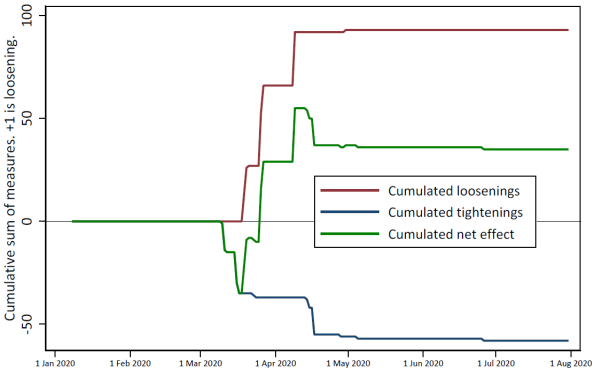


Panel B: Market-Based Measures (Structure-Specific policy)

a) Daily Actions

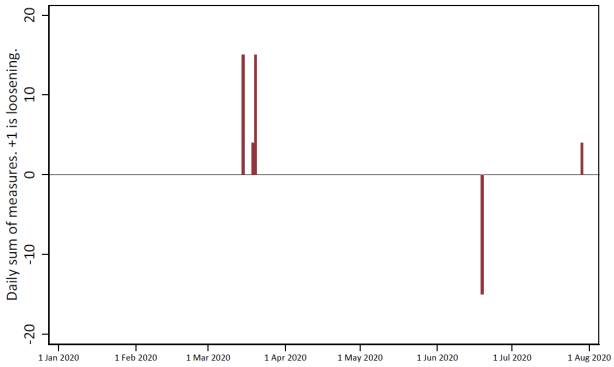


b) Cumulative Actions

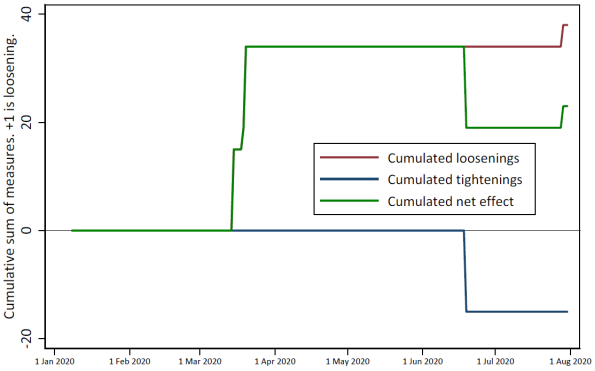


Panel C: US$ Swap Lines (Structure-Specific policy)

a) Daily Actions

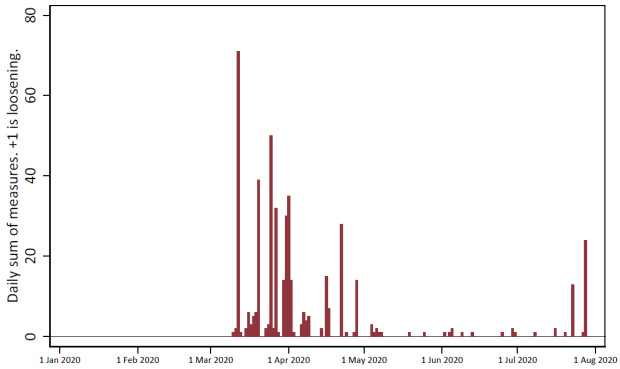


b) Cumulative Actions

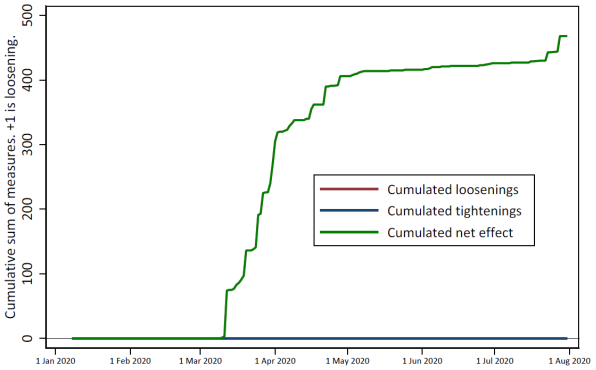


Panel D: Prudential Regulation (Bank-Specific Policy or Economy-Wide Policy)

a) Daily Actions

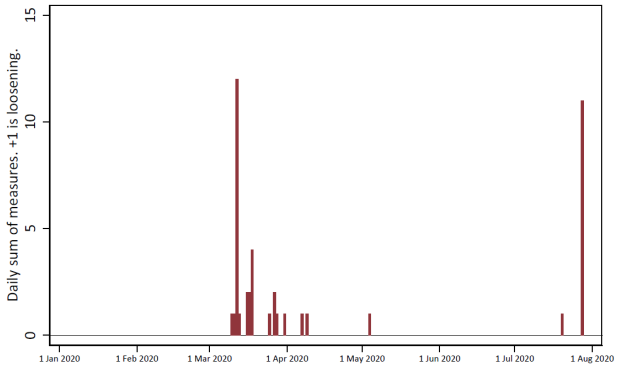


b) Cumulative Actions

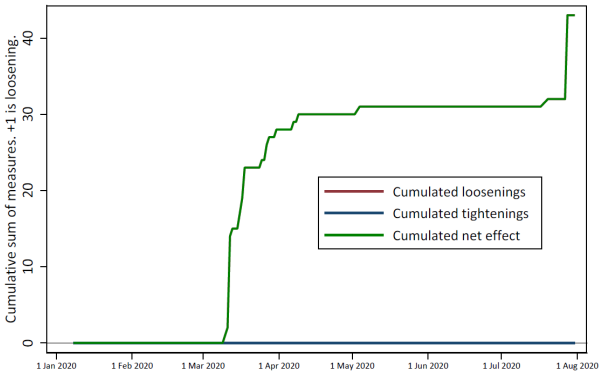


Panel E: Macroprudential Buffers (Bank-Specific Policy)

a) Daily Actions

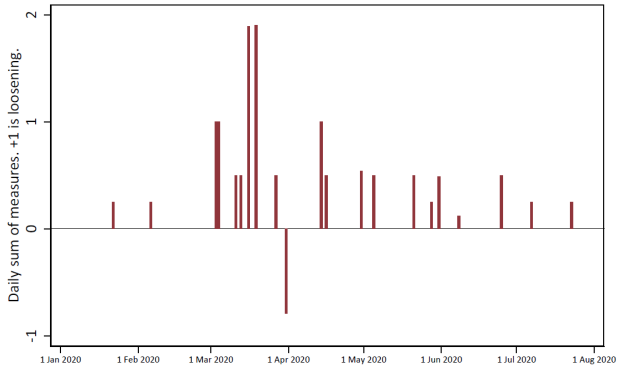


b) Cumulative Actions

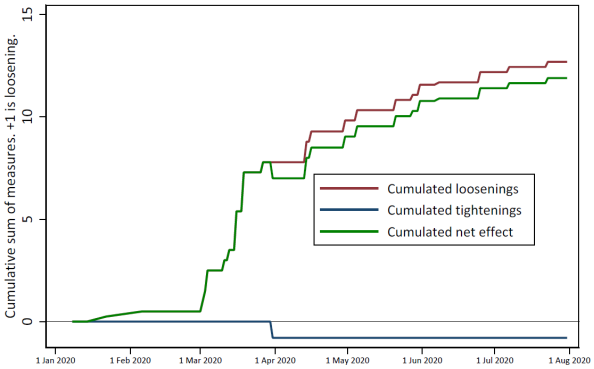


Panel F: Policy Rate Changes (Economy-Wide Policy)

a) Daily Actions

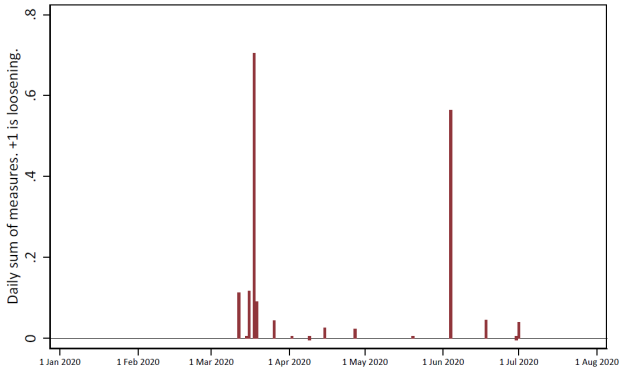


b) Cumulative Actions

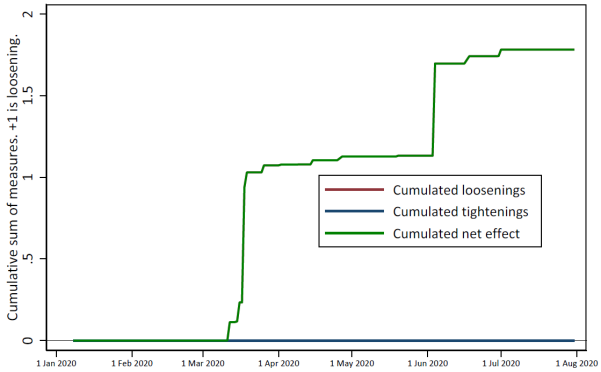


Panel G: Asset Purchases (Economy-Wide Policy)

a) Daily Actions

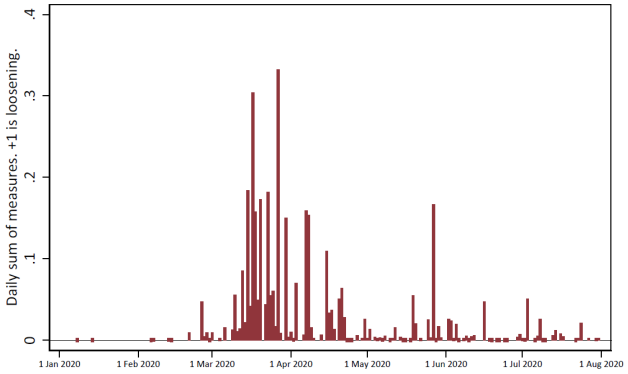


b) Cumulative Actions

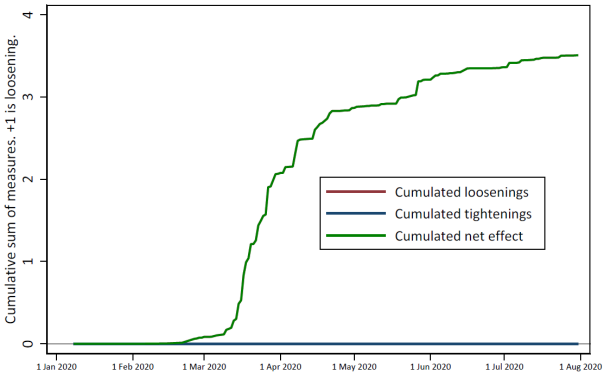


Panel H: Fiscal Policy (Economy-Wide Policy)

a) Daily Actions

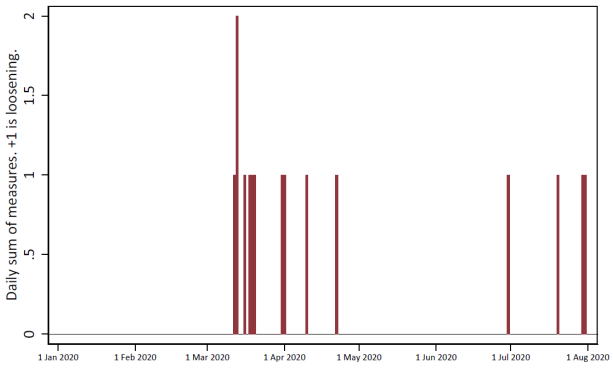


b) Cumulative Actions

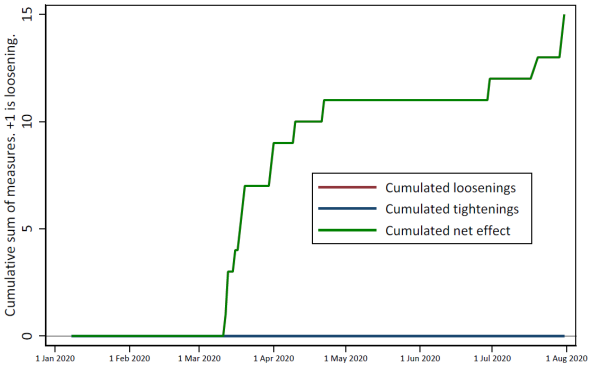


Panel I: Market Liquidity Policy (Economy-Wide Policy)

a) Daily Actions



b) Cumulative Actions



Note: The left-hand side charts show the policy actions on a *daily basis*. The right-hand side charts show the *cumulative policy actions over time*. An increase corresponds to a policy loosening and a decrease to a tightening. The sample ranges from Jan. 1 to July 31, 2020, and covers the following countries: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong, Ireland, Italy, Japan, Malaysia, Netherlands, Philippines, Portugal, Saudi Arabia, South Africa, South Korea, Spain, Sweden, Switzerland, and the United Kingdom.

Appendix A – CDS Data: Compilation and Categorization across Sectors

Data Compilation

To compile CDS data, we downloaded daily data from Refinitiv via Datastream between October 21 and November 2, 2020, covering the window from January 1 through October 20, 2020.

Clean the dataset:

- We drop all inactive CDS (labelled as "Dead" by Refinitiv)
- We drop all duplicates (labelled as "Duplicate" by Refinitiv)
- We drop all CDS that relate to indices instead of individual entities
- We drop all CDS that do not refer to a specific market/country:
    - "Eastern Europe (Oxford Econ Industry)" "Oil Exporting Countries", "Other African", "Other Asian", "Other Australasian", "Other Caribbean", "Other Central America", "Other Western European", "International"
- We drop all CDS that do not have a company name (18 cases)*
- We drop all CDS from central banks (3 cases)*
- We drop all CDS where the company cannot be identified because the company name is too short or too generic (12 cases)*

* Later in the process

Extract provided information:

- Seniority information
    - Senior vs. Subordinated; a few cases carry the classifications: PREF and SEC
- Term length
    - Ranges from 0 years to 30 years
- Extract entity information
    - (A) Banks, (B) Sovereigns, (C) Extended Government, (D) Non-bank Financials, (E) Corporates

Extract Entity Information

For each entity type, we employ four complementary approaches to extract the entity information from the CDS data:

- ***Refinitiv info*:** Refinitiv provides information on entities for a limited set of CDS through its data explorer. The main advantage of this approach is that the entity information is readily available. A disadvantage of this approach is that this information is only available for a (small) subset of entities and in some cases does not agree with our own classification (e.g., for some of the non-bank financials).
- ***Pre-specified list*:** This approach identifies entities based on a comparison of the company name in the CDS data with a pre-specified list of entity names that we obtain from public sources. An entity is identified if there is a perfect match between (parts of) the company name in the CDS data and the name entry in the pre-specified list. The main advantage of this approach is that well-known entities are identified, even though their names may not reveal the entity type (e.g., a bank that does not carry the term "Bank" in its name). Disadvantages are that this approach requires comprehensive external inputs (e.g., list of banks, insurance companies, sovereigns,

etc.) and that it relies on an exact match (i.e., if any of the names contain a typo or they are written in an unusual way, they will not be matched).

- ***Generic text search*:** This approach identifies entities based on generic name stubs that are usually associated with this type of entity. In particular, the approach checks whether a stub (e.g., "bank") is contained anywhere in the CDS name. The advantage of this approach is that lesser-known entities can be identified as well. The main disadvantage is that certain stubs occur naturally in company names unrelated to the entity type, and thus entity can be misclassified. Moreover, entities could have non-English names that require the use of foreign language stubs.
- ***Visual inspection of the residual file*:** The last approach is based on a visual inspection of the residual file of non-identified entities. This approach is based on a manual Google search of each company name in the residual file and a determination of the entity type based on the returned search result.

(A) Banks

The identification of banks is based on the following approaches (a CDS is classified as belonging to the category of Banks if any of these approaches classify it as such):

- ***1) Refinitiv info*:** Banks that have been identified by Refinitiv (category "Banks")
- ***2) Pre-specified list*:** The universe of company names in the CDS data is checked against a list of pre-specified bank names obtained from external sources. If there is an exact match of all characters in the list of pre-specified bank names and the company name in the CDS data (or a subset of the company name), then the CDS is identified as belonging to a bank.
    - The list of pre-specified bank names includes the largest 120 banks by asset size worldwide[53] and a sample of 5000 international bank names[54]
    - To increase the probability of a match, we make the following modifications to the pre-specified list of bank names:
        - We drop all "." and ","
        - We drop all parentheses, including their content (e.g., abbreviations of the bank name)
        - We drop the following abbreviations of companies' legal entity information: LTD, SA, AG, PLC, CORP
- ***3) Generic text search*:** A text search that searches for the following terms and identifies a CDS as that of a bank when the company name contains this word:
    - *bank, banco, banca, banche, banque, caixa, sparkasse, cassa, bankë, banku, банк, banka, банка, banc, banca, pank, pankki, τραπεζα, bainc, bankas, bancă, breh*
- ***4) Visual inspection of the residual file*:** All banks that were found in the residual file are manually classified as banks (after conducting a Google search that confirms their entity type)

Finally, we manually exclude all Development Banks, ExIm Banks, and Central Banks as well as wrongly identified corporates[55] from the list of banks.

[53] Source: https://www.relbanks.com/worlds-top-banks/top-world-banks-by-assets-2019; download 27 Oct. 2020.
[54] Source: https://www.globalbrandsmagazine.com/list-of-banks-by-country/; download 27 Oct. 2020.
[55] E.g., "Pepsi Bottling Group" may be wrongly identified as bank because of "ING Group". Moreover, in a few cases, we reclassify a bank as a non-bank financial company (e.g., "Hartford Financial Services").

(B) Sovereigns

A CDS is classified as that of a sovereign entity based on the following approaches:

- ***1) Refinitiv info*:** The CDS of sovereigns that have been identified by Refinitiv (category "Sovereigns")
- ***2) Generic text search*:** A text search based on the following search terms:
  - *government, gvt, govt, republic, rep, kingdom, states*
- ***3) Pre-specified list*:** A comparison of the universe of CDS company names with a pre-specified list of country names from the WEO Database[56]
- ***4) Visual inspection of the residual file*:** The manual addition of a few sovereign CDS found in the residual file

Finally, we exclude all wrongly identified corporates[57] and extended government agencies[58] from the list of sovereigns.

(C) Extended Government:

A CDS is classified as that of an extended government entity based on the following approaches:

- ***1) Refinitiv info*:** Use the information contained in the Refinitiv categories "Agency", "Supranational", and "Official & Municipal"
- ***2) Generic text search*:** A text search that used the following terms:
  - *state, province, prefectur, city*
- ***3) Pre-specified list*:** All Development Banks and ExIm Banks that were identified in the process of conducting the sovereign identification
- ***4) Visual inspection of the residual file*:** The manual addition of a few extended government entities found in the residual file

Finally, we exclude all wrongly identified corporates[59] from the list of extended government entities.

(D) Non-Bank Financials

The identification of non-bank financials is based on the following approaches:

- ***1) Refinitiv info*:** All CDS names from Refinitiv in the category "Non-bank financials" that could be identified as such based on a Google search[60]

[56] Since many company names contain a country name as reference to their country of origin, the pre-specified list approach is implemented slightly differently than in the other cases. Conditional on not being identified as a sovereign via Approaches 1 and 2, the names that appear in both the pre-specified list of country names and in the universe of CDS company names are manually classified as sovereigns. This is equivalent to conducting an automatic search for an exact match between the pre-specified list of country names and the universe of CDS company names and excluding the wrongly identified cases by hand afterwards. However, due to the frequent use of country references in company names, this list would be quite large.

[57] E.g., "Republic Services INC" may be wrongly identified as sovereign because of the search term "Republic".

[58] E.g., "Govt of Ontario" may be wrongly identified as sovereign because of the search term "Govt".

[59] E.g., "Allstate Corp" may be wrongly identified as extended government because of the search term "State".

[60] This category appears to contain a considerable number of firms that could be considered as non-financial firms. These cases are manually reclassified as corporates.

- ***2) Pre-specified list*:** A search for an exact match between the universe of CDS company names and a pre-specified list of non-bank financial institutions.[61] To increase the chances of a match, we make the same adjustments to the pre-specified list of names as in the approach to identify banks:
    - We drop all "." and ","
    - We drop all parentheses, including their content (e.g., abbreviations of the bank name)
    - We drop the following abbreviations of companies' legal entity information: LTD, SA, AG, PLC, CORP
- ***3) Generic text search*:** A text search using the following words:
    - *fin, insur, invest, venture, leasing, fund, mutual, hedge, trust, pension, assurance, estate, asset, capital, credit, guaranty, sec, life*
- ***4) Visual inspection of the residual file*:** Manual addition of the non-bank financials entities found in the residual file

Finally, we exclude all wrongly identified corporates[62] from the list of non-bank financials.

(E) Corporates

The identification of corporates differs slightly from the previous cases and is based on the following approaches:

1) ***Refinitiv info*:** Use of all information from the Refinitiv categories "Consumer", "Electric", "Energy", "Gas", "Manufacturing", "Services", "Telephone", and "Transportation"
2) ***Pre-specified list*:** Addition of all corporates that are included in the Refinitiv category "Non-bank Financials" but that belong in the group of corporates[63]
3) ***Other*:** All CDS that are not identified as banks, sovereigns, extended government, non-bank financials
    - Manually checked with a Google search (around 1250 cases that have non-missing and time-varying CDS data)

[61] This list includes the largest global insurance companies (https://www.statista.com/study/40950/top-100-insurance-companies-global/), asset management firms (https://en.wikipedia.org/wiki/List_of_asset_management_firms), and financial services companies (https://en.wikipedia.org/wiki/List_of_largest_financial_services_companies_by_revenue).

[62] E.g., "Securitas AB" may be wrongly identified as non-bank financial because of the search term "Sec".

[63] E.g., even though "Porsche Automobil" is a holding company, based on its clearly defined investment focus on the automotive sector, it fits the corporate classification better than that of a non-bank financial firm.

Appendix Table A1
Country and Sectoral Coverage in CDS Sample

Country	*Sovereign*	*Bank*	*Corporate*	*Total*
Argentina	2	0	0	2
Australia	3	29	41	73
Austria	3	6	2	11
Bahrain	2	0	0	2
Belgium	4	6	1	11
Bermuda	0	2	18	20
Brazil	2	7	12	21
Canada	0	7	55	62
Cayman Islands	0	0	4	4
Channel Islands	0	0	1	1
Chile	2	0	2	4
China	2	5	0	7
Colombia	2	1	0	3
Croatia	2	0	0	2
Cyprus	2	0	0	2
Czech Republic	1	0	0	1
Denmark	2	6	9	17
Dominican Republic	1	0	0	1
Egypt	3	0	0	3
Finland	4	0	19	23
France	2	15	93	110
Germany	3	31	82	116
Greece	4	2	5	11
Guatemala	1	0	0	1
Hong Kong	2	2	11	15
Hungary	2	0	0	2
Iceland	1	0	0	1
India	1*	18	7	26
Indonesia	1	0	0	1
Iraq	1	0	0	1
Ireland	4	0	2*	6
Israel	2	0	5	7
Italy	3	28	20	51
Jamaica	1	0	0	1
Japan	4	13	54	71
Latvia	2	0	0	2
Lithuania	1	0	0	1
Luxembourg	0	0	12	12
Malaysia	1	0	4	5

Country	*Sovereign*	*Bank*	*Corporate*	*Total*
Mexico	1	0	12	13
Morocco	2	0	0	2
Netherlands	3	16	41	60
New Zealand	0	0	2	2
Norway	3	0	6	9
Pakistan	3*	0	0	3
Peru	2	0	0	2
Philippines	2	0	2*	4
Poland	2	0	0	2
Portugal	4	2	6	12
Romania	2	0	0	2
Russia	2	5	2	9
Saudi Arabia	2	1	0	3
Serbia and Montenegro	1*	0	0	1
Singapore	0	9	4	13
Slovakia	2	0	0	2
Slovenia	2	0	0	2
South Africa	2	0	1	3
South Korea	2	15	18	35
Spain	3	23	26	52
Sweden	3	11	32	46
Switzerland	0	9	28	37
Taiwan	0	4	2	6
Thailand	2	0	0	2
Turkey	2	2	0	4
United Kingdom	4	52	156	212
United States	0	69	1212	1281
Uruguay	2	0	0	2
Vietnam	1*	0	0	1
Total	**127**	**396**	**2009**	**2532**

Note: Table lists the number of CDS series for each country by sector (*Sovereign*, *Bank*, and *Corporate*). Underlying data on individual CDS is from Refinitiv, compiled and collapsed as described in Section III and Appendix A. Entries with stars (*) indicate that CDS with shorter maturities between 1 and 3 years have been used to calculate the composite measure at the country-sector level.

Appendix B – Summary Statistics and Data on Funding Structures and Stress

Table B1: Data for Funding Structures: *Intermediation* and *Internationalization*

Sector	Variable	Construction/Sources	Mean	Med.	S.D	Obs.
Intermediation						
Banks						
Source	*Household liabilities / total liabilities*	Banks' liabilities vis-à-vis households divided by total liabilities from all sources. Domestic and, where available, foreign sources. All instruments. Source: BIS International Banking Statistics (IBS)	0.31	0.291	0.113	56
	Bank liabilities / total liabilities	Banks' liabilities vis-à-vis other banks divided by total liabilities from all sources. Domestic and foreign sources. All instruments. Source: BIS IBS	0.253	0.25	0.105	66
	NBFI liabilities / total liabilities	Banks' liabilities vis-à-vis NBFIs divided by total liabilities from all sources. Domestic and foreign sources. All instruments. Source: BIS IBS	0.127	0.091	0.076	66
Instrument	*Loans / total liabilities to banks*	Loans and deposits from all sectors as share of funding in all instruments from all sectors. Domestic and foreign sources. Source: BIS IBS	0.821	0.821	0.102	66
	NBFI loans / total liabilities to NBFIs	Loans and deposits from NBFIs as share of funding in all instruments from NBFIs. Domestic and foreign sources. Source: BIS IBS	0.72	0.675	0.183	49
Corporates						
Source	*Bank liabilities / total liabilities*	Claims by local and cross-border banks on corporates (BIS IBS Locational banking stats (LBS) and consolidated stats (CBS) where LBS not available) divided by total credit extended to corporates from all sources (from BIS long-time series for domestic credit).	0.491	0.441	0.189	56
	NBFI liabilities[3] / total liabilities	1 minus the previous measure.	0.509	0.559	0.189	56
Instrument	*Bank loans / total liabilities to banks*	Loans and deposits from banks as share of all instruments from banks. Source: BIS IBS	0.899	0.901	0.046	55
Internationalization						
Banks						
Currency	*US$ liabilities / total liabilities[4]*	Local US$ liabilities from all sectors plus US$ loans from cross-border sources + US$ international debt issuance by private banks (nationality basis) divided by total liabilities calculated in the same way for all currencies. Source: BIS IBS and BIS International Debt Statistics (IDS).	0.135	0.108	0.101	66
Counterparty location	*Cross-border liabilities / total liabilities*	Liabilities from cross-border sources divided by total liabilities. Source: BIS IBS.	0.253	0.241	0.137	66
Corporates						
Currency	*US$ liabilities / total liabilities[4]*	Local US$ claims by banks on corporates plus US$ loans from cross-border banks to corporates + US$ international debt issuance by corporates (nationality basis) [A] divided by total liabilities calculated in the same way for all currencies or, if not available, by total credit extended to corporates from all sources. Source: BIS IBS, BIS IDS and BIS long-time series for domestic credit.	0.126	0.087	0.094	66
Counterparty location	*Cross-border liabilities / total liabilities*	Claims by cross-border banks on corporates + international debt issuance of corporates (residency basis) [B] divided by total credit extended to corporates from all sources. Source: BIS IBS, BIS IDS, and BIS long-time series for domestic credit.	0.179	0.143	0.144	62
Intermediation and Internationalization						
Banks						
Source / currency	*US$ bank liabilities / total liabilities[4]*	Banks' US$ liabilities vis-à-vis other banks divided by total liabilities from all sources. Domestic and foreign sources. All instruments. Source: BIS IBS.	0.058	0.051	0.042	66
	US$ NBFI liabilities / total liabilities[4]	Banks' US$ liabilities vis-à-vis NBFIs divided by total liabilities from all sources. Domestic and foreign sources. All instruments. Source: BIS IBS	0.017	0.009	0.016	63
Source / counterparty location	*Bank cross-border liabilities / total liabilities*	Banks' cross-border liabilities vis-à-vis other banks divided by total liabilities from all sources. All instruments. Source: BIS IBS	0.138	0.11	0.061	66

	NBFI cross-border liabilities / total liabilities	Banks' cross-border liabilities vis-à-vis NBFIs divided by total liabilities from all sources. Source: BIS IBS	0.041	0.03	0.037	66
Instrument / currency	*Loans / US$ liabilities*	Local and cross-border US$ loans from all sectors divided by total US$ liabilities (i.e., in loan and other debt instruments). Source: BIS IBS	0.733	0.746	0.14	66
Instrument / counterparty location	*Loans / cross-border liabilities*	Loans from cross-border sources divided by all liabilities from cross-border sources (both from all sectors). Source: BIS IBS	0.702	0.734	0.188	66
Corporates	*US$ bank liabilities / total liabilities*[4]	US$ claims by local and cross-border banks on corporates divided by total credit extended to corporates from all sources. Source: BIS IBS and BIS long-time series for domestic credit	0.037	0.023	0.032	48
Source / currency	*Cross-border bank liabilities / total liabilities*	Claims by cross-border banks on corporates divided by total credit extended to corporates from all sources. Source: BIS IBS and BIS long-time series for domestic credit	0.061	0.055	0.037	62
Source / counterparty location	*Loans / US$ liabilities*[4]	Local US$ loans by banks on corporates plus US$ loans from cross-border banks to corporates divided by total corporate US$ liabilities [see [A] above]. Source: BIS IBS and IDS	0.442	0.44	0.18	49
Instrument / currency	*Loans / cross-border liabilities*	Loans by cross-border banks on corporates divided by total liabilities from cross-border sources [see [B] above]. Source: BIS IBS and IDS	0.314	0.287	0.195	66
Instrument / counterparty location						

Table B2 – Additional Data and Summary Statistics

Variable	Construction/Sources	Means	Median	S.D.	Obs.
Country-sector approach (equation (2))					
Stress	Log change in CDS over the *Covid Shock* (from Jan. 1 to Mar. 23). Sources: See Appendix A	0.812	0.823	0.418	66
New Covid cases per 100k	Average cases in the two weeks between Mar. 10 and 23. Source: Haver	1.598	1.292	1.739	66
Country-sector-time approach (equation (3))					
Stress	Log change in daily CDS. Sources: See Appendix A	0.014	0.001	0.047	3,696
New Covid cases per 100k	Daily Covid cases per 100 thousand inhabitants. Source: Haver	0.275	0	0.892	3,696
Δvix	Daily growth rate in VIX. Source: Datastream	0.039	0.002	0.147	3,696

Appendix C – Additional Analysis

Table C1 – Sectoral dummies and Covid controls

	(1)	(2)	(3)	(4)	(5)	(6)
sector_bank	-0.31***		-0.37***	-0.19		-0.37*
	(0.09)		(0.11)	(0.15)		(0.19)
sector_corp		0.05	-0.12		-0.16	-0.31*
		(0.10)	(0.12)		(0.15)	(0.17)
New Covid Cases per 100k*sector_bank				-0.06		0.01
				(0.04)		(0.06)
New Covid Cases per 100k*sector_corp					0.13**	0.13*
					(0.05)	(0.07)
Observations	66	66	66	66	66	66
R-squared	0.54	0.44	0.55	0.55	0.51	0.61
Number Countries	25	25	25	25	25	25
Adjusted R-squared	0.252	0.0893	0.256	0.257	0.178	0.311

Notes: The table shows the estimated parameter values from a panel regression of equation (2). All columns include country and sector fixed effects (in the form of bank and corporate sectoral dummies *sector_bank* and *sector_corp*, respectively). Standard errors are clustered at the country level. The dependent variable measuring financial stress is the log change in sector-specific CDS during the *Covid Shock* (Jan. 1 to Mar. 23, 2020). See Appendix Table B for detailed definitions, sources, and sample statistics for each variable.

Appendix D: Construction of Policy Response Variables

The IMF database in Kirti et al. (2022) contains two policy variables that are highly relevant for our empirical analysis, but their original coding does not distinguish between tightening and loosening: "*27. market_based_measure*" (= Market-Based Measures) and "*28. NBFI*" (= Non-Bank Financial Institutions). To be able to use these variables consistently with other policy variables in our analysis, we code their direction based on the event description in the IMF database and, if more information is needed, on the basis of the linked background documents.

Our central guiding principle is that we code a policy action as a "loosening" ["tightening"] if a policy action *eases [increases]* today's challenges for an institution (for NBFI) or of a market participant (for market-based measures) at the cost [benefit] of increasing [decreasing] the challenges of either (i) another entity today (e.g., the customer, the regulator, a counterparty) or (ii) the same entity in the future.

Consider the following example: The policy action "*EIOPA [European Insurance and Occupational Pensions Authority] recommendations on supervisory flexibility regarding deadlines of supervisory reporting and public disclosure by insurers*" (recorded for the variable NBFI in Austria on Mar. 20, 2020). This suggests that the regulator offers operational relief to the regulated entities by allowing delays in reporting and public disclosure standards. Hence, this policy action eases the impact on the personnel and financial resources of the regulated entity today, but possibly at the cost of lowering the regulatory standards in the sector, which might complicate the work for the regulator contemporaneously (e.g., who now faces data gaps) or negatively affect the work of the regulated entity in the future (e.g., investors may be more cautious due to the reduction in transparency).

Typical policy actions included in the NBFI variable are related to modifying reporting requirements, providing instructions on how to handle customer claims during the pandemic, and placing restrictions on share buy backs and dividend payouts for insurance companies.[64] For the market-based measure variable, common policy actions include modified reporting requirements as well as bans on short selling. We exclude a small number of policies that are very unlikely to have any impact on CDS prices, e.g., the policy action "*Clarification of issues related to the application of MiFID II requirements on the recording of telephone conversations*" (recorded for the variable market-based measures, Spain, Mar. 20, 2020) appears to merely modify previously issued guidelines on the recording of phone conversations.[65]

[64] In line with the guiding principle above, restricting share buybacks and dividends eases the challenges of the regulated entity today (i.e., through an increase in retained earnings) but could come at the cost of increased challenges in the future (i.e., investors may be more hesitant to invest in the company if the stock performs poorly or may not pay a dividend).

[65] While this minor modification of an already small policy action is unlikely to have any detectable impact on CDS prices, there are good reasons to still include seemingly smaller policy actions in the analysis. For example, instructions by the regulator to conduct audits in a virtual setting instead of in person could reduce the level of thoroughness with which the audit is conducted, impact personnel and financial resources of the regulated entity, and increase the possibility of legal challenges in the future.

Appendix Table D1: Summary Statistics and Data on Policy Responses

Variable	Variable in Kirti et al. (2022)	Description based on Kirti et al. (2022)	Mean	Med.	S.D.	Min	Max	Obs.
Non-Bank Financial Intermed-iation (NBFI) Policies	*NBFI* with a directional coding (Dummy)	All prudential measures applied to non-bank financial institutions. Actions unrelated with prudential regulations are not included. We add a directional coding to the variable from Kirti et al. (2022).	0.0472	0	0.2546	-1	1	5,444
Market-Based Measures (MBM)	*market_based_ measure* with a directional coding (Dummy)	Regulations on financial market participants or recommended actions in response to Covid, such as rules on short selling, security issuance, reporting, etc. We add a directional coding to the variable from Kirti et al. (2022).	0.0068	0	0.2495	-1	1	5,444
US$ Swap Lines	*swap_line* but only cases related to US$ swap lines (Dummy)	Swap lines between central banks. Kirti et al. (2022) record swap lines for only the counterparty with a relatively greater need for foreign exchanges. If relative need cannot be determined, they record the measure for both sides. We focus only on US$ swap lines in our analysis.	0.0173	0	0.1303	0	1	5,444
Prudential Regulations	*prudential* (Dummy)	Summary measure of all prudential policies in Kirti et al. (2022). Sign of the sum of all policy dummies in this category, which covers prudential buffers, buffer usability, capital requirements, dividend restrictions, special provisioning rules, borrower-based measures, supervisory expectations, lending standards, reporting requirements, liquidity requirements, and other.	0.0952	0	0.2934	0	1	5,444
Macro-prudential Buffers	*pru_buffer* (Dummy)	Three specific buffers are included: the countercyclical capital buffer (CCyB), the capital conservation buffer (CCoB), and the systemic risk buffer (SyRB). Sizes are actual buffer changes. Therefore, as is often the case, if a measure is to postpone scheduled future buffer changes, Kirti et al. (2022) recognize the measure but code its size as missing. If different banks are subject to different buffer changes, Kirti et al. (2022) choose one that affects most banks for CCyB and CCoB and take a simple average for SyRB.	0.0145	0	0.1196	0	1	5,444
Policy Rate Changes	*pol_rate_size (rescaled to percentage points)*	Changes in the policy interest rate. An announcement of no change or a speech on the expected rate path is not considered an actual policy. If a central bank uses multiple interest rates, Kirti et al. (2022) select the one that is most related to lending as the policy rate and include changes to other interest rates under "other rates." Once Kirti et al. (2022) select the policy rate, they do not change it for consistency.	0.0038	0	0.0527	-0.79	1	5,444
Asset Purchases	*APP_gdp (rescaled to share of GDP)*	Purchases of securities, such as bonds, stocks, and commercial paper in the secondary market by the central bank. The intention should not be only to improve short-term market liquidity.	0.0006	0	0.0059	0	0.099	5,444
Market Liquidity Policy	*market_liquidity* (Dummy)	Short-term lending or interventions in asset markets, with the explicit and sole intention of improving short-term market liquidity. Kirti et al. (2022) determine the intention of a measure based on its stated aim as well as any relevant context.	0.005	0	0.0703	0	1	5,444
Fiscal Policy	*broad_fiscal_gdp (rescaled to share of GDP)*	Summary measure of all fiscal policies in Kirti et al. (2022). Sign of the sum of all policy dummies in this category, which covers grants, tax reliefs, tax referrals, equity participation, public loans, public guarantees.	0.0015	0	0.0105	0	0.1591	5,444