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EXECUTIVE BOARD MEETING

SM/20/151

CONFIDENTIAL

September 17, 2020

To: Members of the Executive Board

From: The Secretary

Subject: **October 2020 Global Financial Stability Report—Analytical Chapter 4 and Online Annex**

Board Action:	Executive Directors' **consideration** (Formal)
Tentative Board Date:	**Wednesday, September 30, 2020**
Publication:	Yes, it is intended that the October 2020 Global Financial Stability Report documents will be released to the public at the time of the Global Financial Stability Report press conference, tentatively scheduled for **Tuesday, October 13, 2020**. The analytical chapters will be made available to the public on the IMF website in advance of the publication of the full document.
Questions:	Mr. Natalucci, MCM (ext. 37108) Mr. Raddatz Kiefer, MCM (ext. 36636) Mr. Caparusso, MCM (ext. 37193)
Additional Information:	The paper will be revised for publication in light of the Executive Board discussion. If Executive Directors have additional comments, they should notify Mr. Natalucci, Mr. Raddatz Kiefer, and Mr. Caparusso by **5:30 p.m. on Friday, October 2, 2020**.

BANK CAPITAL: COVID-19 CHALLENGE AND POLICY RESPONSES

Approved By
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Chapter 4 at a Glance

- The COVID-19 crisis may pose challenges to the capital of banks, even though they entered the crisis with higher capital ratios than before the global financial crisis and despite the large policy interventions aimed at containing the economic fallout from the current crisis.
- Forward-looking simulations based on a new global stress test tool show that in a baseline scenario consistent with the October 2020 *World Economic Outlook* (WEO) bank capital falls sharply but recovers quickly, while a U-shaped adverse scenario suggests sustained damage to average capital ratios.
- In the adverse scenario, a weak tail of banks, corresponding to nearly 15 percent of banking system assets, would fail to meet minimum regulatory requirements, and the capital shortfall relative to broad regulatory thresholds reaches $400 billion.
- In absence of the bank-specific mitigation policies already implemented, the weak tail of banks would reach 20 percent of banking system assets, and the global capital shortfall would be $650 billion.
- Bank-specific mitigation policies would help reduce financial stability risks if the crisis recedes promptly but may pose risks to banks' capital adequacy if the crisis proves to be longer lasting.

Will Banks Remain Adequately Capitalized?

Banks entered the current coronavirus disease (COVID-19) crisis with higher levels of capital than before the global financial crisis, and policymakers have quickly deployed an array of policies to support economic activity and the ability of banks to lend. However, the sheer size of the shock and the likely increase in defaults from firms and households may pose challenges to banks' profitability and capital positions. A forward-looking simulation of the trajectory of capital ratios in a sample of 350 banks from 29 jurisdictions, accounting for 73 percent of global banking assets, shows that such ratios would decline as a result of the COVID-19 crisis, but remain, on average, comfortably above regulatory minimums. However, there is heterogeneity across and within regions, and a weak tail of banks, accounting for about 15 percent of banking assets in the sample, might fail to meet minimum regulatory capital requirements in an adverse scenario. Government loan guarantees and other bank-specific policies that adjust the calculation of capital ratios help relieve the decline of reported capital ratios and reduce the incidence of bank capital shortfalls. In considering the duration of these and other measures, policymakers should pay attention to the intertemporal trade-off they pose, as policies that reduce the financial stability risks of a transitory shock may increase vulnerabilities related to banks' loss-absorbing capacity and overall indebtedness if the crisis proves to be persistent. Policies aimed at limiting capital distributions and ensuring adequate funding for deposit guarantee programs, as well as contingency plans that lay out how to respond to possible pressures, would help deal with the consequences of a potentially adverse scenario.

Introduction

1. In many respects, the COVID-19 crisis presents the largest shock that banks have experienced since the Great Depression (see the October 2020 *World Economic Outlook*). Authorities have adopted unprecedented policy measures to blunt the impact of this shock. Governments have introduced substantial fiscal support to households and businesses (see the October 2020 *Fiscal Monitor*), monetary policy rates have been cut worldwide, and many central banks have implemented large asset purchase programs to support markets and to maintain the credit flow to the real economy (see the April 2020 *Global Financial Stability Report* [GFSR]).

2. Importantly, policymakers have taken steps to avoid the procyclical credit crunch that was evident during the global financial crisis, encouraging banks to use the flexibility embedded in the global regulatory framework to deal with the temporary consequences of the COVID-19 shock and thus stifle negative feedback loops that could amplify the impact of the crisis. Following a decade during which banks aggressively built their capital positions, standard setting bodies (SSBs) have issued guidance to support national authorities in their policy response to the pandemic. Policy makers have released capital buffers to sustain the flow of credit to households and firms. Banks have also been allowed, for loans whose deterioration is attributed to the shock, to defer the recognition of bad debts and the reporting of loan loss provisions and to waive the increase in risk-asset weightings and the deduction of provision charges from capital. Banks have also been compelled (by regulation or strong administrative guidance) to cancel capital distributions.

3. Despite the large negative impact of the pandemic on the global economy during recent quarters, banking systems have so far been able to weather these economic difficulties, due in part to aggressive policy support. Following an initial plunge, bank equity prices have partially recovered. While banks' assessment of borrower credit quality has naturally deteriorated, bank credit expanded in March as corporate borrowers drew on committed credit lines and has since remained stable. Nonetheless, credit conditions have remained tight. Despite significantly increased loan loss provisions in virtually all systems, most banks continue to report positive earnings, and capital positions have declined only modestly over the initial quarters of the crisis.

4. This chapter addresses two central questions.

- How prepared are banks to withstand continued challenging economic conditions in the coming years?
- How much would bank-specific regulatory policies recently implemented help them face these scenarios?

5. The chapter also discusses policy options to deal with the potential challenges that banks could face in the baseline and adverse scenarios and highlights the intertemporal trade-off that arises from targeted policies that encourage banks to use the flexibility embedded in the regulatory regime to sustain the flow of credit to borrowers facing liquidity problems in response to a transitory shock.

Initial Impact of COVID-19 on the Global Banking Industry

6. After spending the past decade building capital and liquidity buffers following the regulatory reforms put in place after the global financial crisis, banks came into the COVID-19 crisis in much better shape than they did before previous crises (Figure 4.1, panel 1). However, bank profitability was already challenged in many jurisdictions amid the prolonged period of low interest rates and low term spreads in recent years (Figure 4.1, panel 2). This low-interest-rate environment is likely to persist for several years, as policymakers have engaged in further expansive monetary policies to support the flow of credit to the real economy (see the April 2020 GFSR).

7. Despite the stronger initial position of banks and the aggressive response of policymakers, the initial stage of the COVID-19 crisis has confronted banks with significant challenges. The initial contractionary shock triggered a scramble for liquidity. In the United States, corporate borrowers aggressively drew on committed credit lines, causing a sudden increase in loans that drove down bank capital ratios.[1] Since then, bank credit in the United States and Europe has remained largely flat. Crucial elements of financial system plumbing (for example, repo and US Treasury markets) encountered liquidity challenges, as did emerging market banks in US funding markets, and financial markets were severely stressed for several weeks. Increased loan loss provisioning—particularly among US banks, for which the onset of the crisis coincided with a transition to "expected credit loss" accounting standards—weighed on bank financial results in the first quarter of 2020.[2] In the second quarter, financial market stress subsided, but most banks took sharply higher loan loss provisions and tightened lending standards as the economic outlook continued to deteriorate (Figure 4.1, panel 3), with loan officers in the United States reporting the tightest credit standards since 2005.

8. As improved liquidity conditions relieved borrowers' appetite for precautionary borrowing, the first-quarter spurt of loan growth slowed or reversed for most banks. This relieved risk-

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[1] Risk weights for undrawn credit lines are in the range of 20–50 percent, while those for drawn credit lines are 100 percent. Therefore, the large drawdown of committed credit lines has an immediate material impact on risk-weighted assets, the denominator of bank capital ratios.

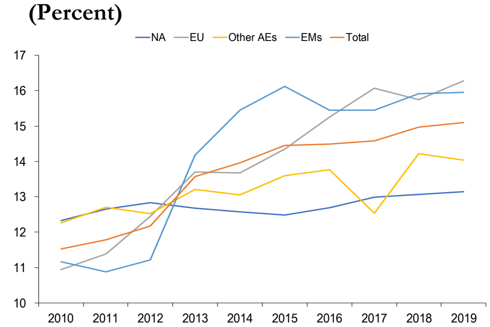
[2] The transition to expected credit losses in the United States became effective on January 1, 2020, and virtually all US banks chose to book large provisions for "transitional" increases in loan loss reserves. In one extreme example, Citi took a $4.2 billion current expected credit losses transitional charge, more than half of the $7 billion total 2020 first-quarter loan loss provision. The Federal Reserve promulgated a regulation allowing banks to defer transition-related provisions, but most large banks chose to retain the transition charges recognized on January 1. However, US bank regulations mitigate the impact of this transition charge on bank capital. Before the COVID-19 outbreak, the Federal Reserve announced a rule allowing banks to phase in the impact of current expected credit losses transition provisions over three years. During the first quarter of 2020, the regulator lengthened the phase-in path to zero capital charges over two years, followed by a three-year phase-in path.

weighted asset pressure on capital ratios (Figure 4.1, panel 4). During the second quarter of 2020, some major banks (particularly in the United States) also reported large capital-market-driven gains.

Figure 4.1. Historical Context: Magnitude of the Current Crisis and the Ex Ante Position of Banks

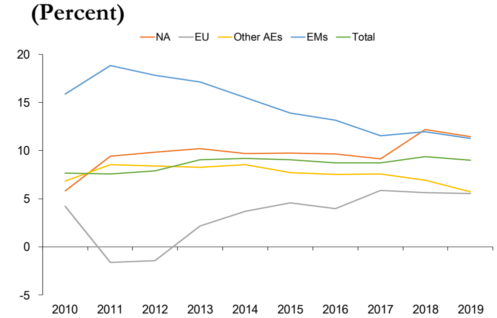
Banks, particularly in Europe and in emerging markets, massively improved their capital positions in the last decade …

1. Average Tier 1 Ratio, by Region
(Percent)



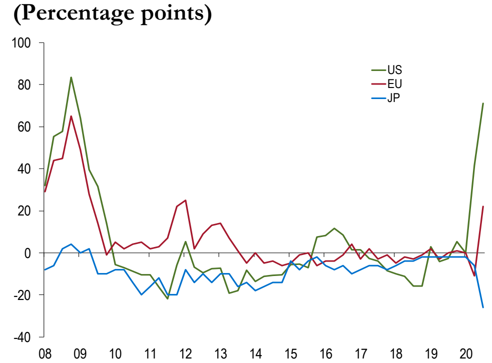
… despite low profitability challenging capital accretion in some regions.

2. Average Return on Equity, by Region
(Percent)



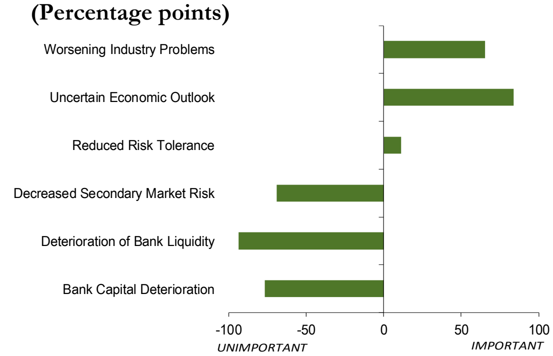
Bank lending standards tightened sharply—to near the 2008 peak in the United States.

3. Bank Lending Standards: Net Tightness
(Percentage points)



Banks attribute tightening to deteriorating borrower conditions, not to capital or liquidity constraints.

4. Causes of Bank Credit Tightening
(Percentage points)



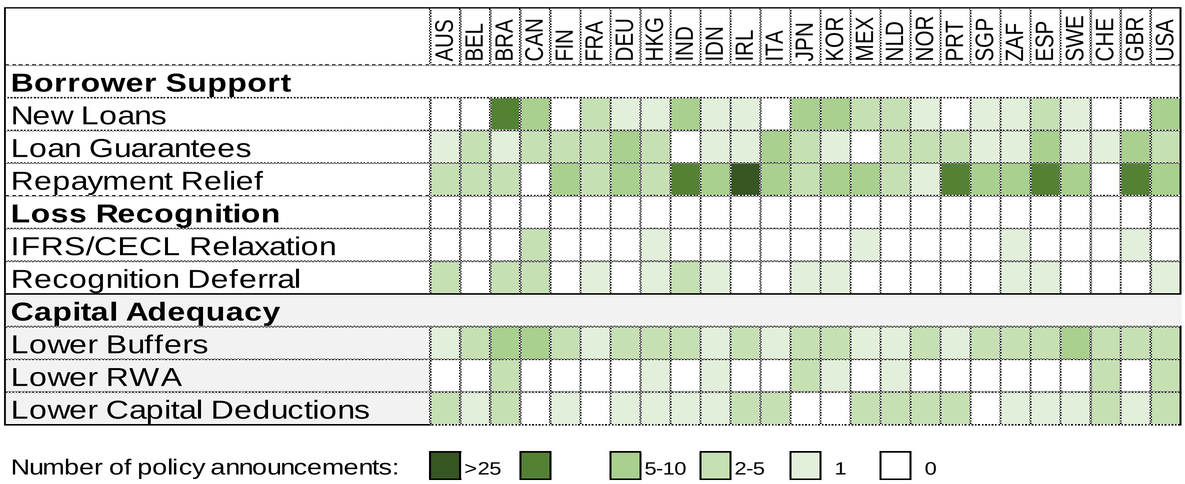
Source: Haver Analytics.
Note: The Asian financial crisis shock is dated at 1997:Q2, and the global financial crisis shock is dated at 2008:Q3. Stress test scenarios are identified by supervisor and year. V, U, and W refer to the three scenarios outlined in the Federal Reserve's June 2020 assessment of bank capital during COVID-19. BoE = Bank of England; EBA = European Banking Authority; ECB = European Central Bank. CCAR = Comprehensive Capital Analysis and Review. GFC = global financial crisia. Other AEs = other advanced economies, including Japan, Australia, Hong Kong, and Singapore; EMs = emerging markets; EU = Europe, including the United Kingdom and continental Europe; JP = Japan; NA = North America, including United States and Canada.

The Reactions of Financial Sector Authorities to the COVID-19 Crisis

9. Governments around the world have responded to the economic disruption of the COVID-19 crisis with policies of unprecedented scope and magnitude to support the real economy, prevent permanent damage to the balance sheets of firms and households, and maintain the flow of credit to the real economy. These policies extend from broad macroeconomic policies to specific measures that directly address bank balance sheet management (Figure 4.2).[3]

Figure 4.2. Mitigation Policies Announced since February 1, 2020, by Category and Jurisdiction ***(Color indicates number of policy announcements)***

Among the wide range of policy responses to the COVID-19 shock and slowdown, this chapter focuses on three that relate most directly to a bank's capital position: borrower support, loss recognition, and capital adequacy.



Sources: Financial Stability Board; KBW; Yale School of Management; and IMF staff estimates.
Note: Includes policy announcements up to July 10, 2020. See Online Annex 4.2, www.imf.org/en/Publications/GFSR, for an explanation of the data and methodology on which this policy taxonomy is based. Data labels use International Organization for Standardization (ISO) country codes. CECL = current expected credit loss; IFRS = International Financial Reporting Standards; RWA = risk-weighted assets.

10. This chapter focuses specifically on the impact of government loan guarantee programs and capital adequacy policies that can be directly quantified (henceforth, "bank-specific" policies). Other policies have an indirect effect on banks' capital adequacy. For example, fiscal stimulus and monetary policy indirectly support banks' financial results through macroeconomic channels. Policies to support bank funding could affect bank capital by lowering costs and allowing banks to sustain their level of activity. Policies intended to support borrowers' repayment ability, including repayment moratoria, may reduce banks' need to set aside provisions for loan losses—and thus bolster capital—by lowering the probability that a borrower will enter default (probability of default). Nonetheless, some of these policies may also simply postpone loss recognitions.

[3] The intensity of the colors in the figure denotes only the number of measures announced but has no bearing on the absolute or relative economic magnitude of those policies. For instance, a single large policy announcement in one jurisdiction could surpass in economic relevance many announcements by a different jurisdiction.

11. Within the risk-based capital framework, the policies analyzed in this chapter can alter the capital space through three channels.

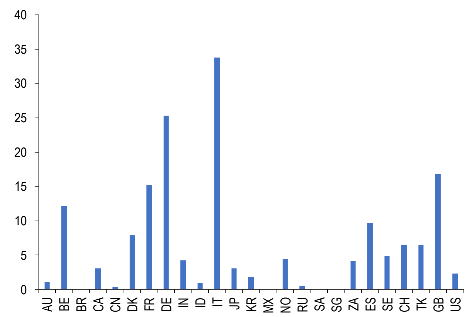
- **Increasing capital levels:** This has been promoted mainly through restrictions (often "voluntary" guidance) on distribution of profits through dividends and share buybacks. Most of these come with specific end dates (typically not later than the end of 2020). Policymakers have issued such guidance for the large European banks and for all banks in Brazil, Italy, Japan, Switzerland, the United Kingdom, and other countries. Government loan guarantees can also boost capital levels by reducing the loss that a bank experiences when a borrower defaults and the need to set aside loan loss provisions for this event (loss given default).
- **Lowering risk-weighted assets or "leverage exposure"—the capital ratio denominators:** National regulators have typically waived risk-asset weights for loans covered by government guarantees (Figure 4.3, panel 1).[4] In some instances, policymakers have also reduced risk weights on banks' exposures to targeted borrowers, often small businesses, to encourage credit to this segment. A few countries—Japan, the United Kingdom, and the United States—have exempted central bank reserves and government bond holdings from banks' leverage exposure measures (the denominator of the leverage ratio) as a means to account for large asset purchase programs and to encourage banks to continue to intermediate in government bond markets.
- **Releasing some capital buffers:** In many jurisdictions, policymakers have increased banks' overall space between reported and regulatory capital levels by releasing the countercyclical capital buffer that is designed to be used during downturns (Figure 4.3, panel 2). Policymakers have also reminded banks that the capital conservation buffer—a buffer of 2.5 percent of total capital aimed at preventing banks from breaching the minimum regulatory capital adequacy ratio—could be used to support lending and be gradually rebuilt through retained earnings as conditions improve. A few countries have gone beyond these measures and reduced the size of the capital conservation buffer or the buffers for domestic systemically important banks.

[4] This is distinct from the effect of government guarantees on the borrowers' "point-in-time" probability of default resulting from improved access to funding—which is captured in the analysis of the corporate sector—and from their effect on the "loss given default," previously discussed and quantified in the next section.

Figure 4.3. Magnitude of Announced Mitigation Policies

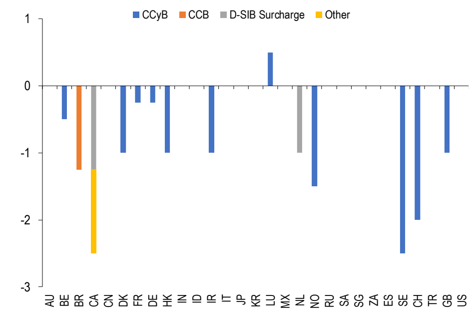
The magnitude of loan guarantees varies widely across countries.

1. Loan Guarantees
(Percent of GDP)



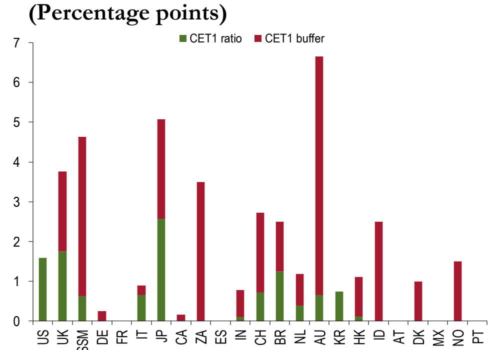
Many jurisdictions have relaxed capital buffer requirements to support banks' credit underwriting.

2. Change in Bank Regulatory Capital Buffers since February 1, 2020
(Percent of risk-weighted assets)



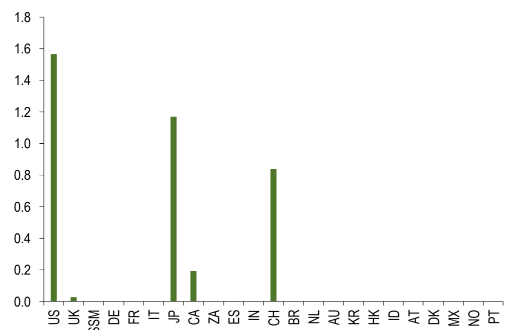
Some jurisdictions have also taken steps to improve reported capital ratios or lower required capital buffers.

3. Estimated Pro Forma Increase in CET1 Capital Ratio and Buffer from Announced Policies
(Percentage points)



A few countries highly sensitive to capital market depth have also taken steps to improve leverage ratios.

4. Increase in Leverage Ratio from Announced Policies
(Percentage points)



Sources: Bloomberg Finance L.P.; Financial Stability Board; IMF (2020b); KBW; SNL Financial; Yale School of Management; and IMF staff estimates.

Note: "Loan guarantees" is based on the announced programs, not actual take-up of guaranteed loans. DSIB surcharges are not captured as a separate buffer in several jurisdictions, mainly because DSIB requirements are often expressed in terms of the overall CET1 ratio. Data labels use International Organization for Standardization (ISO) country codes. CCB = capital conservation buffer; CET1 = common equity Tier 1; CCyB = countercyclical capital buffer; DSIB = domestic systemically important bank; GSIB = global systemically important bank.

12. These policies combined are estimated to have already improved banks' reported CET1 ratios and, by releasing some capital buffer requirements, to have expanded the capital space between banks' current positions and broad regulatory capital levels (Figure 4.3, panel 3). In addition, while this section focuses on the CET1 capital position because that is the binding constraint for most banking systems where bank market-making activity is not large, policymakers in a few jurisdictions (Switzerland, Japan, United States) have also eased constraints on banks' leverage ratios, typically by excluding government bonds, central bank reserves, or other low-risk assets from the leverage exposure denominator. This facilitates trading depth in countries with a high level of capital market activity and a need for banks to hold government bonds and other low-risk assets (Figure 4.3, panel 4).

Bank Capital Ratios in the Wake of COVID-19 and the Role of Policies

13. This chapter assesses the consequences of the COVID-19 crisis for the future capital ratios of global banking systems in a forward-looking manner using the latest baseline projection of the economic outlook and the adverse scenario outlined in the October 2020 WEO (Figure 4.4). These two scenarios provide a broad assessment of the potential paths of the pandemic; however, given the unprecedented nature of the shock, uncertainty remains.

14. These macro scenarios implicitly incorporate the effects of broad macroeconomic and monetary policy interventions, including interest rate cuts, unconventional monetary policies, fiscal measures, social safety net packages, and other policies that support the real economy. By improving the liquidity of borrowers, these policies indirectly affect the condition of banks. However, the consequences of bank-specific policies for the distribution of banks' capital may not be fully captured in macro aggregates. The chapter also assumes that the accounting impact of bank-specific policies on bank balance sheets is not fully captured in macro trajectories.

15. The assessment relies on a recently developed global stress test (see Online Annex 4.1) that uses publicly available data on the financial statements of about 350 banks in 29 major banking systems—accounting for 73 percent of global banking sector assets—to estimate how key components of banks' financial statements react to macroeconomic variables.[5] The future paths of these variables are embedded in the scenarios used to conduct a forward-looking simulation of the evolution of the profitability and capital position of each of the banks in the sample, which is then aggregated across different regions and across global systemically important banks (GSIBs).

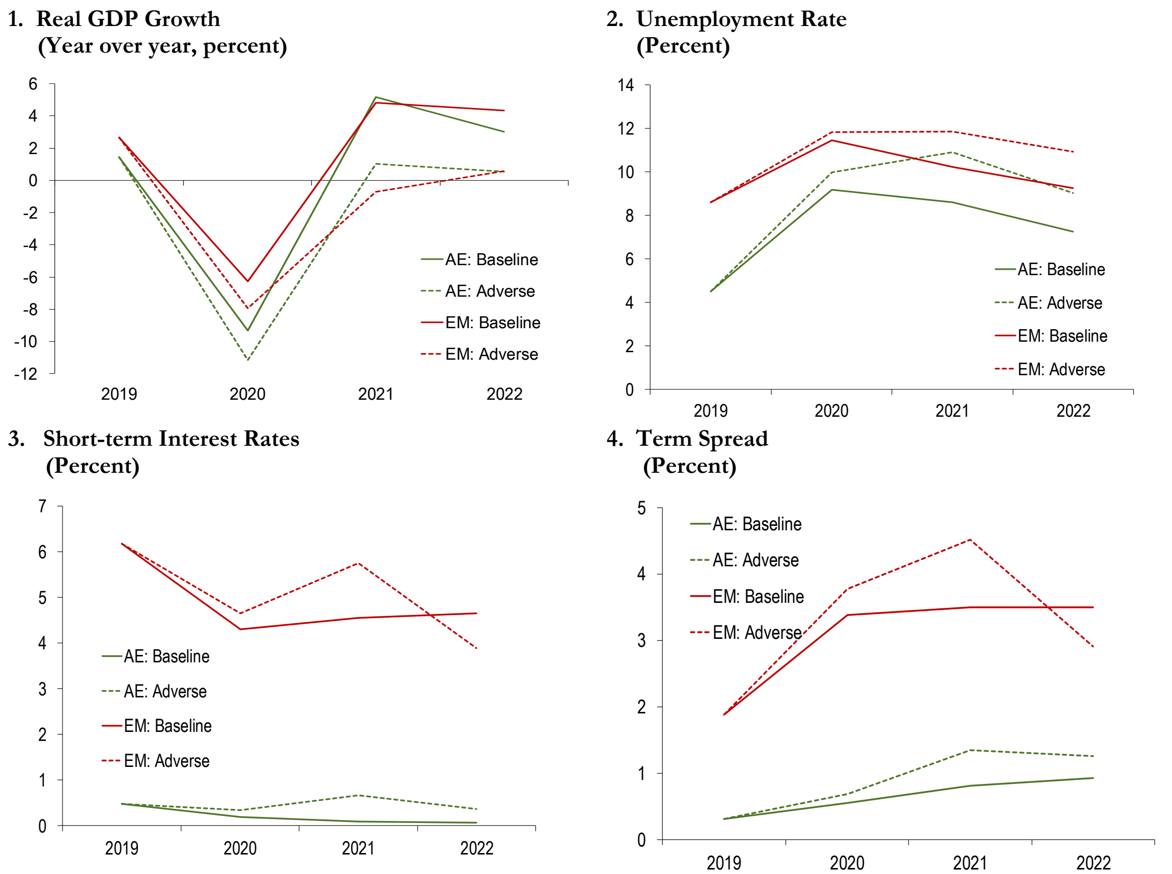
16. The stress test exercise relies on publicly available data. While this allows for a global assessment of the prospective health of the banking system, it comes at the cost of lower data granularity and higher reliance on statistical methods than in supervisory stress tests. This narrows the types of policies that can be analyzed in this context and also requires several assumptions to map the impact of those policies to banks' financial statements.[6] The base model is augmented by a satellite model that explicitly considers the contribution of corporate and

[5] Online Annex 4.1 is available at www.imf.org/en/Publications/GFSR. The jurisdictions included are Australia, Austria, Belgium, Brazil, Canada, Denmark, Finland, France, Germany, Greece, Hong Kong SAR, India, Indonesia, Ireland, Italy, Japan, Luxembourg, Mexico, the Netherlands, Norway, Portugal, Korea, Singapore, South Africa, Spain, Sweden, Switzerland, the United Kingdom, and the United States.

[6] Given the lower granularity of the data, the global stress test also relies more heavily on econometric methods than standard supervisory stress tests and is simpler than models that would typically be used by authorities. Also, the exercise does not allow for behavioral responses by banks that may change their balance sheets. It is a stand-alone solvency stress test that does not consider interaction with other risks, such as liquidity and contagion risks or macro-feedback effects, such as between the banking sector and the sovereign, which might amplify the impact of initial shocks, nor does it take into consideration spillovers across interconnected banking systems. The model also assumes that bank balance sheets remain static during the simulation period, which does not allow banks to reach lower levels of capital by deleveraging (see Online Annex 4.1).

consumer risk to banks' loan loss provisions and is used to estimate the impact of government guarantees (see Box 4.1).[7]

Figure 4.4. Scenarios for Stress Test Simulation



Source: IMF, October 2020 *World Economic Outlook*.
Note: Median across sample countries in each group. AE = advanced economy; EM = emerging market.

Consequences of COVID-19 for Bank Capital

17. The consequences of each scenario for banking systems' future capital ratios are first simulated without adjusting for how the bank-specific mitigation policies discussed earlier alter the recognition of provisions, calculation of risk-weighted assets, or flexibility in using existing capital buffers.

[7] The COVID-19 crisis has had a heterogenous impact across sectors beyond nonfinancial corporations and households. For instance, the transportation and entertainment industries have suffered disproportionately from the social distancing measures implemented to mitigate the spread of the disease. For this reason, it would be desirable to incorporate further sectoral disaggregation in the analysis, but more granular decompositions of banks loan portfolios are typically available only for a small subset of banks.

18. The results of the stress test show a significant decline in CET1 of the global banking system, reaching minimum levels of 9 percent in the baseline scenario and 8.4 percent in the adverse scenario—a drop of 4.2 percentage points and 4.8 percentage points, respectively, below the CET1 level in 2019. The trajectory of aggregate CET1 recovery also varies importantly across scenarios. In the baseline scenario, CET1 steadily recovers after reaching a trough in 2020, but is still 1.1 percentage points below its initial level at the end of the simulation in 2022. In contrast, the capital position decline is much more persistent in the adverse scenario, with CET1 levels remaining 4.2 percentage points below their initial levels by 2022 (Figure 4.5, panel 1).

19. The decline in the CET1 ratio over the simulation horizon stems mainly from an increase in loan loss provisions (Figure 4.5, panel 2). In the baseline scenario, higher loan loss provision expenses contribute to a 5.2 percentage point decline in CET1, while in the adverse scenario their contribution is 6.7 percentage points. This is directly related to the different trajectories of economic activity in the two scenarios, where the rebound projected in the baseline scenario for 2021 results in lower provisioning expenses. In contrast, the increase in risk-weighted assets plays only a minor role in driving the changes in CET1.

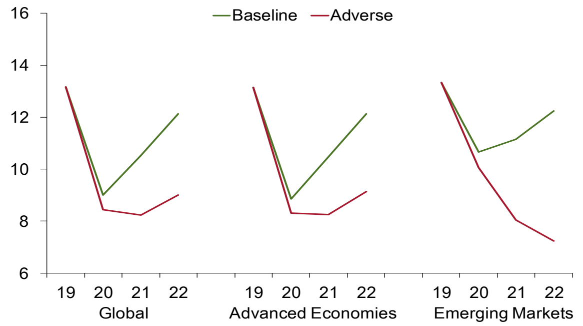
20. The sizes of the aggregate decline and the contribution of different components vary across regions. The maximum decline in CET1 in the baseline scenario is much larger in advanced economies, reaching 4.3 percentage points, compared with 2.7 percentage points in emerging market economies (Figure 4.5, panel 1). The situation reverses, however, in the adverse scenario, where advanced economies see a maximum decline in CET1 of about 4.9 percentage points, compared with 5.3 percentage points for emerging markets. This difference is a result mainly of higher provision costs in emerging markets resulting from the relative economic underperformance of this group of countries in the adverse scenario and the varying sensitivity of banks in these economies to macro-financial conditions.

21. The trajectory of aggregate capital ratios masks significant heterogeneity across banks. Even at their trough, and in the adverse scenario, one-third of the banks in the sample (by assets) have CET1 ratios above 10 percent—much higher than the minimum requirement of 4.5 percent. But a weak tail of banks, accounting for almost 20 percent of assets in the sample, fails to meet the 4.5 percent requirement in the adverse scenario (Figure 4.5, panel 3). This weak tail is also present in the baseline scenario, although it is smaller, with about 3 percent of bank assets in the sample falling below the 4.5 percent.

Figure 4.5. Bank Solvency under COVID-19

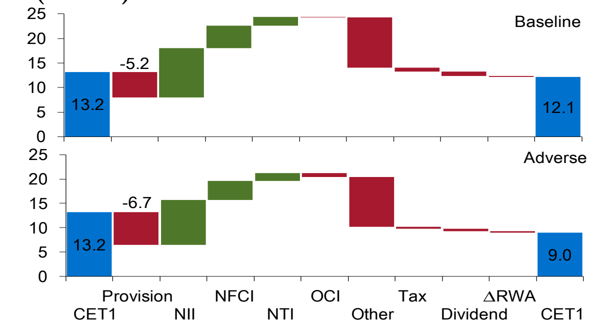
Banks' capital ratios fall significantly …

1. Common Equity Tier 1 (CET1) Ratio
(Percent)



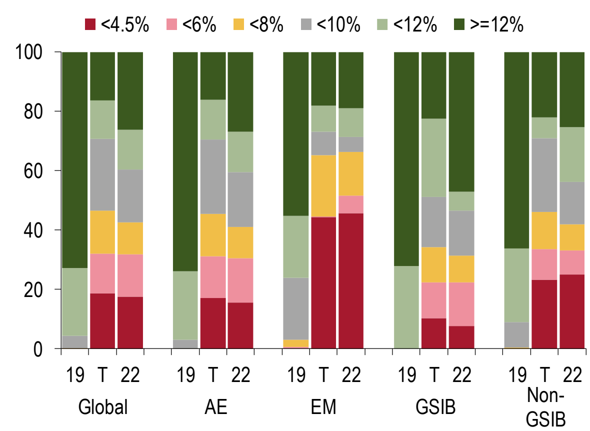
… driven by large provision costs.

2. Drivers of Changes in the CET1 Ratio between 2019 and 2022
(Percent)



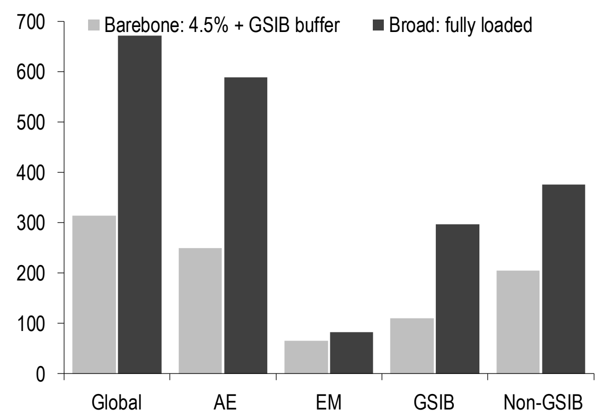
Nearly one-fifth of the global banking system will breach minimum capital requirements.

3. Distribution of Bank Assets by CET1 Ratio under Adverse Scenario
(Percent; T = trough year)



The maximum capital shortfall against a broad capital requirement could reach $650 billion globally over the stress test horizon.

4. Maximum Broad Capital Shortfall under Adverse Scenario
(Billions of US dollars)



Sources: Haver Analytics; SNL Financial; and IMF staff estimates.
Note: The Asian financial crisis shock is dated at 1997:Q2, and the global financial crisis shock is dated at 2008:Q3. AEs = advanced economies, which comprise euro area, low-rate AEs, North Atlantic, and other AEs; CET1 = common equity Tier 1; EMs = emerging markets; GSIB = global systemically important bank; NFCI = net fee and commission income; NII = net interest income; NTI = net trading income; NI = net income; OCI = other comprehensive income; "Other" includes several financial accounts, including operating expenses and non-operating items; RWA = risk-weighted assets. In panel 2, green and red bars denote increases and decreases in capital, respectively.

22. In the adverse scenario, there is also heterogeneity in the weak tail of banks across regions and between global systemically important banks and other banks. Global systemically important banks fare better than the average bank, in part because of their stronger initial capital ratios resulting from their mandatory systemic buffers. However, almost 10 percent of these banks' assets end the simulation period with capital ratios below 4.5 percent, failing to meet regulatory thresholds at their lowest point, and an additional 15 percent of their assets falls to capital ratios below 6 percent, corresponding to a globally systemic risk buffer of 1.5 percent (the second smallest buffer bucket applied to these banks). This is especially troublesome, given that these banks are considered systemically important. Among non-GSIBs, 25 percent of bank assets fail to meet the 4.5 percent minimum regulatory threshold by 2022. Banks from emerging markets are the most severely affected, with almost 50 percent of total banking assets ending the simulation period with CET1 ratios below 4.5 percent. Banks from advanced economies fare better, although there is still a 15 percent of banks' assets below 4.5 percent by 2022.

23. Further analysis of the banks that fall into the weak tail during the simulation period shows that, across regions and types of banks, the main difference between banks that fail to meet regulatory minimums and the rest of banks is the initial level of CET1. Banks that fail to reach a 4.5 percent CET1 ratio had initial ratios about 1 percentage point below those that maintain their ratios above 4.5. Also, banks with a high propensity to fall below minimum capital standards generate meaningfully lower returns than peers that maintain adequate capital throughout adverse conditions.

24. The importance of the weak tail of banks can also be assessed by estimating the capital shortfall, which is the difference between simulated CET1 ratios and those set by regulation. The shortfall is measured against two benchmarks: the regulatory minimum for CET1—corresponding to a ratio of 4.5 percent plus the bank-specific capital surcharge for each global systemically important bank—and a broad regulatory threshold that also includes the current levels of the capital conservation buffer and the countercyclical buffer in place as of June 2020.[8] The first threshold defines a "barebones capital shortfall" with respect to a level of capital at which supervisory action would take place. The second threshold defines a "broad capital shortfall" relative to a capital ratio that includes the buffers currently in effect.[9] While banks facing a shortfall relative to this broad threshold have the capital space to provide credit by using some of these buffers—as envisioned by the international regulatory framework, they may feel less willing to expand lending activity for precautionary reasons or because of market pressure.

25. The two measures of capital shortfall in the adverse scenario show important variation across groups of banks (Figure 4.5, panel 4). At the global level, the barebones capital shortfall is about $300 billion, and the broad capital shortfall reaches about $650 billion (0.5 percent of sample banking assets). In both cases, global systemically important banks capture an important part of the shortfall, which is largely explained by the size of these institutions. The differences across regions are driven by differences in the size of their banking systems, with the level of capital shortfalls being much larger for advanced economies. When considering the broad measure, the global shortfall represents 1.3 percent of the GDP of countries where at least one bank has a capital shortfall. Across those countries, the average broad shortfall is 1.5 percent of

[8] For large US banks this includes the stressed capital ratio levels recently defined by the Federal Reserve instead of the countercyclical capital buffer and the capital conservation buffer. While many jurisdictions have recently released the Countercyclical Capital Buffer, the buffer is different from zero in a few ones.

[9] The calculation assumes that counter-cyclical capital buffers will remain at current levels -- 0 percent in almost all countries – and does not assume that this buffer will revert to a pre-pandemic or 'normalized' level that is difficult to determine a priori.

GDP. Relative to the initial—as of 2019—CET1 level of those banks that experience a capital shortfall in the adverse scenario, the global shortfall corresponds to 28 percent, with a median across countries of 30 percent.

Effect of Bank-Specific Policies on Capital Ratios

26. As discussed, authorities have implemented policies aimed at giving banks flexibility to maintain the flow of credit to the real economy. These policies, which include government loan guarantees and capital adequacy policies, affect the need to set aside provisions and the way in which capital ratios are computed and should therefore also improve measured bank capital ratios over the next three years.

27. The mitigating impact of some of these policies can be quantified in the stress testing exercise as follows:

- *Government guarantees:* The impact of government guarantees on banks' provisions is captured by their impact on banks' expected losses. These losses are the product of banks' exposure to firms, the probability of default of those firms, and the loss experienced by banks when firms default. Government guarantees can be understood as reducing the latter term—known as the "loss given default"—because, under these conditions, the guarantee would be executed. Because of lack of data on the extent to which banks originate guaranteed loans, all banks in a country are assumed to benefit equally from the guarantee in a proportion equal to the ratio of government guarantees to total corporate loans. Since announced guarantee programs apply mostly to new loans, this assumption likely overestimates their initial impact. It is also assumed that guarantees are used to the full extent of announced amounts (full uptake).[10] In the model, a lower uptake of government guarantees would lead to a proportional increase in provision expenses and therefore a proportionally lower impact of the policy on loan loss provision expenses.

- *Capital adequacy policies:* The three categories of capital adequacy policies are quantified from the estimated impact of each announced policy on each bank. For example, the effect of canceling dividends is quantified from stress test model forecasts. The release of capital buffers is estimated by applying the reduction to forecast risk-weighted assets. Changes to the calculation of risk-weighted assets similarly apply to the announced change to the relevant exposure class. In a very few instances, bank-specific policies are applied on a bank-

[10]Many of these programs were announced only a few months ago, so the extent to which the guarantees will be used by banks to originate loans is still unclear.

specific basis.[11] These increments are integrated into each bank's balance sheet positions at the end of each period.

28. In quantifying the impact of these policies, it is assumed that they are maintained over the three-year horizon of the scenario, unless an explicit expiration date was mentioned when the policy was announced. Although this assumption avoids speculating about the timing of withdrawal of some of these policies, it may be too benign, especially in the baseline scenario, in which authorities might decide to withdraw them as the economy recovers during the latter part of the simulation window.

29. Bank-specific mitigation policies improve average capital ratios across countries and scenarios. In the adverse scenario, both at the trough and at the end of the simulation, the CET1 ratio for advanced economies is about 80 basis points higher when both government loan guarantees and capital adequacy policies are considered. In the simulations, the improvement in capital ratios is a result largely of the decline in provision expenses because of government loan guarantees; capital adequacy policies explain about a third of the overall improvement in CET1 at the end of the simulation period in advanced economies (Figure 4.6, panels 1 and 2). In the sample of emerging market economies, capital adequacy policies do not play a meaningful role, as these policies are largely absent in this sample. Given the estimated impact of loan guarantees, the final uptake of these policies—the extent to which the announced guarantee programs are used—could be an important driver of the final solvency position of the banking system. As discussed, an ultimate uptake of half the announced amount would reduce the mitigating effect of the policy roughly by half.

30. Government loan guarantees and capital mitigation policies also reduce the troubled tail of banks, although it remains sizable. The share of bank assets with CET1 ratios below 4.5 percent in the adverse scenario drops from near 20 percent without mitigation policies to 15 percent when those policies are in place (Figure 4.6, panel 3, compared with Figure 4.5, panel 3). Global systemically important banks also see a substantial improvement in their distribution of CET1 during the simulation horizon, with the simulation of the impact of these policies reducing the share of global systemically important bank assets with CET1 below 4.5 percent from about 10 percent to about 6 percent. This decline is also important for non–global systemically important banks, going from 25 percent to 20 percent. In advanced economies, the policies analyzed shrink the weak tail of banks from 15 percent to 10 percent, and in emerging markets, the consideration of these policies in the simulation has only a small effect on the troubled tail of banks, which declines from 50 percent to 46 percent of bank assets.

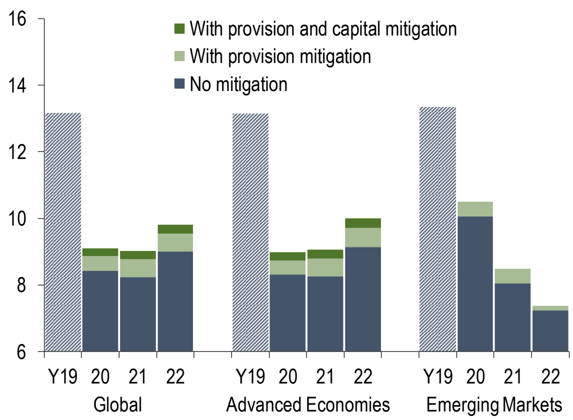
31. The mitigating role of bank-specific policies also maps into lower barebones and broad capital shortfalls (Figure 4.6, panel 4), with an especially remarkable decline for global systemically important banks. Across banks, the broad capital shortfall is about $400 billion, half of which corresponds to the barebones shortfall. In economies where banks with shortfalls are

[11] Online Annex 4.1 describes the estimation of policy mitigation effects in greater detail.

Figure 4.6. Bank Solvency under COVID-19 with Policy Mitigation

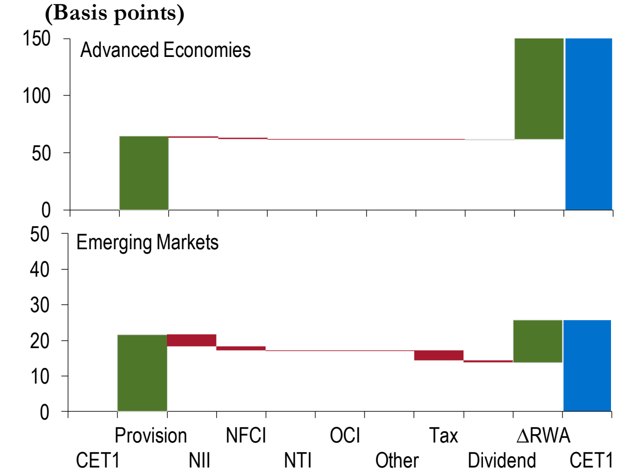
Policy mitigations would cushion some of the capital depletion …

1. CET1 Ratio under Adverse Scenario
(Percent)



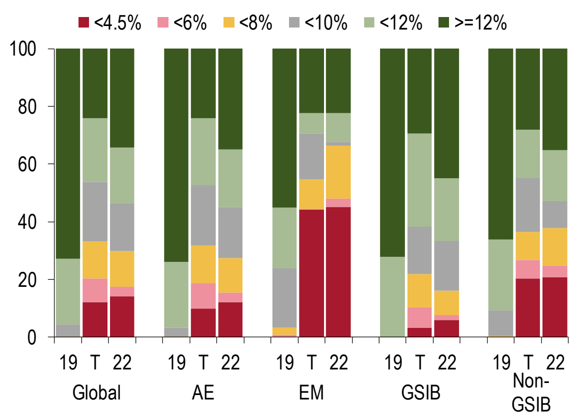
… especially provision policies.

2. Impact on CET1 from Policy Mitigations under Adverse Scenario
(Basis points)



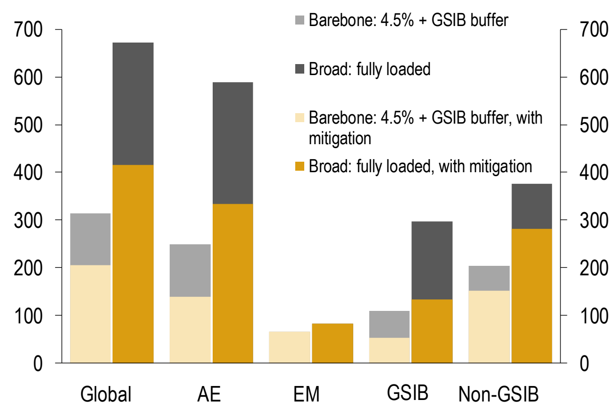
Policy support would reduce the weak tail of banks by 5 percent …

3. Distribution of Bank Assets by CET1 Ratio under Adverse Scenario
(Percent; T = trough year)



… and the capital shortfall by over $200 billion.

4. Maximum Broad Capital Shortfall under Adverse Scenario
(Billions of US dollars)



Source: Haver Analytics.
Note: Provision mitigation policies include guarantees only. Estimation of the impact of capital mitigation is explained in Online Annex 4.1. AEs = advanced economies; CET1 = common equity Tier 1; EM = emerging markets; GSIB = global systemically important bank; NFCI = net fee and commission income; NII = net interest income; NI = net income; OCI = other comprehensive income; "Other" comprises several financial accounts, including trading and investment income, operating expenses, and non-operating items; RWA = risk-weighted assets.

headquartered, the broad shortfall represents about 0.8 percent of their combined GDP, and, across countries, the average shortfall is about 1.1 percent of GDP. In terms of the initial CET1 ratios of those banks that experience a shortfall during the simulation, in the adverse scenario the global shortfall reaches 11 percent and the average is 12 percent. All in all, the bank-specific policies quantified in this chapter mitigate the impact of the adverse scenario on bank capital ratios, but the impact is still sizable, and a share of global systemically important bank assets would still be part of the weak tail of banks, even when maximizing the impact of these policies on capital ratios.

32. Some policies that are more challenging to quantify would also lead to an improvement in bank capital ratios. Most important, several countries have provided guidance on loan classification, provisioning, and disclosure and have revised the automatic reclassification for restructured loans. Others have gone further and changed the criteria for the reclassification of loans or frozen those classifications. The effects of these policies on loan loss provisions, in principle, are captured through GDP effects of continued credit flow. However, the changes in reclassification criteria for credit also spare it from increased risk-asset weighting. Because the quantity of loans that would have been reclassified in the absence of these measures cannot be quantified in advance and is generally not reported, the stress test model cannot capture the risk-weighted asset savings associated with these policies.

33. Overall, while the bank-specific policies quantified in this section help improve banks' capital ratios over the simulation period, the main contribution of the broad policy packages implemented by authorities likely comes from the support they provide to the macroeconomy. This is because the increase in loan loss provision expenses in response to the macroeconomic scenario is the main driver of the simulated decline in capital ratios, even after accounting for the bank-specific mitigation policies. A more adverse macroeconomic scenario, as would be the case in the absence of the broad support measures implemented, would have likely resulted in significantly lower capital ratios. While counterfactual forecasts for the trajectory of the global economy in the absence of broad support policies are not available, the important difference in simulated capital ratios between the baseline and adverse scenarios suggests how broad macroeconomic support has likely helped banks' capital adequacy.

34. The policies discussed in this section support the solvency of banks, but they also pose intertemporal trade-offs that could become relevant in the future. Delaying provision expenses because of temporary liquidity shocks to borrowers can help prevent borrowers' liquidity challenges from immediately turning into insolvency, thus reducing lending procyclicality and supporting banks' profitability and solvency. Similarly, the use of capital buffers creates lending space to support the real economy. Hence, these policies can help bridge the impact of the COVID-19 shock and reduce the chances that a transitory shock will have permanent consequences for financial stability and the global economy. However, if the pandemic and the containment measures last longer than initially expected, ultimately affecting the solvency of borrowers despite the mitigating role of these policies, banks will need larger future provisions and will have lower buffers against future shocks, including from a meaningful second wave of the virus. Maintenance of generous guarantee programs over an extended period of time could also jeopardize fiscal solvency if defaults eventually materialize, and could lead to further bank losses related to their sovereign exposures.

Summary and Policy Discussion

35. COVID-19 has had important consequences for the global banking sector and will pose further challenges. As the odds of a quick rebound in economic activity diminish, corporate and household solvency problems will likely deteriorate further and collateral values may decline, resulting in greater credit losses and posing challenges for banks globally. These challenges could interact with other, more structural challenges, such as the low profitability observed in some regions in an environment of persistently low interest rates and term spreads, a scenario that has become increasingly likely in the wake of the pandemic.

36. The simulations presented in this chapter show that, on aggregate, the banking systems analyzed would remain solvent in coming years, although there is heterogeneity across and within regions. The aggregate solvency is partly due to the buffers accumulated as a result of the regulatory reforms introduced after the global financial crisis. In fact, banks analyzed in this chapter had a median CET1 ratio of 11.9 in 2007, compared with 16.2 percent in 2019. This improvement in the initial solvency conditions carries over to the minimum CET1 ratios achieved in response to the COVID-19 crisis.

37. Nonetheless, while aggregate capital ratios remain above regulatory minimums, at a global level and within regions there is a weak tail of banks that could see their solvency challenged. The size of this tail depends largely on the depth and persistence of the crisis, becoming sizable across almost all regions and groups of banks in an adverse scenario with a persistent decline in economic activity. Some global systemically important banks are also part of this weak tail, which could have broader repercussions for financial stability in an adverse scenario.

38. Policies adopted by governments, central banks, and bank regulators have helped ease banks' challenges amid the COVID-19 crisis. Direct support to borrowers (both firms and households)—and liquidity provision to key markets, banks, and other financial intermediaries—have had a marked effect on bank capital ratios through the resultant improvement in macroeconomic conditions. On top of this support, government loan guarantees and capital adequacy policies have provided a second line of defense that has eased and will likely continue to ease pressures, as shown in the quantitative forward-looking analysis of this chapter.

39. The majority of regulatory responses taken so far are consistent with the core standards implemented after the global financial crisis and with internationally agreed guiding principles. National authorities have taken capital and liquidity measures using the flexibility embedded in the prudential framework to help support lending to the real economy. Authorities have clarified the usability of capital and liquidity buffers, encouraged banks to use these buffers to absorb losses and sustain credit, and restricted capital distributions to preserve capital. However, in several cases, regulatory easing was achieved by lowering minimum requirements below Basel framework levels. Such deviations risk undermining the credibility of the internationally agreed standards, could contribute to market segmentation, and may increase the risks to bank safety and soundness. Standard setting bodies (like the Basel Committee) and national authorities have also encouraged banks to work constructively and prudently with borrowers and have issued guidance on how to treat restructured loans and public and private moratoria for prudential asset classification and provision. Nonetheless, some measures that run contrary to these recommendations have been observed, such as the freezing of asset classification status and provisioning requirements. These measures affect the reliability of financial statements and capital ratios and risk undermining the confidence in the banking system. Moreover, they may lead to lending to insolvent borrowers while not recognizing loan losses, which may not only jeopardize the financial soundness of banks but also the recovery as credit is diverted from productive uses.

40. Looking ahead, the benefits of these policies in easing banks' capital constraints and maintaining the flow of credit to the real economy should be carefully balanced against their potential medium-term risks to financial stability. Although using the flexibility embedded in the prudential framework in accordance with recommendations made by standard setters could help reduce procyclicality and negative feedback loops in response to temporary liquidity shocks, relaxing loan classification and provisioning rules undermines transparency and data reliability as financial statements and prudential ratios may no longer adequately reflect the true strength of banks. A decline in the quality of information could lead to a loss of confidence in the banking system, with adverse implications for stability. It is thus important that some of these measures be carefully phased out as the economy recovers, especially in the baseline scenario. It is also essential that, in any scenario, banks promptly recognize losses for borrowers that become insolvent as evidence of impairment becomes available. More broadly, phasing out government support, including government guarantees, too quickly would lead to lasting damage to the economy, but phasing it out too late could risk damaging public finances or unduly keeping insolvent borrowers afloat.

41. Despite the mitigating effect of government policies, in the adverse scenario simulated in this chapter, there is a weak tail of banks that fail (or nearly fail) to meet minimum regulatory requirements. This finding highlights the usefulness of forward-looking stress tests to assess the health of banking systems and to guide prospective policy responses to the current crisis. When conducted by regulators or supervisors, this type of assessment would rely on more granular data than used in this global exercise, and thus would provide additional richness.

42. Once the assessment is done, however, what should authorities do about banks that could become troubled? The answer to this question should take into consideration country-specific circumstances. Acting now to strengthen the financial safety net, including deposit guarantee programs, resolution regimes, and central bank liquidity facilities is key. Capital preservation measures will help, including temporarily limiting the distribution of dividends, as some countries have already done. For countries that allowed banks to draw down capital buffers, the stress test results will help guide the timing and pace at which these exceptional measures can be unwound. Supervisors could use this information to reassess forward-looking capital plans and take measures aimed at preserving and supporting plans to rebuild capital gradually for the most vulnerable entities to ensure confidence, avoid procyclicality, and preserve financial stability.[12] Preparing contingency plans that detail how the authorities will respond to possible future pressures is critical to support effective policy responses if the adverse scenario materializes.

[12] For a broader discussion of the banking regulatory and supervisory actions to deal with COVID-19, see IMF (2020a).

Box 4.1. The Role of Corporate and Consumer Risk in the Evolution of Banks' Loan Loss Provisions

The COVID-19 crisis is likely to impact the credit risk of both firms and households. Household and firms may have different effects on bank provisioning and capital, according to the severity of the shock and the composition of the lending portfolios. Disentangling the impact of these two sources of credit risk is important to evaluate the policy response to the crisis as both the magnitude and type of support measures differ across these two sectors.

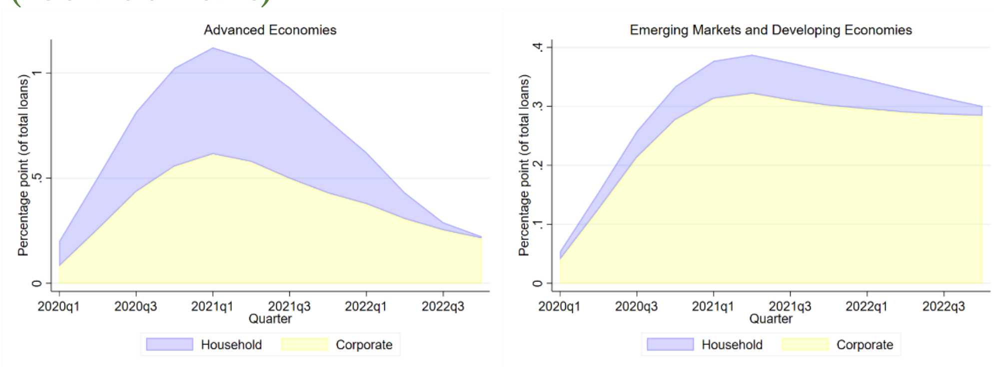
A satellite model of loan loss provisions that considers the mix of bank loans across corporate (firms) and consumer (households) loans was developed to complement the core global stress test model. This model relies on the local projection method to decompose bank loan loss provisions into a component related to household risk (captured by the unemployment rate or changes in house prices) and another related to corporate loans risk (captured by a measure of the probability of default of the corporate sector). It provides a starting point for a more nuanced discussion of the implications of bank business models for future financial performance and for tackling the impact of mitigation policies that target specific sectors (see the online Annex for additional details).

A forward looking simulation of the evolution of loan loss provisions (as a share of total loans) in the baseline scenario of the World Economic Outlook, and the share of them explained by corporate and consumer risk shows that the crisis generates a strong but gradual response that peaks during the first half of 2021 (Figure 4.1.1). At its peak, the increase in the loan loss provision ratio is about 1 percentage point in AEs and about 0.4 percentage points in EMEs.

Most of the increase is due to heightened corporate risk, although households play a significant role in AEs because of their larger share on AE banks' portfolios. These results show that the level and composition of total provisions depends on the mix of bank loan portfolios and on the relative size of the shocks to corporates and households. The analysis highlights the importance of considering the loan mix for the assessment of the impact of the crisis and the analysis of policy responses. In the chapter, these insights are carried to the global stress testing model to assess the impact of policies that affect a specific sector, such as the government loan guarantees that tend to be focused on corporate loans. If data were available, this type of analysis could also be used to further disaggregate the impact of the crisis on different productive sectors.

Box 4.1. *(continued)*

Figure 4.1.1. Additional Quarterly Provisioning
(As share of Loans)



Source: Fitch Connect; S&P Global Market Intelligence; IMF staff estimates.

This box has been prepared by Nicola Pierri and Tomohiro Tsuruga.

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ONLINE ANNEX 4.1. TECHNICAL NOTE[1]

This Annex describes the models methodology that is used as a basis for the analysis presented in Chapter 4 of the GFSR, which provides a quantitative assessment of the impact of COVID-19 on bank capital, including loan loss provisioning as one of its major drivers. Section A of this Online Annex presents an overview of the Global Solvency Stress Test (GST) methodology, its scope, data, and limitations. Section B provides details on the econometric estimation component of the methodology, which is used to relate banks' income and expense drivers to macro-financial conditions. Section C focuses on the decomposition of net loan loss rates (NLR) into probability of default (PD) and loss given default (LGD). Section D presents an empirical satellite model component which is part of the GST model suite, whose aim is to further decompose the aggregate loan loss provision forecasts into those stemming for corporate and retail loans. Section E presents a quantification of the impact of Government guarantees.

A. Global Solvency Stress Test for Banks in Advanced Economies and Emerging Markets

1. The objective of the GST is to assess the impact of the pandemic shock on bank capital in 29 advanced economies and emerging markets. Banks' resilience is assessed against three scenarios: the latest 2020 World Economic Outlook (WEO) baseline scenario (as of October 2020) and two adverse scenarios. The exercise is based on publicly available data and consequently on simpler stress testing methodologies than those usually employed by IMF staff in FSAPs.

Scope

2. The GST covers the largest banks in advanced economies and emerging markets (Online Annex Table 4.1.1). The country sample comprises 29 jurisdictions (Online Annex Table 4.1.1); the banking sector assets of which account for 73 percent of global banking system assets. The objective was to include as many banks as necessary to cover at least 80 percent of their respective banking system's total assets. The combined sample contains 347 banks.

Online Annex Table 4.1.1. Scope of the GST

Africa	Asia and Pacific	Europe	Western Hemisphere
South Africa	Australia	Austria	Brazil
	Hong Kong SAR	Belgium	Canada
	India	Denmark	Mexico
	Indonesia	Finland	United States
	Japan	France	
	Singapore	Germany	
	Republic of Korea	Greece	
		Ireland	
		Italy	
		Luxembourg	
		Netherlands	
		Norway	
		Portugal	
		Spain	
		Sweden	
		Switzerland	
		United Kingdom	

[1] This is an Annex to Chapter 4 of the October 2020 *Global Financial Stability Report*. © 2020 International Monetary Fund. The authors of the Annex include John Caparusso, Marco Gross, Nicola Pierri, and Tomohiro Tsuruga.

Data and Caveats

3. The GST is based on publicly available data. Data for bank income and expense flow data, balance sheet stock data, and several risk metrics were sourced from Fitch, Bloomberg, S&P Global, and banks' financial reports. Consolidated data at annual frequency covering the 1995–2019 period for 347 banks formed the basis for the model and the analysis.

4. The use of publicly available data imposes constraints on the methodology and therefore on the use and interpretation of the results. FSAP stress tests usually rely on supervisory data, which implies that detailed and advanced stress testing methodologies can be employed. For the present exercise, however, supervisory data was not available. Public data are of lower granularity, coverage, and quality compared to supervisory data. Therefore, the results should be interpreted with caution, including when comparing the results with exercises that are based on more granular, supervisory data.

Scenarios

5. Banks' resilience was assessed against three scenarios (the 2020 WEO baseline and two adverse scenarios) over the period 2020–2022. The latest 2020 WEO baseline scenario reflects the expected impact of COVID-19 pandemic and is characterized by a severe recession in 2020, followed by a rapid recovery in 2021. The adverse scenario is based on the October adverse WEO projections characterized by a more severe recession than in the baseline and assumes a second COVID-19 outbreak in early 2021. A second, more severe adverse scenario assumes a protracted COVID-19 pandemic resulting in a two-year recession. The January 2020 WEO baseline is included as a reference scenario, which did not reflect the effects of the COVID-19 pandemic yet. In the June baseline scenario, weighted-average real GDP drops by 8 percent year on year in 2020 for the country sample considered under the GST.

6. The scenarios include seven macro-financial variables. They included real GDP, the unemployment rate, short-term interest rates, term spreads, stock price growth, corporate bond spreads, and the VIX. For the baseline scenario, all variables except the last three were projected by IMF desk economists as a part of the WEO scenarios. Paths for the missing three variables in the baseline scenario were projected by using additional empirical bridge equations that link them to the variables included in the WEO (e.g., GDP growth, unemployment rates, etc.).

7. The severity of the adverse scenarios primarily reflects the assumed duration of the measures to contain the spread of the virus (the lockdown shock). The disruptions to domestic economic activity in all countries in 2021—resulting from measures taken to contain a second outbreak—were assumed to be roughly one-half the size of what is reflected already in the baseline for 2020. The severe adverse scenario takes the same WEO adverse scenario for 2020-21 but assumes no growth in 2022. This is an additional ad-hoc stress scenario to further assess the resilience of banks to a prolonged economic downturn. All scenarios are reflective of monetary and fiscal policy measures in response to COVID-19.

Stress Testing Methodology

8. A methodology which caters to publicly available data has been developed. The methodology aims at projecting banks' capital ratios as a function of scenario-conditional trajectories for their profit and loss (P&L) components, other comprehensive income (OCI), and risk weighted assets. It consists of two parts:

- Econometric models for the main components of P&L and OCI (Online Annex Table 4.1.2). These econometric models are cross-bank-country panel regression models that are used to derive scenario-conditional forecasts of the main components of the banks' P&L (except trading income, details follow below), and changes in OCI. The components of the P&L include: (i) net loan losses (NLL) (later supplemented with models of probability of default (PD) and loss given default (LGD), details follow in Section C), (ii) net interest margins (NIM), (iii) net trading income (NTI), (iv) net fee and commission income (NFCI), and (v) a residual income/expense component that "closes" the P&L (equal to the pre-tax net income minus the four main components which are modeled explicitly). A static balance sheet assumption was employed, meaning that gross loan stocks were assumed to stay constant and only the composition of performing and nonperforming assets therein was allowed to vary. Financial assets other than loans were assumed to not be actively traded. However, their market values were allowed to vary as a function of the scenarios reflected through the impact on trading income/change in OCI model. Risk weights were held constant for standardized exposures and made a (smooth) function of changes in risk parameters (PDs in particular) and hence a function of the underlying scenarios for IRB exposures.
- A balance sheet projection module. The module maps the projections of P&L components, RWAs and OCI into banks' balance sheets, including the impact on Common Equity Tier 1 (CET1) capital. The module involves assumptions for dividend distributions and effective tax rates.

9. All banking system-specific models (Online Annex Table 4.1.2) were estimated using bank-fixed effects panel structures. A Bayesian Model Averaging (BMA) methodology specific to panel model structures was employed to thereby account explicitly for model uncertainty.[2] In addition, sign constraints on the long-run multipliers of the macro-financial predictor variables were involved. The BMA entails the estimation of a large set of models for any given dependent variable, consisting of all possible combinations of the right-hand side variables.

10. For internationally active banks (GSIBs in particular), exposure weights were involved to create exposure weighted right-hand side variables. This is instrumental for capturing such banks' susceptibility to macro-financial conditions in all countries where they are active. From a

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[2] See Gross and Población (2017), "Implications of model uncertainty for bank stress testing," Journal of Financial Services Research, Vol. 55, pp. 31-58; and Desbordes et al. (2018), "One size does not fit all… panel data: Bayesian model averaging and data poolability", Economic Modelling, November 2018, vol.75, p.364-376.

methodological viewpoint, it is an efficient means to capture such cross-border dependencies without increasing the number of model coefficients.[3]

11. Beyond the inclusion of the aforementioned macro-financial predictor variables which were allowed to enter in time contemporaneous and lagged form, no lags of the dependent variables were considered in order to maximize the predictive content that could be extracted from the macro-financial variables.

12. The balance sheet model was designed to take account of the fact that rising nonperforming loans imply less interest income. Nonperforming loan stocks do not generate any interest income by assumption. To capture this, the NII flows were defined as a ratio to total interest earning assets net of nonperforming loan stocks. Thus, even if a net interest margin was constant, a rising NPL ratio would imply a fall in the absolute NII.

Online Annex Table 4.1.2. Methodology: Econometric Model Components

<table>
<tr><th colspan="2">Model Component</th><th>Definition for the Model / Comments</th></tr>
<tr><td rowspan="5">P&L Flows</td><td>Net Interest Margin (NIM)</td><td>NIM = NII(t) / (av(TEA(t)+PR(t)-NPL(t), TEA(t-1)+PR(t-1)-NPL(t-1)))
TEA = Total Earning Assets net of loan loss provisions stocks (PR). NII = Net Interest Income. NPL = Nonperforming Loans.</td></tr>
<tr><td>Net Loan Loss Ratio (NLR)</td><td>NLR = NL(t) / (TEA(t-1)+PR(t-1)-NPL(t-1))
NL = Net Loan Loss flow.</td></tr>
<tr><td>Net Trading Income Ratio (NTIR)</td><td>NTIR(t) = av(NTIR) -a(t) stdev(NTIR)
NTIR(t) = NTI(t) / TA(t), the average and standard deviation taken over the last five years and the a(t) multiplier reflecting scenario-implied stress on positional risk and bank business.</td></tr>
<tr><td>Net Fee and Commission Income Ratio (NFCIR)</td><td>NFCIR(t) = NFCI(t) / av(TEA(t)+PR(t), TEA(t-1)+PR(t-1))</td></tr>
<tr><td>Other Income/Expense (RESR)</td><td>RES = NI after tax + tax + NL – NII – NTI – NFCI.
RESR = RES / av(TEA(t)+PR(t), TEA(t-1)+PR(t-1))</td></tr>
<tr><td colspan="2">Delta OCI Ratio (DOCIR)</td><td>DOCIR = (OCI(t)-OCI(t-1)) / av(AFS(t), AFS(t-1))
AFS = Available for Sale securities.</td></tr>
</table>

Source: IMF staff.

13. The loan loss model was coupled with an additional model that decomposes loss rates into PDs and LGDs. While the loan loss model is based on P&L provision flows, PDs were needed to infer the dynamics of the performing and nonperforming loan stocks (details follow in Section C). Cures (migration of nonperforming back to performing loans) were allowed but not explicitly modeled. Projections of the loan loss provision flows were also cross-checked against

[3] The cross-border exposures have been sourced from banks' annual reports, and other data sources such as Bloomberg (which largely mirror information from bank reports in this respect). The weights reflect both loan and trading book exposures combined. They were sourced for the years 2018/19 and assumed to be constant in history.

the provision forecasts for a subset of European banks and alternative models that were estimated based on the EBA/ECB/SSM 2018 stress testing results.

14. The NTI ratio was projected as a difference between the bank-specific average NTI ratio over the last five years and a product of a scalar and the bank-specific standard deviation of the NTI ratio over the last five years (to account for historical variability of NTI). The scalar was set to a common value for all banks, reflecting the scenario-implied stress on positional risk and net trading income from agency business.

15. Tax rates and dividends over the stress testing horizon were set to zero if projected net income before taxes is negative. Otherwise they were assumed to be equal to individual banks' effective tax rates and dividend payout ratios in 2019. No deferred tax asset accumulation is considered.

16. Credit risk weighted assets were allowed to change with the scenarios. First, a breakdown of total credit exposures into exposures under STA and IRB regulatory approach were approximated for each bank based on publicly available data. For the STA component, the densities of risk weighted assets were assumed to remain constant over the stress horizon. The risk weight densities corresponding to IRB credit exposures were projected using the Basel formulas. Through-the-cycle PDs were adjusted using the change of scenario-dependent point-in-time PDs and a "smoothness" parameter to account for the fact that risk weights are ideally fed with smoother through-the-cycle variants of the relevant risk parameters; as per Basel guidance and reflecting bank practice in many jurisdictions. Downturn LGDs were held constant over the stress testing horizon. Other risk weighted assets (market, operational and residual) were assumed to remain constant.

B. Panel Econometric Models for P&L and Other Components

17. A bank-fixed effects (FE) model structure was the basis for the econometric analysis. The dependent variables, as defined in Online Annex Table 4.1.3, were regressed on macro and financial variables (X) using an FE panel structure:

$$y_t = a_i + \mathbf{b}_{ig}\mathbf{X}_{i,t,g} + \varepsilon_{it}$$

18. The subscripts i, t, and g denote banks, time, and groups to which banks might have been assigned (see below). The vector **X** was allowed to contain contemporaneous and lagged macro-financial predictor variables.

19. A Bayesian Model Averaging Methodology (BMA) was employed to account for model uncertainty. It entails estimating a large set of models for a given dependent variable, which consists of all possible combinations of a predefined set of potential predictor variables. The left-hand side variables are shown in Online Annex Table 4.1.3. The right-hand side variables included real GDP growth, unemployment rates (and year-on-year changes), stock price growth, short-term interest rates and term spreads, corporate bond spreads, and the VIX; and first lags of all these variables—16 variables in total. The individual models for a given left-hand side variables are combined into a final model by computing predictive performance-weighted averages of the individual models based on Bayesian Information Criteria (BIC). The initial number of models in the "model space" for each dependent variable is

$$I = \sum_{l=1}^{L} \frac{K!}{l!\,(K-l)!}$$

where K is the total number of independent variables and L is the maximum number of independent variables which was set to five. For K=16, I equaled 6,884 models. The resulting number of models was reduced by imposing a condition that no model was allowed to contain both unemployment rates and their changes at the same time and that each equation should contain at least one of the macro variables (real GDP growth, unemployment rates, their changes, or one of the lags of these three). This reduced the number of models to 4,722.

20. Sign constraints on long-run multipliers ensured that the long-run effects of changes in macro-financial variables on the banks' P&L and other drivers are consistent with economic theory and rationale (Online Annex Table 4.1.3). Models that did not meet at least one sign constraint were removed from the pool of candidate models. This ensured that the final, weighted average models (the so-called posterior models) resulted in meaningful conditional forecasts.

Online Annex Table 4.1.3. Sign restrictions on Long-Run Multipliers

	Real GDP growth	Unemployment rate	Short-term interest rate	Term spread	Stock price growth	Corporate bond spread	VIX
Net loan loss rates	-1	1	5	1	-1	1	1
Net interest margin	1	-1	5	0	5	-1	5
Net fee and commission income ratio	1	-1	0	0	1	-1	0
Other income/expense ratio	1	-1	5	-1	1	-1	-1
Change in OCI	1	-1	0	0	1	-1	-1

Notes: 1: positive sign constraint, -1: negative sign constraint, 0: no constraint, 5: forced exclusion.

Rationale behind sign restrictions

Real GDP growth and unemployment rates: lower growth (higher unemployment) increases loan loss rates and compresses other income (such as fees and commission income).

Short-term interest rates: The reason for not imposing sign restrictions on level (short-term) interest rates is because interest rates have an ambiguous effect on the P&L. For example, for NFCI, and dOCI, the effect of interest rate changes depends on the structure of banks' trading portfolios, the extent to which they are hedged, etc. The empirical estimates indeed suggest different signs of the LRMs on short-term rates in the NTI, NFCI, and dOCI models.

Term spread: Terms spreads are high at the outset of an expansionary period and they slowly decrease throughout the boom to reach a local trough ahead of an ensuing recession. This strong empirical regularity is reflected by imposing a positive sign constraint in the model for loan loss rates (term spreads down during booms, realized loan loss rates down too). For NIMs, the sign on the term spread coefficient is expected to be positive, as the widening of term spreads after the onset of a recession reflects the fact that banks' funding costs (incl. deposit rates) drop due to an expansionary central bank policy response, while loan interest rates may decrease more slowly, depending on how strong is a fall in credit demand. In the model, imposing a sign restriction was not necessary as the estimated LRMs on terms spreads in the NIM models had a positive sign in all specifications across countries.

Stock price growth and corporate bond spreads: The rationale for the imposed constraints is broadly in line with that for real GDP and unemployment.

VIX: A strong increase in VIX is associated with disruptions in financial markets and economic recessions, suggesting the positive sign on loan loss rates. Effects on fees and commissions are ambiguous because more volatile markets (irrespective of the direction of a move) can mean more underwriting business and related income for banks. There is no direct channel (albeit perhaps indirect) from the VIX to NIMs.

C. Decomposing Net Loan Loss Rates into Default Rate and Loss Given Default

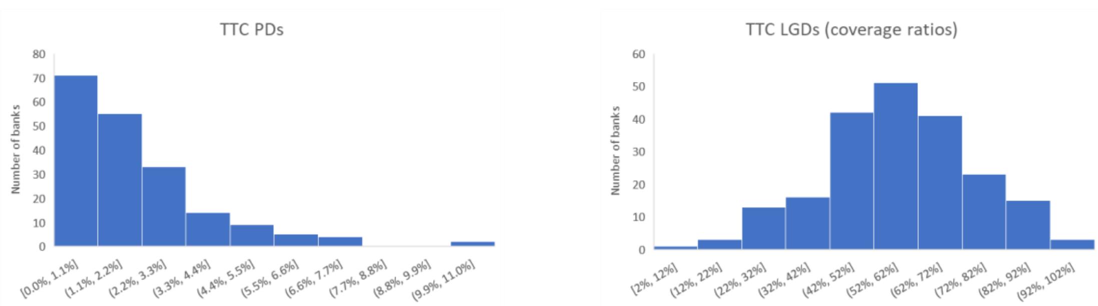
21. Net loan loss rates were decomposed into expected default rates and loss given default. The decomposition was required to compute the projected performing exposure stocks and the related ratios (Online Annex Table 4.1.2) and to derive NII and compute other P&L and balance sheet items. The principle underlying the methodology from Frey and Jacobs (2012) has been used to do the decomposition.

22. *Step 1:* Compute a bank-specific LGD risk index, denoted k:

$$k_i = \frac{\Phi^{-1}[PD_i^{TTC}] - \Phi^{-1}[PD_i^{TTC} \times LGD_i^{TTC}]}{\sqrt{1-\rho}}$$

23. The through-the-cycle (TTC) LGD (LGD_i^{TTC}) was proxied for each bank i by its historical long-term average coverage ratio (defined as accounting provision stocks over NPL stocks). The long-term average net loss rates (NLR) were divided by that TTC LGD proxy to obtain the TTC PD proxy (PD_i^{TTC} in the equation). The asset correlation was set to 10 percent. Online Annex Figure 4.1.1 shows the distribution of the resulting TTC PD and LGDs for all banks. The LGD index k is assumed to be constant over the scenario horizon.

Online Annex Figure 4.1.1. TTC PD and LGD Proxies for All Banks
(Locational data, 261 entities)



24. *Step 2:* Imply a point-in-time (PiT) PD using k and the PiT NLR projections. The PiT PDs in period horizon h for bank i is given by:

$$PD_{ih}^{PiT} = \Phi\left[\Phi^{-1}\left[NLR_{ih}^{PiT}\right] + k_i\right]$$

25. *Step 3:* Imply the PiT LGDs.

$$LGD_{ih}^{PiT} = {NLR_{ih}^{PiT}}/{PD_{ih}^{PiT}}$$

D. Analysis on Corporate and Consumer Loan Loss Provisions

26. This section explains the technical details regarding data and specifications employed in the satellite analysis regarding the bank provisioning in Box 4.1.1. The objective of this analysis is to disentangle the impact of changes in risk of corporate versus household borrowers in terms of banks' aggregate loan loss provision dynamics.

27. Data are based on the quarterly consolidated bank financials in 15 advanced economies and 9 emerging economies (Online Annex Table 4.1.4). The sample period spans from 2005Q1 to 2020:Q1 with 910 banks included. The data sources are similar to those for the broader GST methodology, and include in addition SNL and data on LGD from EBA.

Online Annex Table 4.1.4. Quarterly Global Bank Panel Data Universe

Universe	Sample Universe
Data Period	2005:Q1 – 2020:Q1 Quarterly
Data Source	SNL, EBA, and Bloomberg
Country Coverage	
Advanced Economy (15)	AUT, BEL, CAN, DEU, DNK, ESP, FIN, GBR, ITA, KOR, NLD, NOR, SGP, SWE, USA
Emerging Economy (9)	CHN, IDN, IND, MEX, MYS, POL, RUS, THA, TUR
Industry Category	Bank (commercial, development, investment), saving banks, bank holding company
Consolidation	Consolidated basis

28. This satellite analysis is intended to complement the global stress testing exercise to account for decomposing the aggregate loan loss impact into that stemming from the corporate and household sector-related risks. The following local projection method (Jordà 2005) was employed to that end:

$$LLP_{i,c,t+h} - LLP_{i,c,t-1} = \alpha_i + \alpha_t + \beta_h \cdot CorpExposure_{i,t-1} \cdot \Delta CorpEL_{c,t} + \gamma_h \cdot ConsExposure_{i,t-1} \cdot \Delta ConsEL_{c,t} + controls + \epsilon_{i,c,t} \quad (1)$$

where i refers the index of bank, c refers the country, α_i is the bank fixed effect, α_t is time fixed effect, LLP is the loan loss provision per average loans, $CorpExposure$ is the share of the exposure to the corporate loans such as C&I loans, $ConsExposure$ is the share of the exposure to the household loans such as unsecured consumer loans and mortgages, $\Delta CorpEL$ and $\Delta ConsEL$ are the change in expected losses based on the riskiness of corporate loans and consumer loans as described in below. The set of controls includes 3 lags of the dependent variable, changes in riskiness, and a set of bank-level characteristics (NIM, cost-to-income ratio, corporate exposure, log assets, and log loans).

29. The changes of riskiness of corporate loans ($\Delta CorpEL$) and consumer loans ($\Delta ConsEL$) are given as follows:

$$\Delta CorpEL_{c,t} = LGD_{c,corporate} \cdot \left(PDcorporate_{c,t} - PDcorporate_{c,t-1}\right) \; (2)$$

$$\Delta ConsEL_{c,t} = LGD_{c,consumer} \cdot \left(PDconsumer_{c,t} - PDconsumer_{c,t-1}\right) \; (3)$$

where $PDcorporate_{c,t}$ is the country average of the probability of default (PD) proxied by one year expected default frequency of nonfinancial private firms obtained from Moody's KMV; $LGD_{c,corporate}$ and $LGD_{c,consumer}$ are the LGD for corporate and retail sector obtained from EBA (countries outside the EBA dataset are assumed to have average LGD); $PDconsumer_{c,t} = \rho \cdot Z_{c,t-1}$ where $Z_{c,t}$ is the harmonized unemployment rate obtained from OECD, and ρ is a coefficient estimated by regressing the PD of default for retail loans from EBA on the unemployment rate.[4]

30. The equations were estimated using OLS. In order to give to each country a weight equal to the size of its economy, each observation is weighted by the GDP of the country divided by the number of observations relative to the same country.

31. A decomposition of provisions can be performed based on the right-hand side of equation (1), which can be split into two components: a corporate risk-related component (fourth term of right-hand side of (1) $= \beta_h \cdot CorpExposure_{i,t-1} \cdot \Delta CorpEL_{c,t}$) and a household risk-related component (fifth term on the right-hand side of (1) $= \gamma_h \cdot ConsExposure_{i,t-1} \cdot \Delta ConsEL_{c,t}$).

32. Therefore, given a change in corporate and consumer riskiness, the share of changes in provisions due to corporate provisions in each quarter is equal to

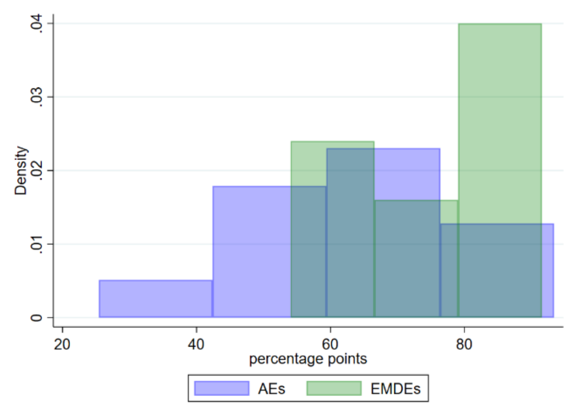
$$ShareCorp_{c,h} = \frac{\beta_h \cdot CorpExposure_{i,t-1} \cdot \Delta CorpEL_{c,t}}{\beta_h \cdot CorpExposure_{i,t-1} \cdot \Delta CorpEL_{c,t} + \gamma_h \cdot ConsExposure_{i,t-1} \cdot \Delta ConsEL_{c,t}}$$

33. Online Annex Figure 4.1.2. illustrates, for the economies in the main GST sample, the share of the increase in LLP (in 2020) coming from the increase in corporate risk due to COVID-19. In fact, it possible to use the satellite model to predict these shares also for countries outside the estimating sample, as long as data on corporate exposure and PDs are available.

[4] The coefficient ρ is used to normalize the unemployment rate, so that a change in unemployment has the size of a change in PDs. The PDs from EBA are not included directly in the main estimating equation as data are available only for a relatively short time period.

Online Annex Figure 4.1.2. Share of the Increase in LLP coming from Corporate Risk

(country-level distribution)



E. Quantification of the Impact of Government Guarantees

34. A simple methodology is used to quantify the potential impact of Government guarantees on bank provisioning. A detailed assessment of each country's policy, together with the related implementation challenges, is beyond the scope of this exercise; such an endeavor might also require confidential data on the composition of bank lending portfolios. It is therefore preferred to rely on the following simplifying assumptions

a. guarantees have full uptake and are kept in place for the whole analysis period: while the initial uptake has been low in some jurisdictions, it is difficult to forecast the final uptake.

b. guarantees covers only credit to non-financial corporations: these policies have been mainly implemented to protect NFC, however some of these programs may also offer some coverage to households.

c. all banks in a country are all equally covered by the guarantees: this assumption may be problematic if guarantees are directed to support a specific set of firms (e.g., SME, touristic sector) and some banks lend disproportionally more to such firms. However, data availability constraint the analysis in this respect.

d. guarantees do not impact the probability of a borrower defaulting: guarantees could, instead, impact default if they decrease banks' incentives to properly monitor borrowers or improve economic conditions by protecting bank solvency and financial stability.

35. Given this set of assumptions, guarantees are represented as policies that decrease the LGD of corporate loans proportionally to the size of the program and on the size of the corporate lending of each bank. As an example, if a country's guarantees scheme is equal to 5 percent of the domestic credit to non-financial corporations, then it is inferred that 5 percent of the losses on corporate will be absorbed by the Government. In this example, the LGD for corporate lending decreases by 5 percentage points. Consequently, the loan loss provisions, normalized by the average loans, for a bank i, in country c are calculated as follows

$$LLP_{i,c} = (1 - ShareCorp_i) * LLP_{household} + ShareCorp_i * \left(LGD_{c,corporate} - g_c\right) ** PD_{i,c}$$

Where g_c is the ratio of the size of the guarantees program to the credit to NFC, $ShareCorp_i$ is the share of provisioning coming from corporate risk (in absence of guarantees), and $LGD_{c,corporate}$ is the loss given default on corporate loans estimated, at the country level, from EBA.[5]

36. The GST's loan loss provision model (see Sections A, B, and C) provides the total provisioning for each bank, while the additional satellite analysis provides the decomposition in terms of household versus corporate sector. These inputs allow for the computation of provisioning with Government guarantees.

[5] If $LGD_{c,corporate} < g_c$, then it is assumed $LLP_{i,c} = (1 - ShareCorp_i) * LLP_{i,household}$

F. Mitigation Policies: Taxonomy and Impact on Banks

37. This section briefly describes the analyses used to estimate the impact of mitigation policies on banks' solvency over the stress test period, 2020 to 2022. It covers the information sources used, a policy taxonomy from the perspective of financial impact on banks, decisions regarding which classes of policies are included in the scope of analysis, and a general discussion of approaches employed to estimate each policy's financial impact on banks.

Data sources

38. Since the start of the COVID-19 pandemic, several organizations have created databases to track national and multilateral economic and financial policies intended to mitigate its impact. The scope of these databases varies widely, and this Chapter relies on those focused on macroeconomic and financial sector policies. The databases include:

Online Annex Table 4.1.5. Main Source Databases

Organization	Scope / Focus	Geographic Focus	Number of Policies	URL
European Systemic Risk Board	Monetary, macroprudential, debt moratoria and fiscal measures, market rules	Europe	1,113	https://www.esrb.europa.eu/home/search/coronavirus/html/index.en.html
Financial Stability Board	Monetary and fiscal policy, borrower solvency, bank balance sheet and operations	Global	2,119	
IMF	Financial sector regulation and supervision	Global	353	
Keefe, Bruyette and Woods	Financial sector policies	US, Europe, Japan	118	
Yale School of Management	Monetary and fiscal policy, credit facilities and guarantees, liquidity facilities, macroprudential policy	Global	3,705	https://som.yale.edu/faculty-research-centers/centers-initiatives/program-on-financial-stability/COVID-19-tracker
IMF	Fiscal policies: Spending, borrower support, guarantees	Global	Country aggregates	
UBS	Fiscal stimulus measures	Global	Country aggregates	

39. As the table suggests, the first five of these databases present information on a policy-by-policy basis. Most of these databases identify, for each policy, the country or other geographic scope, body responsible, announcement date, policy description, classification according to the authors' taxonomy, and links to supporting documents. These five databases provide the raw information to estimate the impact of policies that 'directly' impact banks' capital position – a notion explained in the next section. The final two databases provide supplementary information to estimate the effects of policies that indirectly affect capital positions through loan-loss provisioning.

Taxonomy of Mitigation Policies

40. Virtually all economic policy responses to the COVID-19 shock, from the broadest monetary and fiscal policies to the most specific macroprudential measures, could in principle affect banks' financial performance and position. However, this Chapter's quantification of mitigating policies' impact includes a relatively narrow subset of policies. It excludes very broad policies that affect general macroeconomic and systemic financial conditions, such as economic growth, employment, and the monetary and interest rate environment. These effects are, in principle and probably in practice, more appropriately captured through the macroeconomic scenarios that determine banks' overall financial performance.

41. The quantification exercise also excludes a class of policies that support bank solvency indirectly by lowering bank provisions. These come in three broad categories. The first is policies that borrowers' probability of default—for example, tax breaks, new loans, repayment holidays and other forms of support for corporates and households. These are to some extent captured through the macro scenarios' impact on probability of default, and as a practical matter are difficult to quantify analytically because the ex-post size of any support program is not specified in advance. The second, corporate guarantees, are not captured from individual policy pronouncements, but as a by-product of the aggregate guarantees estimates provided by the IMF's Fiscal Affairs Department. and reduce borrowers' probability of default—repayment holidays, policies' impact on bank performance must be specific and quantifiable—a criterion that excludes very broad fiscal stimulus measures (for example, jobs or public works programs).

42. A second broad category of policies affect banks' recognition and provisioning for loan losses. Some supervisors explicitly allow banks to defer recognition of or provisioning in cases where the borrower is deemed to have deteriorated as a consequence of the COVID-19 shock but is otherwise financially sustainable. In some cases, too, regulators allow banks to dampen the pro-cyclical effects of policies, like IFRS 9 or 'current expected credit loss' recognition, regarded as potentially pro-cyclical. The rationale for excluding these policies from explicit quantification is similar – they are in principle captured through the macroeconomic scenario, and in any case are exceptionally difficult to quantify ex ante.

43. Finally, this analysis excludes a broad range of other announced policies with no analytically discernable effect on banks' solvency positions (business continuity, measures to ease operational burdens, bans on short selling, and many others) or which operate mainly to support bank funding liquidity (either foreign or domestic currency).

44. This quantification exercise focuses on a class of policies that operate directly on bank capital—either reported capital positions or the gap between their current positions and effective minimum capital requirements. There policies operate in three ways: by lowering the denominator of a capital ratio (either risk-weighted assets or the 'leverage exposure' denominator of the leverage ratio; by reducing capital deductions (often through mandatory suspension of dividends or buybacks); or by eliminating or softening the requirement for specified layers of capital buffer (typically the countercyclical capital buffer, capital conservation buffer, or systemic risk buffer) (Online Annex Figure 4.1.3).

Online Annex Figure 4.1.3. Taxonomy of Policies that Directly Affect Bank Financial Position

Policy Class	***Policy Type***	***Model Treatment***
Capital Adequacy: *Explicitly Quantified*	• Lower measured RWA / leverage exposure	• Reduces ratio denominator; raises ratio
	• Lower capital deductions	• Raises forecast capital numerator
	• Lowers solvency threshold	• Lower required buffers
Borrower Support: *Embedded or Included Ex-Post*	• New loan programs • Repayment relief	• Mitigation effect is assumed embedded in stress test model probability of default
	• Loan guarantees	• Country total guarantees applied as ex-post reduction of LGDs
Loss Recognition: *Embedded in Stress Test Provisions*	• IFRS/CECL relaxation • Recognition deferrals	• Implicitly embedded in stress test provision model

45. With this taxonomy in place, the policies in the databases listed earlier were each reviewed and either excluded from consideration (the vast majority of measures) or classified according to their effect on bank capital. This exercise was conducted for the 29 countries considered in this chapter. In addition, pan-European policies under the auspices of the European Central Bank, the European Banking Authority (EBA), or other policy bodies were considered separately and, where appropriate, applied only to the capital positions of banks overseen by the Single Supervisory Mechanism and EBA supervisory exercises.

Quantification of Mitigation Effects

46. Each policy that affects bank capital position does so through one of five financial accounts: two measures of capital (CET1 and Tier 1), two balance sheet size measures (risk-weighted assets and leverage exposure) that serve as denominators of capital ratios, and one measure of change in minimum capital requirement (CET1 buffers).

47. Each policy's impact is in principle estimated based on its unique structure. In practice, a few common policies, which account for the bulk of total policy impact on bank capital across all jurisdictions, are calculated on the basis of a few common patterns. Examples include:

a. All capital buffers are expressed relative to risk-weighted assets, so elimination or reduction of these buffers is likewise estimated with reference to future risk-weighted assets. (Note that risk-weighted assets are typically constant or nearly constant over the forecast period.)

b. The impact of cancellation of dividends is treated simply on the basis of forecast dividends on common equity in the stress test model. Dividend cancellation policies in all instances are applied over a specific time frame (usually 2020). The model conforms to this description and assumes resumption thereafter of dividends forecast in the stress test model.

c. The impact of policies cancelling share buybacks is modelled assuming that buybacks in 2020 would have remained constant with levels reported for 2019. The effect of buybacks is also limited to the policy's stated time horizon.

d. In a few jurisdictions, banks' deposits with the central bank and holdings of domestic government bonds have been excluded from leverage exposures for the purposes of calculating regulatory leverage ratios. The effects of this exclusion are straightforward.

48. More unique policies are modelled to mimic their stated terms, to the extent possible given disclosed data. The following few examples, neither exhaustive nor fully representative, are presented for illustrative purposes:

a. U.S. regulators announced, for newly overdue mortgages, a suspension of the increase in risk-asset weighting that normally accompanies deterioration of the credit. In this case, we note that system-wide overdue mortgages increased from about 3.0 percent before the COVID-19 episode, to about 7.9 percent by the end of May. The estimation approach assumes, for simplicity, that the risk-weighting rises from 20 percent to 80 percent on credit downgrade. This change in risk-asset weighting is applied to each bank's reported on-balance sheet mortgages outstanding.

b. Loans granted under the U.S. Payroll Protection Program have been excluded from risk-weighted assets and leverage exposures for the purpose of measuring capital ratios. Each US bank's quantity of PPP loans outstanding is unknown. However, the size of the total program has been reported as $659 billion. The model assumes that banks included in the stress test (over 80 percent of US bank assets) account for all of the PPP loans. Further, it assumes that the RWA density on PPP loans is the same as each bank's overall credit RWA density (credit RWA as a percent of total loans).

49. These estimates of policy impact on individual balance sheet metrics are then converted into pro-forma effects on bank capital ratios. These bank-specific effects drive the bank-specific capital mitigation effects that determine bottom-up analyses of post-mitigation capital position, capital requirements, and solvency. These bank-specific results are then simply aggregated to country, regional and global estimates.

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