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COVID-19: How Will European Banks Fare?

Shekhar Aiyar, Mai Chi Dao, Andreas A. Jobst, Aiko Mineshima, and Srobona Mitra, with guidance from Mahmood Pradhan

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Glossary

AMC	asset management company
CAR	capital adequacy ratio
CCB	capital conservation buffer
CCyB	countercyclical (capital) buffer
CET1	common equity Tier 1
CRE	commerical real estate
EBA	European Banking Authority
ECB	European Central Bank
ESM	European Stability Mechanism
ESMA	European Securities and Markets Authority
EU	European Union
FSAP	Financial Sector Assessment Program
GFC	Global Financial Crisis
GFSR	*Global Financial Stability Report*
IFRS	International Financial Reporting Standards
IRB	internal ratings-based approach

LGD	loss-given-default
LLP	loan loss provisions
NII	net interest income
NPL	nonperforming loan
MCR	minimum capital requirement
MDA	maximum distributable amount
MREL	minimum required eligible liabilities
PD	probability of default
PIT	point-in-time
REO	*Regional Economic Outlook*
ROA	return on asset
ROE	return on equity
RW	risk weight
RWA	risk-weighted assets
SME	small and medium enterprise
SREP	Supervisory Review and Evaluation Process
SRB	Single Resolution Board
SRF	Single Resolution Fund
SSM	Single Supervisory Mechanism
TTC	through-the-cycle
UTP	unlikeliness-to-pay
WEO	*World Economic Outlook*

Executive Summary

The COVID-19 pandemic is exacting a severe social and economic toll on Europe. While European banks have substantially raised their capital buffers over the years, many suffer from chronically low profitability due to inefficient cost structures, compressed net interest margins, and the drag of legacy assets from the Global Financial Crisis (GFC) and the European sovereign debt crisis. They now stand heavily exposed to economic sectors that have been hard hit by the pandemic.

This paper evaluates the impact of the crisis on European banks' capital under a range of macroeconomic scenarios, using granular data on the size and riskiness of sectoral exposures. The analysis incorporates the important role of pandemic-related policy support, including not only regulatory relief for banks, but also policies to support businesses and households, which act to shield the financial sector from the real economic shock. Compared to previous studies conducted by the European Central Bank (ECB) and European Banking Authority (EBA) in 2020, the analysis covers a wider range of policies and a broader set of banks—including smaller banks—within the euro area, while extending the sample to cover most European countries outside the euro area.

The baseline results suggest that despite a significant fall in capital ratios, banks remain broadly resilient to the shock. While there is no aggregate capital shortfall relative to the minimum prudential requirement, a number of the larger euro area banks may struggle to meet their threshold for the maximum distributable amount (MDA), which could create funding pressures, especially with respect to hybrid capital. The data reveal considerable cross-country variation, with the change in bank capital being sensitive both to the size of the macroeconomic shock and the initial condition of bank balance sheets and profitability. Policy is extremely important in reducing both the extent and variability of capital erosion; in particular, good poli-

cies can substantially weaken the link between the macroeconomic shock and bank capital.

In an adverse scenario with a slower recovery in 2021, the erosion of bank capital would become more pronounced, especially if a premature phase-out of support measures increases default risk. The number of banks potentially breaching their MDA threshold would double, greatly increasing the risk of higher capital costs and funding difficulties.

Based on these results, the paper recommends a multi-pronged policy strategy:

- *Keep in place borrower support measures, such as debt repayment relief or "moratoria", credit guarantees, and direct support for firms, until the recovery is firmly established.* As the recovery gains momentum, eligibility criteria should be tightened to better target illiquid but viable firms and the most vulnerable households while preventing loan misclassification, credit misallocation and the rise of "zombie" firms.
- *Clarify supervisory guidance on the availability and duration of capital relief and conservation measures.* Banks should be allowed to build back capital buffers gradually, so new lending does not need to be cut back. Restrictions on dividend payouts and share buybacks, should be maintained until the recovery is well underway.
- *Support balance sheet repair by strengthening non-performing loan (NPL) management and the bank resolution framework.* As policy measures such as insolvency moratoria expire, a wave of bankruptcies and loan defaults are likely to follow. The EU authorities should use the current system-wide stress test, expected to be completed in July 2021, to assess the need for precautionary recapitalizations. Insolvency regimes should be strengthened, focusing particularly on fast-track procedures to restructure debt.
- *Address structurally low bank profitability.* Rising impairments and provisions will exacerbate the pre-existing challenge of very low rates of return on assets, limiting the ability of banks to restore capital buffers organically. Banks should therefore enhance non-interest revenues and improve their cost structures. Although many banks have appropriately started investing in digital technologies to streamline operations, this is likely to increase expenses over the short term. Further domestic and cross-border consolidation could improve banks' efficiency, while also faciliating a better allocation of capital and liquidity within banking groups.

CHAPTER

1 Introduction

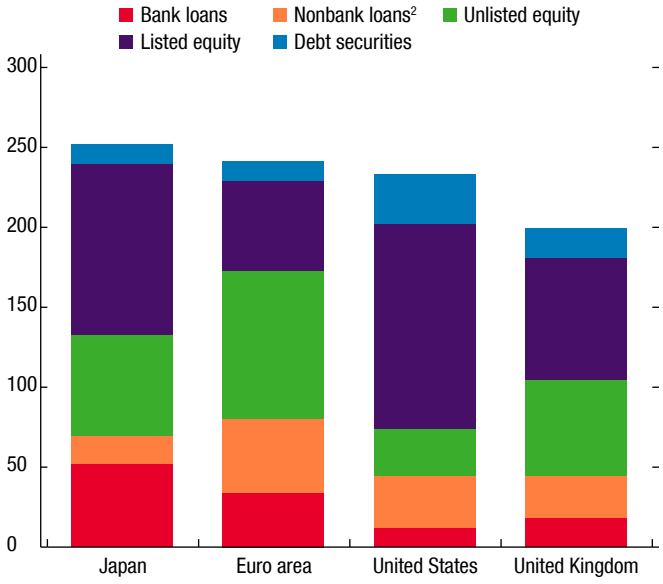
The combined health and economic crises triggered by the COVID-19 pandemic and related adverse confidence effects pose a potential threat to financial stability. Euro area real GDP declined sharply last year, and the recovery is likely to be protracted. Uncertainty remains elevated, with risks to growth tilted to the downside in the face of new waves of infections and vaccine-rollout delays. A prolonged health crisis and slower recovery could depress demand and further weaken private and public sector balance sheets, with adverse effects on the banking sector.

Banks are likely to face rising capital and liquidity pressures due to shrinking profits and deteriorating asset quality. The crisis has intensified profitability challenges. Before the pandemic, most banks' business models were already under pressure because of compressed net interest margins and inefficient cost structures amid legacy assets from the last crisis. The pandemic has amplified these pre-existing conditions as banks are likely to: raise provisions for higher loan losses due to lower average borrower quality; write off a rising share of NPLs to insolvent borrowers with diminishing prospects for collateral recovery; and face lower income from non-lending activities.

Balance sheet pressures in turn could hinder banks' ability to support credit growth for the recovery. With capital markets continuing to function smoothly, helped by central bank support, the challenge will likely be concentrated in companies that lack access to capital markets. European non-financial firms exhibit greater dependence on loans than companies in other advanced economies (Figure 1), so any constraints to bank credit supply would create correspondingly larger challenges for the economic recovery.

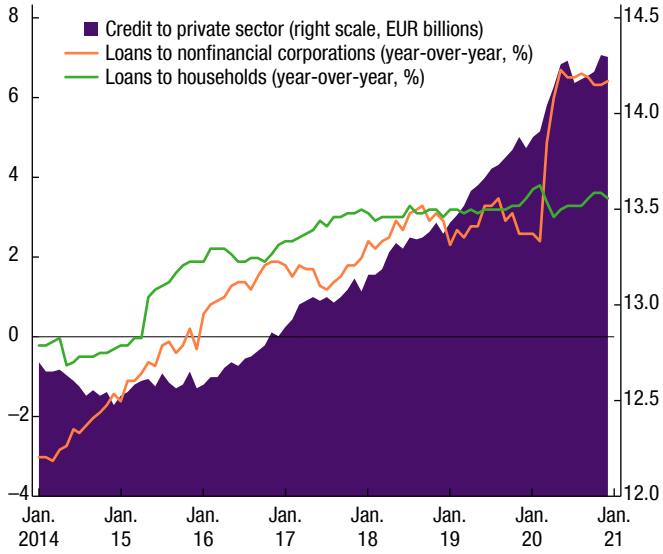
Various national and European-level policy measures adopted in 2020 have helped cushion the adverse economic impact of the crisis. In response to the first wave of COVID-19 infections during the spring of 2020, several

Figure 1. Liabilities of Nonfinancial Corporations, 2019[1]
(Percent of GDP)



Sources: Haver Analytics; and IMF staff calculations.
[1]Liabilities exclude "other equity," "insurance and pension reserves," "financial derivatives and employee stock options," and "other accounts payable."
[2]Include loans from other nonbank financials and other nonfinancial companies.

Figure 2. Stock of Lending to Nonfinancial Corporations and Households
(Percent, year-over-year; EUR billion)



Source: European Central Bank.

European governments introduced a range of exceptional mitigation measures to alleviate the liquidity stresses of firms and households, while the ECB-Banking Supervision and EBA announced capital relief and conservation measures (supplemented by the reduction of macroprudential capital buffers by competent national authorities). Thanks to these measures, to date, the impact on bank capital has been relatively limited. As a result, corporate credit growth increased substantially during the initial phase of the pandemic, especially to highly affected sectors with higher liquidity needs (Figure 2). The net issuance of debt also increased against the backdrop of favorable financing conditions. While some relief measures have been extended in response to surging infections towards the end of 2020, some of them could be phased out this year.

This paper aims to quantify the impact of both the pandemic and policy support on bank capital. We investigate the implications of our baseline and adverse GDP growth and unemployment paths—as published in the IMF's January 2021 *World Economic Outlook* (WEO) *Update*—on bank capital at the end of 2021. To better understand the role of policy, we also attempt to assess a counterfactual: what would have been the bank capital level without

support measures, such as repayment moratoria, loan guarantees, insolvency moratoria, as well as borrower measures?

The paper builds on previous analyses by the European authorities with a wider sample. Both the EBA (2020e) and the ECB (2020a) have already completed preliminary vulnerability analyses. We widen the analysis beyond larger banks to reach a coverage of at least 80 percent of domestic banking sector assets in the euro area, and also include banks in some non-euro area European countries that are not covered by the EBA sample.[1]

The analysis incorporates sector-specific shocks to the real economy and a more comprehensive range of country-specific borrower support measures. Different sectors of the economy have been differentially affected by the pandemic. Aside from assessing the general effect of the COVID-19 shock on banks' credit exposures to households and firms, we also incorporate granular data on bank-specific corporate exposures and map them to the projected loss rate for each sector in each country. At the same time, the paper assesses how banks are directly affected by borrower support measures, including debt moratoria, credit guarantees and deferred bankruptcy proceedings, complementing public information with IMF desk surveys.

Although the impact of the crisis on banks has been limited so far, our analysis suggests that capital pressures will rise during the protracted recovery. Banks have been able to slowly absorb rising impairments without a significant change in their capital ratios given continued borrower-support and effective capital conservation measures.[2] However, vulnerabilities might emerge as policy support measures expire, resulting in a rise of impairments and a surge of bankruptcies due to the declining debt service capacity of nonfinancial corporations and households. A more sluggish recovery than projected in the baseline could lead to potentially larger bank credit losses, especially if a premature phaseout of supportive policy measures creates "cliff effects" and amplifies deleveraging pressures on weaker banks and those most exposed to vulnerable sectors. Indeed, as the EBA's *Risk Assessment Report*

[1]The IMF October 2020 *Global Financial Stability Report* (GFSR) includes a broad stress testing exercise of the largest banks globally, which also covers some European banks. Despite a similar top-down stress-testing approach, the GFSR and this paper differ along many dimensions that affect the results. For example, the GFSR uses macroeconomic projections from the October 2020 WEO, whereas this paper uses the January 2021 WEO, by which time growth projections had generally been revised upwards. While the GFSR explicitly accounts for loan guarantee programs and capital relief only, this paper accounts for a broader set of policy measures. Moreover, while the GFSR assumes a static bank balance sheet, this paper uses a two-period model in which bank balance sheets evolve dynamically, with new lending conditioned on the capital position of the previous period.

[2]In fact, the aggregate CET1 capital ratio of euro area banks that are directly supervised by the ECB increased by almost 30 basis points from end-2019 to end-September 2020.

(2020) has recently warned, traces of asset quality deterioration have already emerged despite support measures.

The paper is structured as follows. We discuss the financial soundness of European banks before the COVID-19 pandemic in Chapter 2. Chapter 3 provides stylized facts on European banks' vulnerability to the pandemic-related shock. Chapter 4 summarizes key policy measures that have a direct or indirect impact on banks. Chapter 5 describes the analytical framework of our exercise, followed by results in Chapter 6. Chapter 7 extends the analysis to a wider set of European banks, and Chapter 8 concludes with policy implications.

CHAPTER

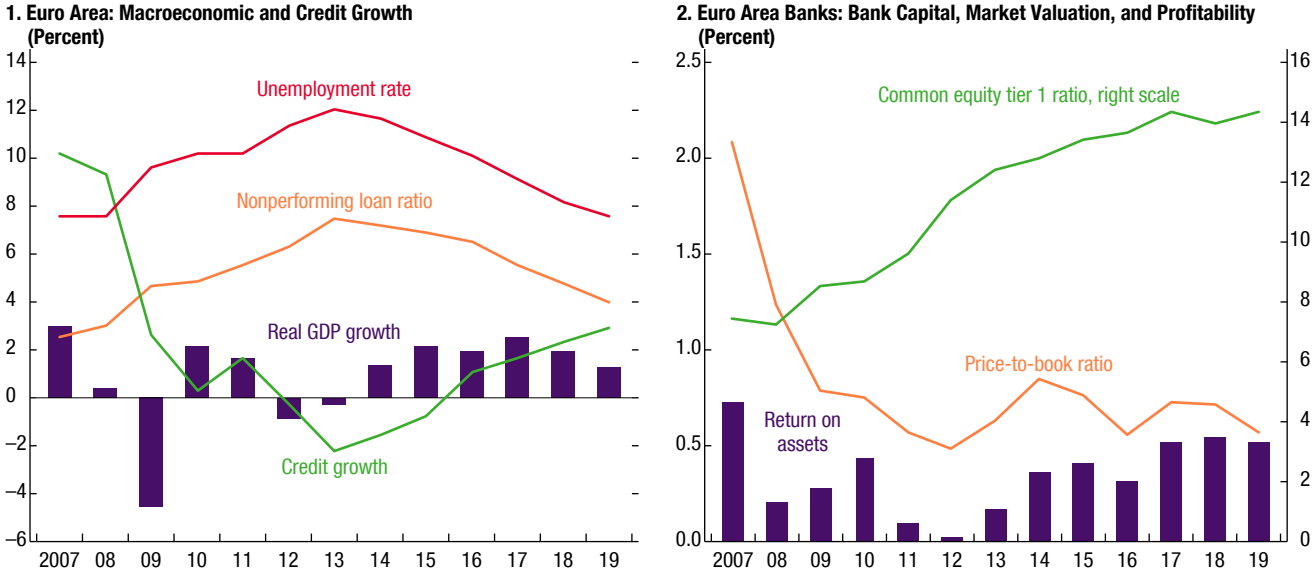
2 Pre-Pandemic Bank Health

European banks entered the COVID-19 pandemic with higher capital compared to 2007—the eve of the global financial crisis (GFC). Banks held nearly 15 percent of Common Equity Tier 1 (CET1) capital in percent of risk-weighted assets (RWA) (Table 1 and Figure 3, panel 2) in 2019 (EC/ECB/SRB 2020).[1] The ratio nearly doubled from about 7 percent in 2007 and was well above the prudential minimum of 4.5 percent (plus the bank-specific Pillar 2 requirement). Likewise, the non-risk weighted leverage ratio (that is, Tier 1 capital in percent of total assets) has also doubled since 2007 and stood at around 6 percent on average, about twice the minimum threshold of 3 percent that will be binding from June 2021. After peaking at 7½ percent of gross loans after the GFC in 2013, NPLs have continuously declined to about 3 percent of gross loans (Aiyar and others 2015), supported by lower unemployment, higher GDP growth, and efforts by banks along with enhanced supervision (Figure 3, panel 1).

Despite higher capital buffers, European banks have been suffering from chronic low profitability. The return on assets (ROA) of many European banks has declined since the GFC (Table 1 and Figure 3, right panel), with euro-area banks' ROA below those in other advanced economies in 2019 (Figure 4, panel 1). Even before the pandemic, analysts did not expect ROA and return on equity (ROE) to rise above levels that investors would find attractive. The limited ability of European banks to build up CET1 capital from retained earnings has been driving down price-to-book ratios of bank equities, especially in the euro area where a quarter of banking system assets were trading with price-to-book ratios below 0.4 in 2019, a share that has increased further in 2020 (Figure 4, panel 2).

[1]CET1 capital is the highest quality of regulatory capital, as it absorbs losses immediately when they occur (FSI 2019).

Figure 3. Euro Area—Macroeconomic Conditions and Bank Health



Sources: FitchConnect; Haver Analytics; and IMF staff estimates.
Note: Euro area SSM-bank sample; asset-weighted ratios of bank indicators. SSM = Single Supervisory Mechanism.

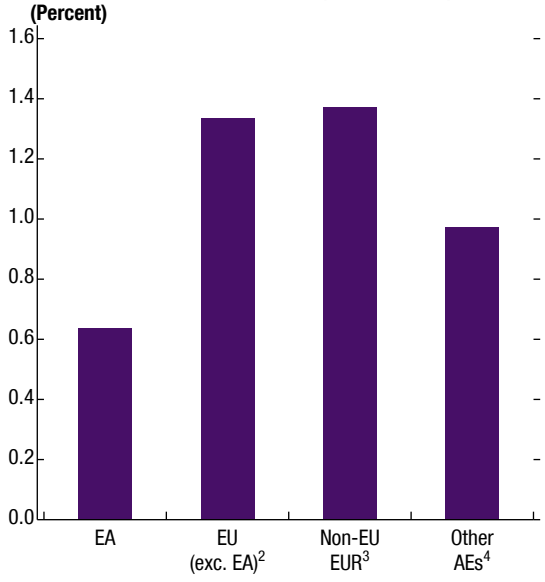
Table 1. European Banks: Selected Financial Soundness Indicators
(Percent, asset-weighted mean)

Country Groups	ROE	ROA	Equity/ Assets	Tier1	CET1	NPL Ratio
EU (EBA sample)						
2007	19.0	0.8	4.0	7.8	6.7	2.2
2019	9.3	0.6	6.0	16.7	14.7	3.4
EU (non EBA)						
2007	9.2	0.5	4.9	9.0	7.5	2.2
2019	8.7	0.6	8.4	16.3	15.6	3.3
EA (SSM sample)						
2007	17.0	0.7	4.3	7.8	7.4	2.5
2019	8.4	0.5	6.1	15.4	14.4	3.9
EA (non SSM)						
2007	9.7	0.5	4.6	8.9	7.0	2.2
2019	8.6	0.6	7.7	16.4	15.3	3.5
CESEE						
2007	24.6	2.1	8.9	10.0		3.6
2019	17.1	1.8	10.8	15.9	14.4	7.6
Non-EU (including UK)						
2019	10.5	0.6	6.0	17.9	14.7	2.2

Sources: FitchConnect; and IMF staff estimates.
Note: The number of banks with available 2019 data in FitchConnect in each subsample are 107 (EBA), 593 (EU-non EBA), 66 (SSM), 501 (EA-non SSM), 291 (CESEE), and 443 (Non-EU). CESEE = Central, Eastern, and Southeastern European economies; CET1 = common equity Tier 1; EBA = European Banking Authority; EU = European Union; NPL = nonperforming loan; ROA = return on assets; ROE = return on equity; SSM = Single Supervisory Mechanism.

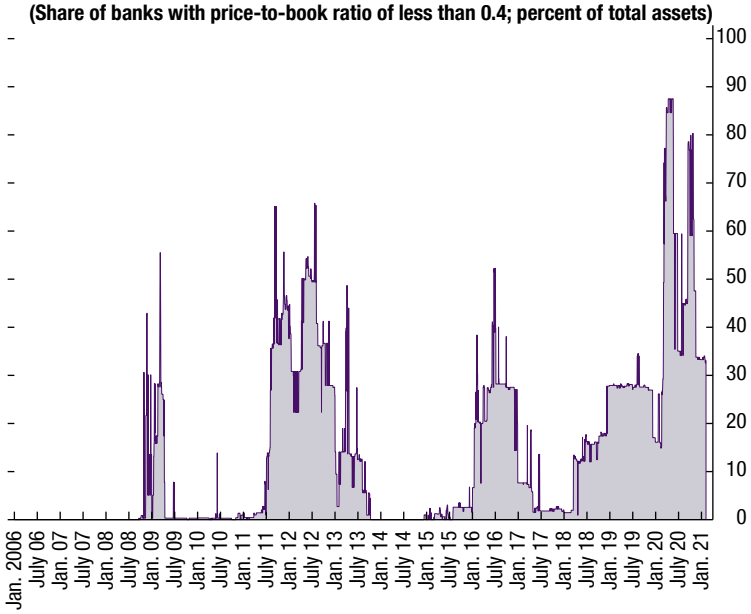
Figure 4. Bank Profitability and Price-to-Book Ratios

1. Euro Area Banks: Return on Asset (2019 or Latest)[1]
(Percent)



Sources: IMF, Financial Soundness Indicators database; and IMF staff calculations.
[1]The median value for reach region based on country-level data.
[2]Bulgaria, Croatia, Czech Republic, Hungary, Poland, Romania, Sweden.
[3]Denmark, Iceland, Norway, San Marino, Switzerland, United Kingdom.
[4]Australia, Canada, Hong Kong SAR, Singapore, United States. In the case of the latter, the comparative impact of the different netting treatment of derivatives under US GAAP (relative to IFRS).

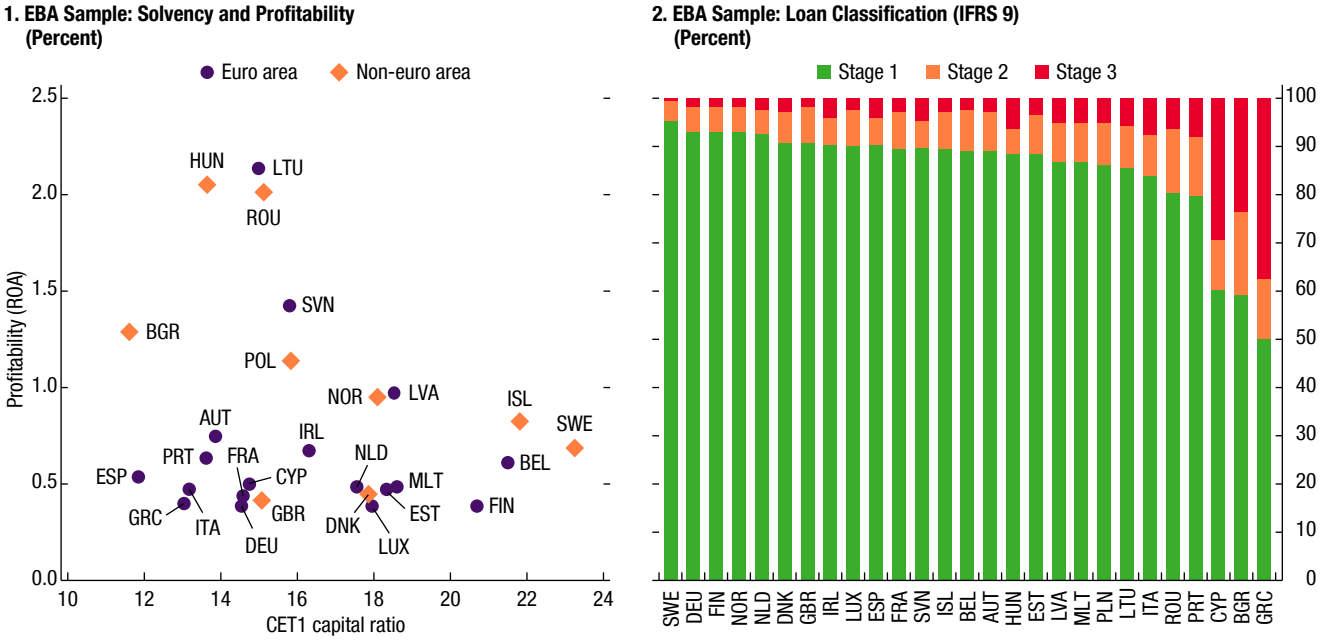
2. Euro Area Banks: Share of Banks with Low Market Valuation
(Share of banks with price-to-book ratio of less than 0.4; percent of total assets)



Sources: Bloomberg Finance, L.P.; and IMF staff estimates.

The health of the banking system in aggregate masks wide variation among countries. CET1 capital ratios and profitability (ROA) vary greatly among European countries (Figure 5, Panel 1). In general, euro area banks underperform their peers outside the bloc, especially in the largest economies. Banks also differ considerably in asset quality. Even though NPLs have significantly declined since the GFC, some more vulnerable euro area economies (for example, Cyprus and Greece) continue to carry a large stock of NPLs (shown as the share of Stage 3 loans in Figure 5, panel 2). In addition, in these countries, the high share of Stage 2 loans indicates that a significant amount of loans were on the cusp of becoming NPLs. While the transition of loans into Stage 2 prior to the pandemic was limited (ECB 2019, 2020d), the disproportionately high share of these loans covered by debt moratoria suggests latent asset quality pressures.

Figure 5. Cross-Country Variation of Profitability, Capitalization, and Loan Classification, 2019



Sources: European Banking Authority 2020 Transparency Exercise; and IMF staff calculations.
Note: CET1 = common equity Tier 1; EBA = European Banking Authority; ROA = return on assets. Data labels in the figure use International Organization for Standardization (ISO) country codes.

CHAPTER

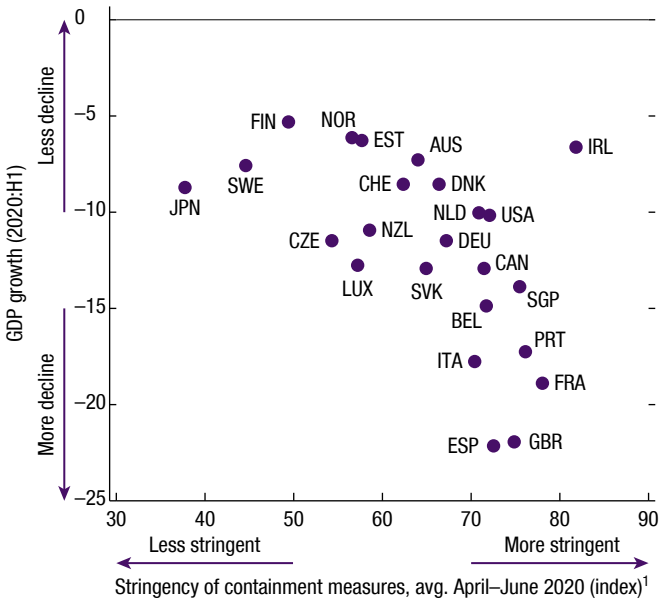
3 Banks' Vulnerability to the Pandemic

The pandemic forced governments to lock down contact-intensive businesses, with the stringency of containment measures varying among countries (Figure 6). Furthermore, the demand for services requiring personal contact plummeted. Firms in these sectors, especially those with pre-pandemic liquidity and solvency concerns, could face bankruptcy if they are unable to tide over their liquidity needs with new bank loans.

European banks are heavily exposed to economic sectors hit hard by the pandemic. More than 60 percent of banks' corporate exposures are to sectors that have been highly affected by the pandemic, especially accommodation and food services, real estate and retail trade, and to a lesser extent, construction and transportation. Bank lending to firms in these sectors is about 200 percent of Tier 1 capital on average and exceeds 250 percent in some countries, such as Finland, Germany, Greece, and Italy (Figure 7). Among the sub-sectors, there is substantial exposure to specific real estate activities, such as commercial real estate (CRE) businesses that faced the closure of shopping malls and offices. In addition, more than half of bank lending is to households, especially in the form of mortgages, which are increasingly affected by adverse income and employment prospects. These exposures are putting pressure on banks' profit and capital positions and will continue to do so as the crisis evolves.

Firms in Europe face an unprecedented synchronized shock to liquidity and solvency, although the decisive policy response of governments has effectively staved off the increase in insolvencies so far (EC 2021b). Chapter 3 of the IMF *Regional Economic Outlook* (REO) for Europe in October 2020 (IMF 2020c) uses detailed balance sheet and income statement data for millions of European companies to show that 30 to 40 percent of firms in advanced Europe and up to 50 percent in emerging Europe would face liquidity gaps in 2020 absent supportive policies, with such gaps being most

Figure 6. Stringency of Containment Measures and GDP Growth



Sources: IMF, World Economic Outlook database; Oxford Coronavirus Government Response Tracker (OxCGRT); and IMF staff calculations.
Note: Data labels use International Organization for Standardization (ISO) country codes.
[1]The index is based on eight policy indicators that aim to measure the strictness of "lockdown style" policies (for example, school closures and restrictions in movement). These indicators simply record the number and strictness of government policies and should not be interpreted as "scoring" the appropriateness or effectiveness of a country's response.

concentrated among small and medium enterprises (SMEs) whose access to external finance would be more curtailed.[1] The share of insolvent firms, that is, firms with negative net worth, could rise to 20 to 30 percent in the median advanced and emerging European economy, respectively.[2] However, policy support from European authorities is expected to play a vital mitigating role—as discussed in the next chapter—reducing the number of illiquid firms in Europe by about two-thirds, and, by design, reducing the number of insolvent firms by a lesser amount.[3]

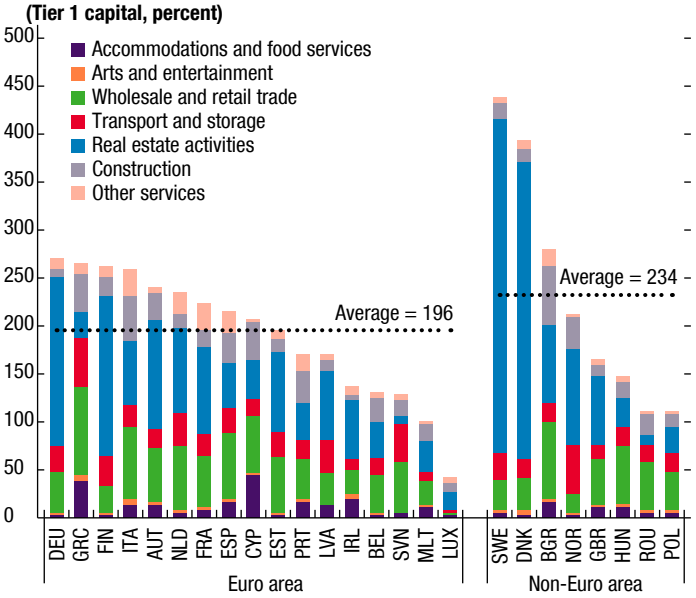
[1]Ebeke and others (2021) lay out the technical details for estimating the impact of the pandemic on corporate balance sheets, which varies significantly across countries. The analysis relies on the results from the top-down impact analysis published in the October 2020 REO for Europe to ensure tractability.

[2]A recent report by the OECD (2020) also finds that the share of insolvent firms is twice as high for young firms (less than 5 years) compared to the average.

[3]The REO finds that policies tend to reduce larger firms' liquidity and solvency gaps to a greater extent than SMEs' for a variety of reasons.

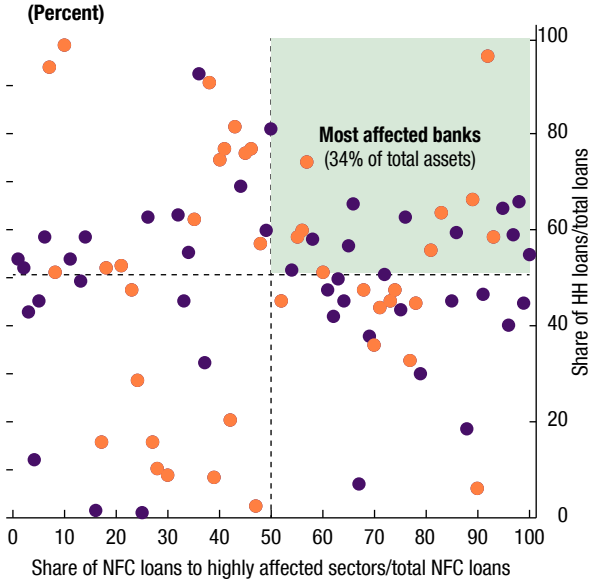
Figure 7. Large European Banks' Exposure to Highly Affected Sectors

1. EU+UK: Large Banks' Exposure to Highly Affected Sectors (Tier 1 capital, percent)



Sources: European Banking Authority 2020 Transparency Exercise; and IMF staff calculations.
Note: Data labels in the figure use International Organization for Standardization (ISO) country codes.

2. Euro Area: Large Banks' Exposure to HH and NFCs (Percent)



Sources: European Banking Authority 2020 Transparency Exercise; and IMF staff calculations.
Note: Orange dots are banks with leverage ratio < 6 percent.
HH = households; NFC = nonfinancial corporations.

CHAPTER

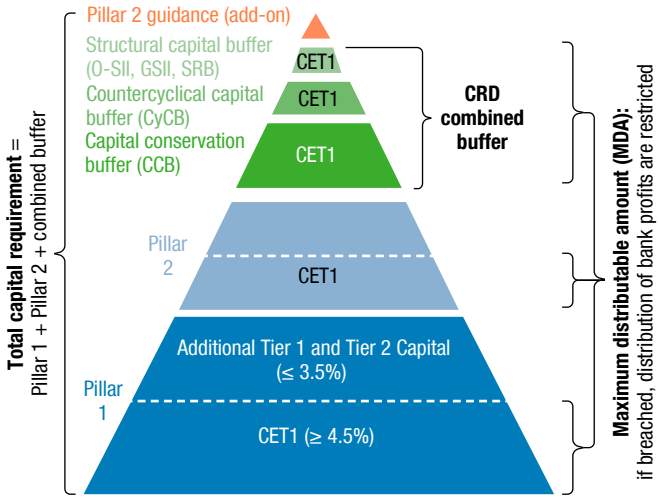
4 Policy Measures to Support Banks, Firms, and Households

Regulators provided substantial capital and liquidity relief for banks to strengthen their capacity to absorb losses while continuing to lend. Banks were allowed to use their combined capital buffers and were temporarily allowed to operate below the level of capital required under Pillar 2 guidance (Figure 8) and the liquidity coverage ratio. Prudential authorities also temporarily granted flexibility in the classification and greater clarity on the provisioning of loans backed by public support measures (EBA 2020e).[1] These temporary measures, which have been enhanced by lower countercyclical capital buffers set by national macroprudential authorities, have provided substantial capital relief. Together with capital conservation measures, such as restrictions on dividend distribution and share buy backs, this has supported bank lending.

Many European countries have implemented policy measures to support the real economy and reduce bank credit risk. A range of policy measures aim to support firms and households. On the labor side, several economies have substantially expanded short-time work schemes to protect jobs and household incomes (IMF 2020a). These schemes encourage firms to retain their workforce by using public funds to supplement up to 70–80 percent of employees' pay for the hours not worked. Several countries have also provided direct liquidity support to firms and households in the form of cash grants, as well as tax deferrals and expanded direct lending to firms. Meanwhile, governments have introduced a range of loan guarantee programs for firms, espe-

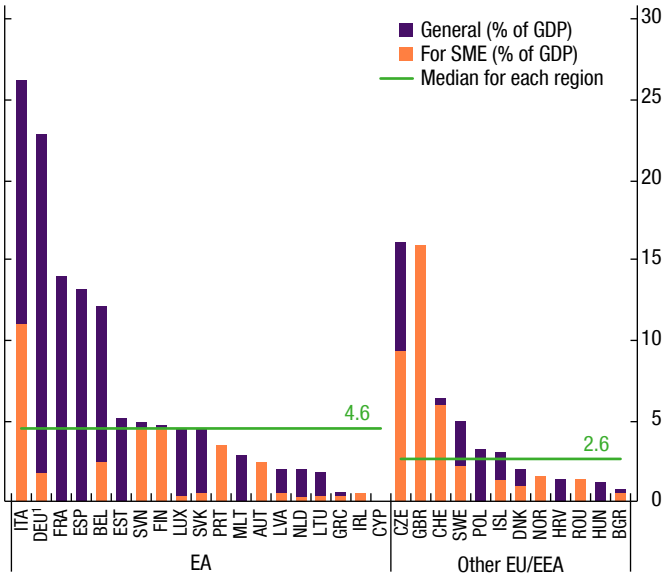
[1]The measures aimed to avoid the automatic reclassification of loans into forborne or defaulted status in case of generalized moratoria. On March 20, the ECB introduced supervisory flexibility regarding the classification of debtors as "unlikely to pay" on public guarantees granted. It recommended that all banks avoid procyclical assumptions in their models to determine provisions. On March 25, EBA published guidance on the definition of default, forbearance and the application of IFRS 9 in the context of COVID-19, and the European Securities and Markets Authority (ESMA), in coordination with EBA, published a statement providing its opinion on how banks should enforce IFRS 9 accounting standards in light of the crisis.

Figure 8. Stylized Stacking of Capital Elements



Sources: Basel Committee on Banking Supervision; European Banking Authority; and authors.
Note: CET1 = common equity Tier 1; CRD = Capital Requirements Directive; GSII = global systematically important institutions; O-SII = other systematically important institutions; SRB = systemic risk buffer.

Figure 9. Total Envelope of COVID-19 Pandemic-Related Public Guarantee Program
(Percent of projected 2020 GDP)



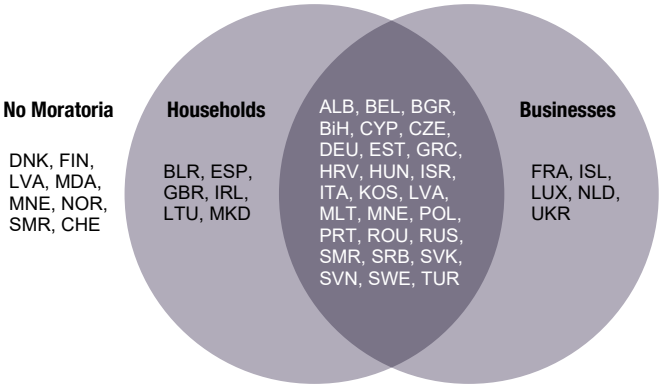
Source: IMF staff.
Note: KfW = Kreditanstalt für Wiederaufbau; SME = small and medium enterprise; WSF = Wirtschaftsstablisierungsfonds. Data labels in the figure use International Organization for Standardization (ISO) country codes. Data as of the end of September 2020.
[1]Include (1) KfW's "Quick loan," (2) KfW's standing guarantee programs that were expanded during the COVID-19 pandemic, and (3) Economic Stabilization Fund ("WSF").

cially SMEs. Debt service moratoria or repayment holidays for households and firms were also introduced by governments or as private-sector initiatives by the banking sector.

Loan guarantees have been one of the main instruments employed by European countries. According to a survey of IMF "desk economists" for 44 European countries, 39 countries offer pandemic-related guarantee programs, although the actual take-up of guarantee programs varies among countries. Guarantees are channeled either through existing development agencies or through newly established guarantee funds. The size of the overall envelope for guaranteed loans varies markedly among countries, with seven countries offering an envelope well in excess of 10 percent of GDP (Figure 9). Public guarantee programs are often targeted at SMEs; for example, guarantee programs in Norway, Portugal, and Serbia are exclusively for SMEs, while more than 90 percent of the total guarantee envelope in Slovenia, Switzerland, and the United Kingdom is for SMEs. Guarantees tend to have a coverage ratio

of 70 to 90 percent, which is expected to be high enough to incentivize banks to extend loans while mitigating the risks of moral hazard by leaving some credit risk with banks. For EU member countries, 100 percent government guarantees are allowed only for loans up to €800,000 according to the State Aid rules.[2]

Figure 10. Key Beneficiaries of Debt Service Moratoria



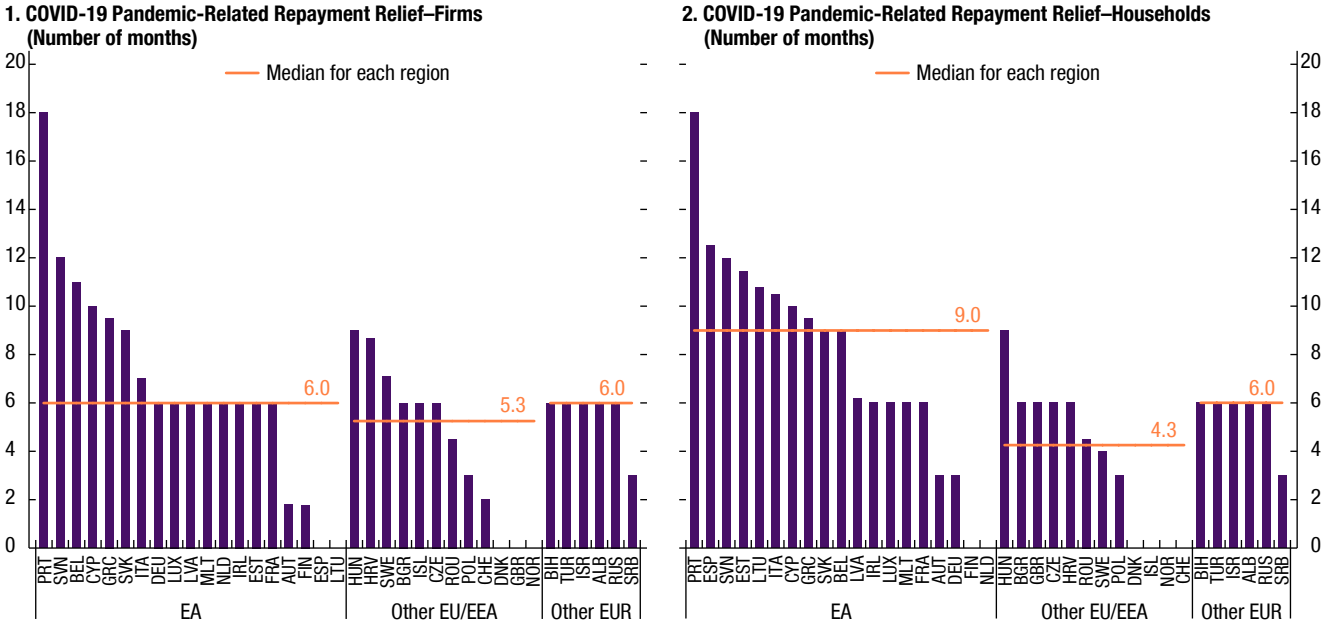
Sources: European Banking Authority; European Systemic Risk Board; national authorities; and IMF country survey.
Note: Data labels in the figure use International Organization for Standardization (ISO) country codes.

Government guarantees on new loans helped firms obtain bank loans to tide over liquidity and working capital needs. Indeed, euro area bank lending growth increased from 5 percent (year over year) at the beginning of 2020 to nearly 9 percent (yoy) in May amid very strong precautionary cash demand (see Figure 2). Even though new lending growth to firms fell to about 6½ percent (year over year) by October, the rate is double of that observed on average over the last few years. Government guarantees do not carry high capital costs for banks as the risk-weights on such loans are lower.

Debt service moratoria have also been widely introduced to mitigate the liquidity concerns of households and firms. Our survey indicates that 38 European countries have introduced debt service moratoria. Such moratoria can be based either on the applicable national law (legislative moratoria) or on the private initiatives of the banking industry (non-legislative moratoria). In most countries, moratoria were provided for both households (mortgage and consumer loans) and businesses (Figure 10). The duration of moratoria originally ranged from three to six months, and was extended in some countries into 2021 (Figure 11). Temporary debt service moratoria can alleviate liquidity concerns for households and businesses and help them tide over difficult times while minimizing the loss of private consumption.

[2]On January 28, 2021, the European Commission announced an increase in the ceiling to €1.8 million per company.

Figure 11. Duration of Pandemic-Related Debt Service Moratoria



Sources: European Banking Authority; European Systemic Risk Board; national authorities; and IMF country survey.
Note: Data labels in the figure use International Organization for Standardization (ISO) country codes.

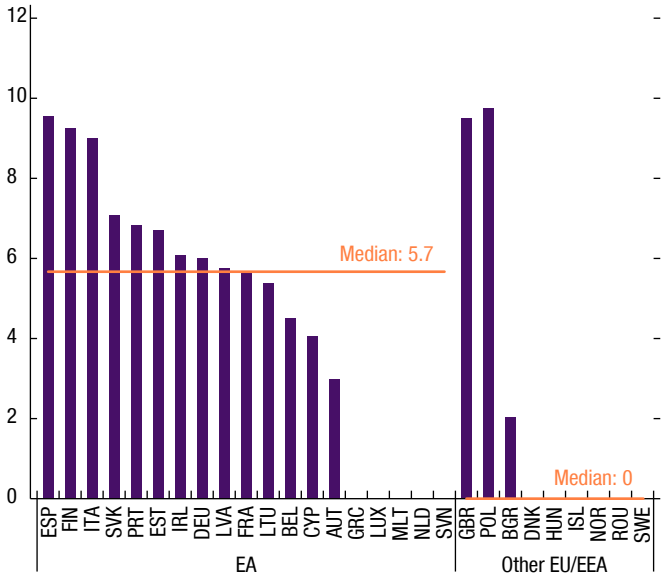
Debt service moratoria entail a mixed impact on bank profitability. On the one hand, such moratoria entail a loss of interest income for banks.[3] On the other hand, prudential authorities were quick to emphasize flexibility in the classification of loans eligible for debt repayment relief.[4] EBA, tasked with ensuring consistent application of the EU banking rules, published temporary guidelines in April 2020 advising banks and supervisors to (1) "look through" the transitory systemic shock as they assessed risks, (2) suspend days-past-due automaticity in classifying loans as forborne or defaulted, and (3) focus on identifying borrowers that might face *longer-term* financial difficulties. In mid-September, EBA announced that its temporary guidelines emphasizing flexible provisioning would lapse at the end of the month, but then reinstated

[3]In bank accounting, which is on an accrual basis, interest payments that are deferred but not cancelled would still be counted as interest income. However, it is assumed that the moratoria delay the cash receipt of accrued income to a time beyond the stress test horizon, and, thus, imposes an economic loss.

[4]The EBA published on April 2, 2020, the *Guidelines on Legislative and Non-legislative Moratoria on Loan Repayments* (EBA/GL/2020/02), laying out the conditions under which exposures covered by the moratoria should not necessarily be classified as forborne and, consequently, would not have to be automatically assessed as distressed restructuring under the definition of default. The ECB issued similar guidance to the significant institutions under its direct supervision, advising that undue volatility in provisioning be avoided by focusing on the full life cycle of each loan. Such guidance applies only to the regulatory definition of default and the regulatory classification of forbearance (as well as any related supervisory assessment via the SREP) but does not extend to accounting requirements determining adequate provisioning.

the guidelines in December while emphasizing that banks need to recognize credit risk in a timely way.

Figure 12. Duration of COVID-19 Pandemic-Related Insolvency Moratoria
(Number of months)



Sources: National authorities; and IMF staff calculations.
Note: EA = euro area; EEA = European Economic Area; EU = European Union. Data labels in the figure use International Organization for Standardization (ISO) country codes.

Deferred bankruptcy proceedings are likely to delay loan write-offs due to corporate default. Most countries adopted insolvency moratoria for about half a year from the end of March 2020 onward (Figure 12). Thus, a potential deterioration of asset quality due to higher borrower default risk resulted first and foremost in higher loan loss provisions without significant loss recognition through write-offs. Banks did not reach the point of being forced to write off bad loans of insolvent companies if consensual debt resolution and/or workout fail. However, once the insolvency moratoria fully expire, there could be cliff-edge risks of suddenly rising bankruptcies, adversely impacting bank capital.[5]

[5]Delayed insolvency proceedings do not result in lower provisioning and loss recognition (which take already place at the point of provisioning not exclusively at the point of write-off). However, it is assumed that banks incur losses due to under-provisioning when write-offs occur. In addition, they delay banks' ability to foreclose and restructure loans after borrowers have defaulted on their obligations, and thus reduce the recovery value of collateral.

CHAPTER

5 Analytical Framework

We adopt a standard top-down stress testing approach, using publicly available data to assess banks' capital buffers in the face of the pandemic shock. Over the past decade, bank stress testing has rapidly evolved to become a key aspect of the IMF's Financial Sector Assessment Program (FSAP) (Ong and Jobst 2020).[1] Stress testing has also grown in importance for many IMF member countries as a forward-looking technique for supervisors and macroprudential authorities to identify vulnerabilities to a deteriorating operational and market environment affecting banks' overall risk profile. In this paper's context, we focus on the implications of the COVID-19 shock on bank capital as a critical determinant of the banking sector's ability to lend and support the economic recovery.

The exercise uses a variety of data sources.

- *First,* detailed data from EBA's 2020 Transparency Exercise (EBA 2020d) for 117 large European banks are used for the main exercise, although the results focus on 90 euro area banks from this "EBA sample." The dataset includes each bank's exposures to firms, including granular information on sectors as well as detailed information on risk weights, impairments, loan loss coverage, and asset recovery rates.
- *Second*, these data are combined with bank-specific time-series data over 2008–19 on key performance variables from FitchConnect, such as categories of assets, capital levels, profitability (ROA), NPLs, and lending growth. These data feed into empirical models linking macroeconomic performance to ROA, ROA-components, loan growth and NPLs. For this

[1]The exercise in this paper differs from stress tests in FSAPs on several fronts. First, while this paper relies on publicly available data, FSAP stress tests draw heavily on confidential supervisory data. Second, this paper's exercise focuses on declines in bank capital ratios primarily due to credit risk and does not include interconnectedness within the financial sector or detailed liquidity stress tests, which FSAP stress tests cover.

purpose, macroeconomic data, including baseline projections for GDP growth and unemployment rate are taken from the IMF *World Economic Outlook* database.

- *Third*, beyond the core sample of large banks in the EBA Transparency Exercise, we use data from S&P Global Market Intelligence to expand our coverage to smaller euro area banks as well as banks in advanced and emerging market economies in Europe outside the euro area. The sample coverage of the various datasets is shown in Figure 13.

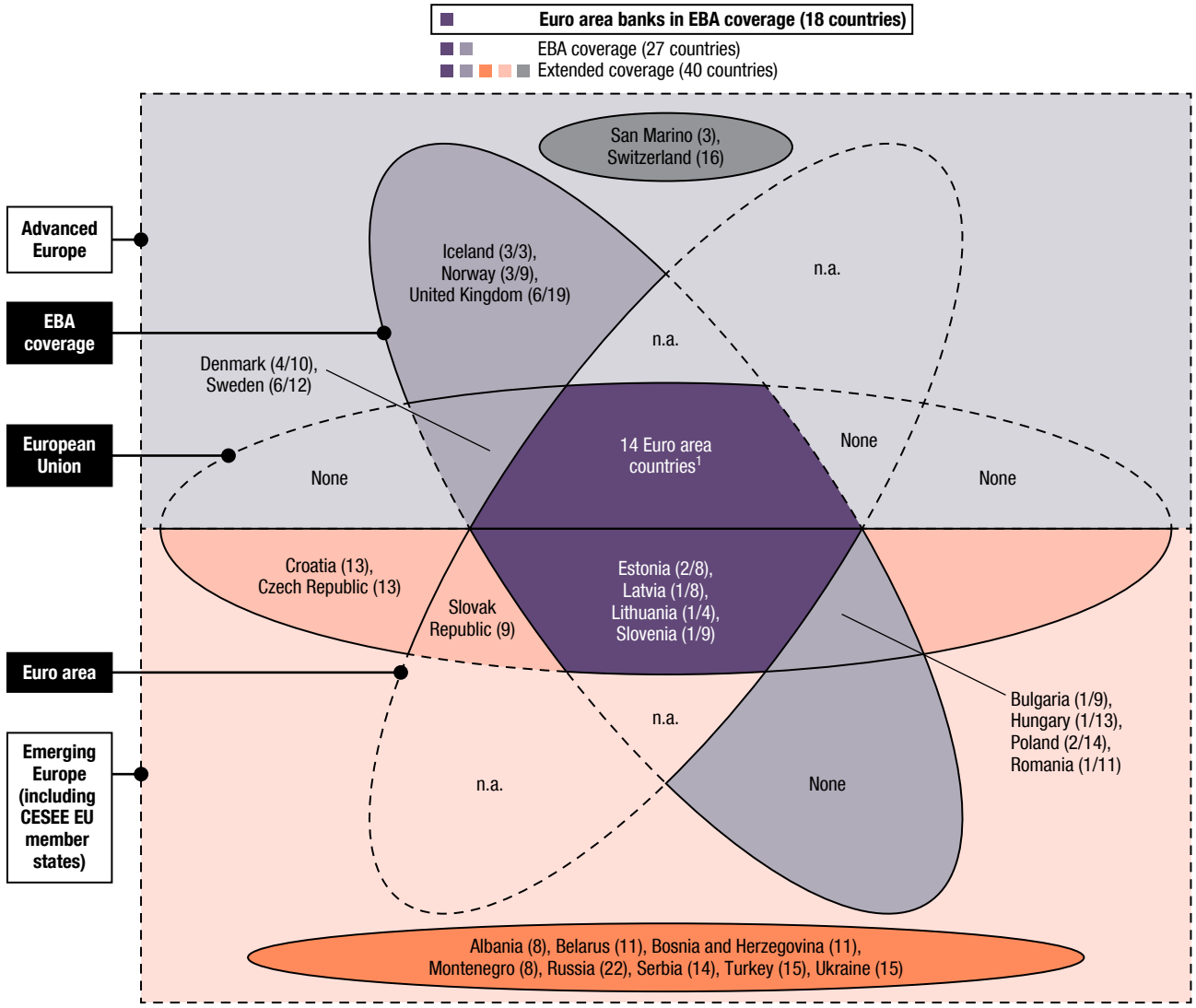
The impact on bank capital derives from three channels—profitability, assets, and risk weights—each of which interacts with policy measures (Figure 14). In response to the worsened macroeconomic conditions and heightened probability of default, banks are likely to (1) raise provisions for higher loan losses across all asset types (mortgage, consumer and corporate lending), and face lower income from nonlending activities; (2) write off a rising share of nonperforming loans to insolvent borrowers and bankrupt firms with rapidly diminishing prospects for effective collateral recovery; and (3) face higher credit risk weights. Starting with the 2019 CET1 capital ratio, the projected profitability (that is, ROA) for subsequent years is added to it. This is because retained earnings from net profits—after accounting for dividend payouts and taxes—organically increase banks' CET1. The extraordinary shock arising from corporate sector bankruptcies is deducted from both assets and capital, and risk-weights on existing and new assets are adjusted up. However, policies help cushion some of these effects. Different complementary approaches are used to estimate the propagation of the macroeconomic impact through each of the channels. In what follows, each of these channels, their estimation, and the effect of policies, is described in greater detail (also see Annex 2).

The *profitability channel* comprises the impact of macroeconomic conditions and bank-specific variables on net operating income and its components. Following Elekdag, Malik, and Mitra (2020) as well as Jobst and Weber (2016), the empirical "satellite model" uses bank-by-bank panel data for 41 European countries over 2008–2019 at a consolidated level. The linear specification of the model tends to generate a conservative estimate of the change in banks' profitability across the entire loan portfolio, covering both household and corporate lending.[2]

The results of the satellite model show that ROA is mainly influenced by real GDP growth and the unemployment rate, along with the past ratio of NPLs to gross loans. Every 1 percentage point decline in real GDP growth reduces the ROA of large euro area (SSM) banks by 27 basis points, while a

[2]For instance, the specification in Table 2 would suggest negative bank profitability due to the deep economic contraction in 2020—albeit with only a muted rise in unemployment—while euro area banks at end-September 2020 still reported a slightly positive ROA.

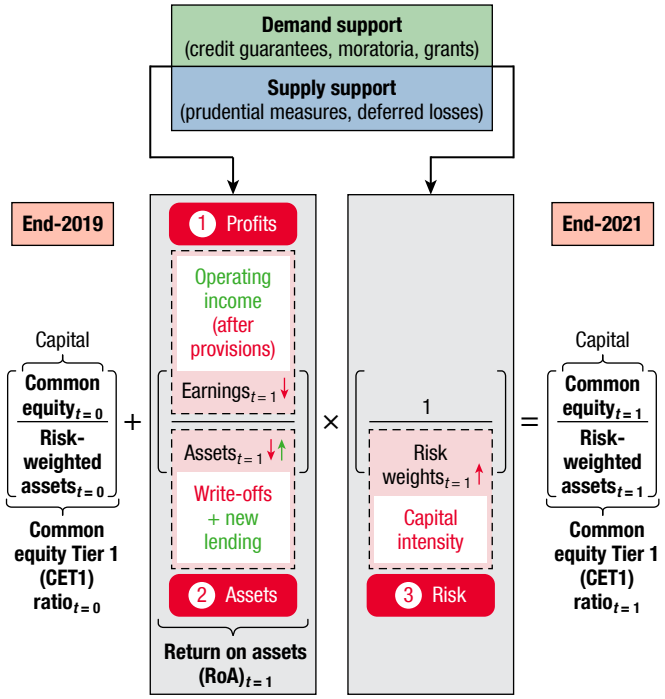
Figure 13. Sample Coverage



Source: IMF staff.
Note: (x/x) indicates the number of banks covered in the "EBA coverage" and "extended coverage." "EBA coverage" = 117 EU/EEA banks, of which 90 are the largest euro area banks (~SSM); "Extended coverage" = 467 European banks (covering all European IMF member countries, except Andorra, Israel, Kosovo, Moldova, and North Macedonia), of which 138 are euro area banks; includes the "EBA coverage." EBA = European Banking Authority; CESEE = Central, Eastern, and Southeastern European economies; SSM = Single Supervisory Mechanism.
[1]Fourteen advanced economy euro area countries (85/181): Austria (6/19), Belgium (6/15), Cyprus (2/9), Finland (4/10), France (8/10), Germany (15/26), Italy (11/16), Ireland (3/9), Greece (4/8), Luxembourg (3/13), Malta (2/9), Portugal (5/11), Netherlands (5/12), Spain (11/13).

1 percentage point increase in the unemployment rate reduces their ROA by 21 basis points, and a 1 percentage point increase in the last period's NPL ratio reduces ROA by 15 basis points (Table 2). There is some variation in the sensitivity to these variables across different sub-samples, with smaller banks facing a somewhat smaller impact from macroeconomic conditions

Figure 14. Capital Impact through Three Channels



Source: IMF staff.

but a larger impact from past NPLs. However, the differences are relatively small, particularly given the large variation in bank performance in the sample and their underlying balance sheet exposures. The effects on ROA can be further disaggregated by its components—net interest income/assets, noninterest income/assets, loan-loss provisions/assets, and operational cost/assets. Quantitatively, the most important of these components is the increase in loan loss provisions (see Annex 2). The corresponding satellite model for loan loss provisions is in turn used to estimate the expected provisions in the absence of policies and applied further to derive the change in credit risk weights (see below and Annex 2).

The *asset channel* comprises two components, the first of which is the write-off component. The pandemic is expected to lead to a surge in bankruptcies and associated loan losses above historical averages. These loans will need to be written off after accounting for existing loan loss reserves.[3] The amount of impaired corporate loans is derived from the analysis in Chapter 3 of the October 2020 *Regional Economic Outlook: Europe.* In particular, the share of firms in each sector in each country projected to become both illiquid and insolvent is mapped into banks' sectoral exposures to corporates to derive the share of credit defaults and related loan write-offs (Box 1).[4]

The second component of the asset channel is the pace of loan growth. We assume that supply factors are the binding constraints on loan growth in the

[3]It is assumed that banks under-provision impaired loans relative to the net present value of collateral and, thus, generate losses. This could occur if debt moratoria delay the timely recognition of deteriorating borrower quality. Moreover, even when debt moratoria expire, a, sudden rise in pent-up bankruptcies could delay debt enforcement and overwhelm the capacity of the court system to manage insolvencies efficiently.

[4]In this paper, the debt-weighted share of firms rather than the number of firms is used to quantify potential losses. This is consistent with ECB (2020d) estimates, which show that the share of loans to firms facing liquidity shortfalls is significantly lower than the share of such firms in the count of all firms, due to the loan book being skewed towards larger and less vulnerable firms.

Table 2. Factors Impacting Profitability

1 Percentage Point Change in ...	... Leads to the Following Change in ROA (in pp, by sample)			
	SSM	EA, ex. SSM	EBA	All Europe
Real GDP growth	0.270***	0.141***	0.197**	0.0752**
Unemployment rate	–0.208**	–0.0789*	–0.171***	–0.0557
NPL ratio (lagged)	–0.0155	–0.0391***	–0.0418**	–0.0295*

Source: IMF staff.

Note: EA = euro area; EA, ex. SSM = euro area non-SSM banks; EBA = European Banking Authority; NPL = nonperforming loan; ROA = return on assets; SSM = sample of large euro area banks that are supervised by the Single Supervisory Mechanism. ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

current crisis. This is because corporate credit demand has been very strong during the pandemic, in part to fund working capital needs. This experience differs from that of the GFC when credit demand fell significantly (Figure 15). In our empirical model, we link changes in lending to initial bank capital ratios—a 1 percentage point lower CET1 ratio is associated with a 0.6 percentage point decline in credit growth (Annex Table 2.4). In turn, lower credit growth directly reduces asset growth in the next period, mechanically generating an increase in the capital ratio.

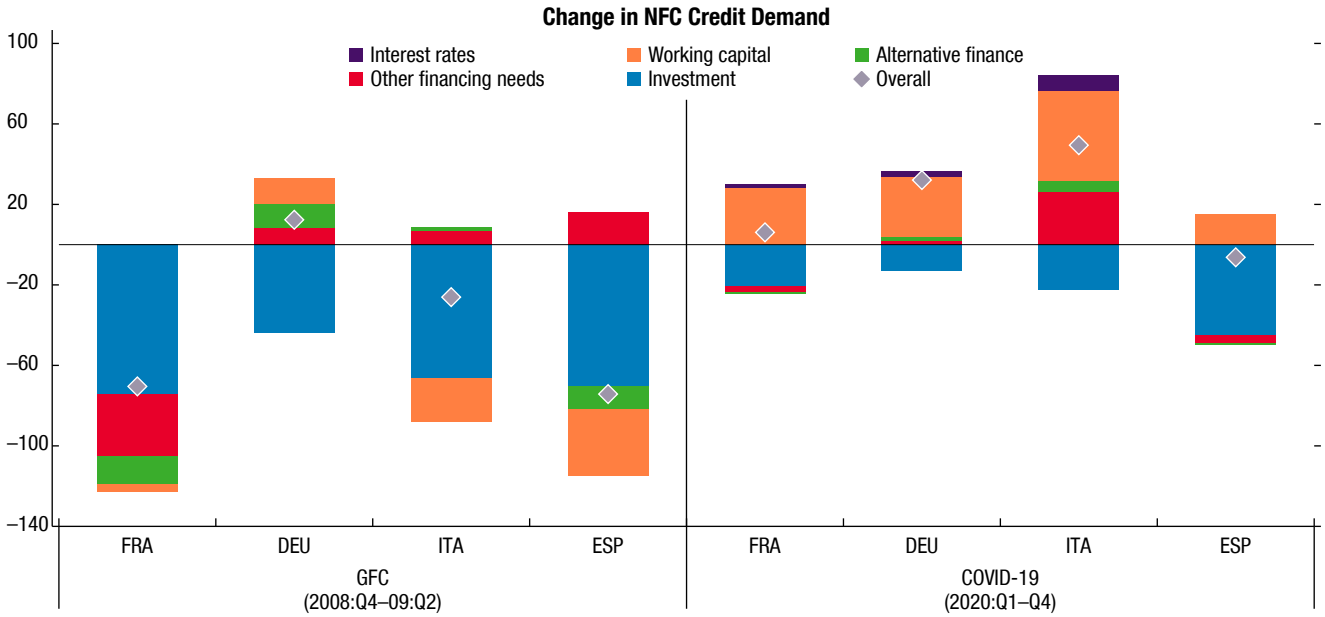
Because the asset channel comprises two conceptually distinct components, the impact of an economic shock through this channel depends empirically on the balance between the components. A negative shock that simultaneously causes an increase in write-offs and a reduction in new lending will generally have an ambiguous effect on capital ratios, which will tend to fall due to higher write-offs but rise due to lower lending.

Finally, changes to *credit risk weights* of bank assets also affect the capital ratio. We adjust the riskiness of corporate, consumer and mortgage exposures by updating their model-implied probability of default (PD) consistent with changes in loan loss provisions.[5] We extract the one-year PD from credit risk weights (as reported in the EBA Transparency Exercise 2020 on a bank-by-bank basis) using the internal ratings-based approach (IRB) formula for credit risk in the Basel framework. The increase in loan loss provisions, in turn, is estimated from sub-components of the ROA satellite model described above.[6] In our calculations, we apply uniform but asset class-specific recovery rates and maturities for each country based on EBA's latest quarterly risk parameters (EBA 2021b) and its recent report on the effectiveness of national insolvency frameworks (EBA 2020c).

[5]Note that this approach generates a point-in-time (PIT) measure of default risk (since the updating is linked to the change in provisions under IFRS-9, which requires the use of PIT PDs). However, the calculation of the regulatory capital only requires through-the-cycle (TTC) parameters, which would result in a lower estimate of PDs under stress.

[6]Higher provisions reflect the increase of general default risk of all exposures, including additional impairments of corporate loans due to corporate insolvencies.

Figure 15. Selected Euro Area Countries: Changes in Credit Demand
(Net percentage change; +/= increase)

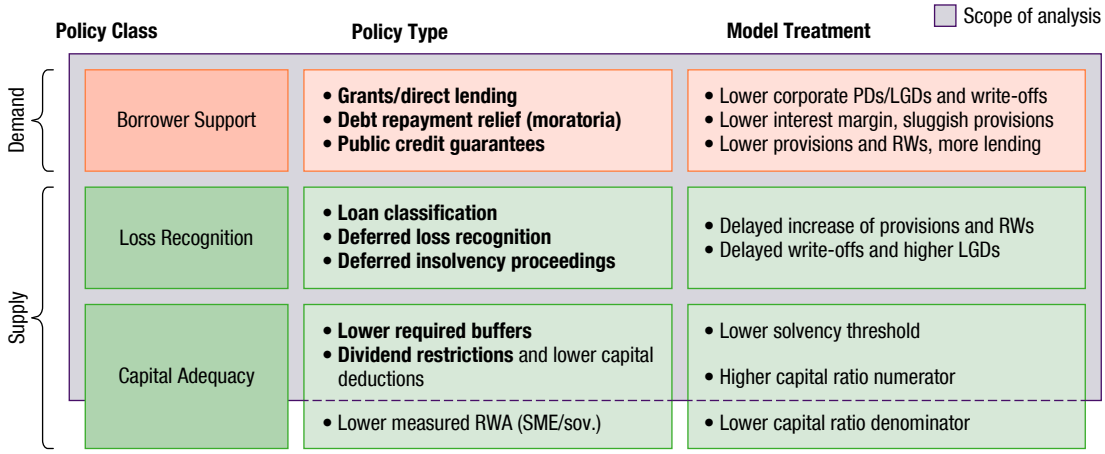


Sources: European Central Bank; Haver Analytics; and IMF staff calculations.
Note: GFC = global financial crisis; NFC = non-financial corporations. Data labels in the figure use International Organization for Standardization (ISO) country codes. Changes in credit demand during the respective quarter(s) based on net percentages calculated as the difference between banks seeing increasing versus decreasing demand. Contributing factors do not add up to the overall assessment of demand conditions. For the global financial crisis and COVID-19 crisis periods, the quarterly values are averaged.

Several policy measures, both on the demand and supply sides, affect each of the three channels. On the demand side, grants, tax deferrals / exemptions, and wage subsidies to firms reduce their default probability and thus reduce write-offs to banks' loan exposures ("asset" channel). Credit guarantees reduce expected losses from borrowers and debt moratoria reduce the default risk of borrowers, slowing the rise in banks' provisions ("profitability channel") and risk weights ("risk channel"). But moratoria also weigh on bank profitability through deferred or lost interest income, and from caps on the interest rate of some guaranteed loans (Figure 16). On the supply side, banks benefit from a wide range of prudential measures, especially significant relief from various capital buffer requirements (such as the countercyclical capital buffer and systemic risk buffer) and delayed provisions in the absence of an automatic reclassification of impaired loans under moratoria.[7] These supply

[7]The extent of capital relief differed greatly among countries, reflecting in part the size of capital buffers prior to the pandemic. For example, the counter-cyclical capital buffer in Ireland was 1 percent, while that in France and Germany was 0.25 percent. In Denmark, following the reduction of the counter-cyclical capital buffer to zero at the onset of the pandemic, it was raised twice (to 1.5 percent in June 2020 and 2.0 percent in December 2020).

Figure 16. Policy Measures and Model Treatment



Source: Authors.
Note: LGD = loss-given-default; PD = probability of default; RW = risk weight; RWA = risk-weighted assets; SME = small and medium enterprises.

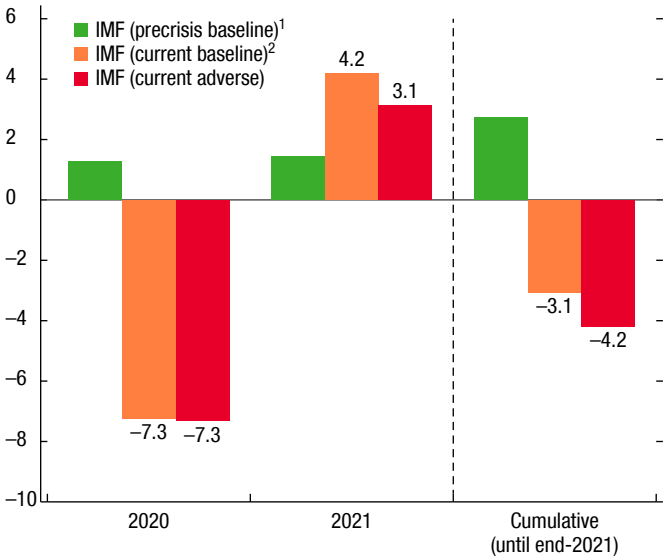
side measures act through all three channels by delaying loss recognition and dampening the rise in provisions and risk weights. For the latter, we assume a sluggish adjustment of provisioning for loans subject to debt moratoria relative to expectations (based on satellite model estimations; see Annex 2).

The stress test covers two macroeconomic scenarios, using publicly available data on bank performance. The first scenario is calibrated to the baseline growth and unemployment forecast of the January 2021 *World Economic Outlook* (WEO) *Update*, which shows a sharp and unprecedented recession in 2020, followed by a partial recovery in 2021 (Figure 17).[8] An illustrative adverse scenario modeled in the January 2021 *WEO* Update sees a slower recovery in 2021. Such an adverse scenario is projected to materialize if vaccinations proceed slower than expected and more stringent or longer-lasting containment measures lead to deeper economic scarring.

Assumptions about the duration of the policy measures and the evolution of their take-up guide the distribution of bank losses over a two-year horizon until end-2021. We calibrate the duration of each bank and borrower-level policy measure—most notably public loan guarantees, debt moratoria and deferred insolvency proceedings—to the announced length of each measure in each country. This granular approach allows us to account for the policy impact in a more precise and flexible manner. For example, the legal requirement to file bankruptcy in Germany was suspended from May until the end

[8]Note that the most recent macroeconomic projections by the ECB in March 2021 suggest that euro area GDP fell by 6.9 percent in 2020.

Figure 17. Specifications of Macro Scenario: Real GDP Growth
(Percent)



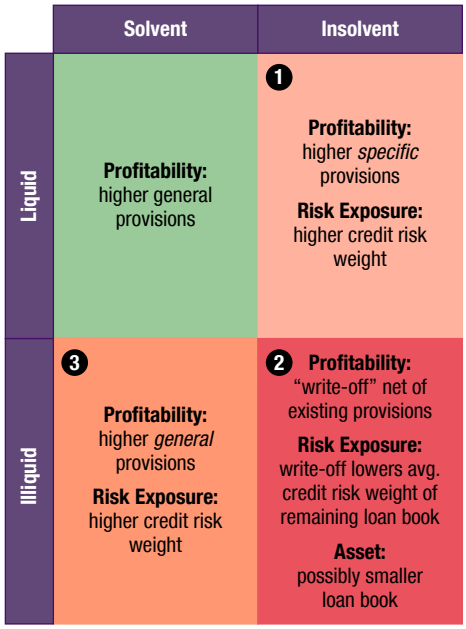
Sources: European Central Bank; and IMF staff calculations.
[1]January 2020 *World Economic Outlook Update.*
[2]January 2021 *World Economic Outlook Update.*

of September 2020 for firms which are illiquid (and until the end of April 2021 for liquid but insolvent firms receiving grants under the November–December aid programs). We thus assume that only 15 percent of the total estimated bankruptcies would materialize in banks' balance sheet write-offs in 2020, with the remainder materializing in 2021.

Box 1. Determining the Corporate Default Risk Shock

We specify the deterioration of corporate risk as a single-factor shock by combining bank-specific exposure data with expected loss rates across all sectors. While the general impact of changes in macroeconomic conditions on bank profitability already includes higher provisioning expenses and impairment charges, the extraordinary economic contraction during the COVID-19 crisis (with potentially significant scarring effects) is likely to result in a more profound impact on corporate default risk beyond the level suggested by historical inference. Corporate exposure data are extracted from the detailed composition of sectoral corporate exposures of sample banks covered by the EBA's annual Transparency Exercise (EBA 2020f). The loss rates for each sector (at the NACE2 level) are based on the findings of Chapter 3 of the October 2020 REO: Europe (IMF 2020c), which determine the "financial status" of all sample firms in each country and sector after accounting for the impact of the crisis on their assets and liabilities, as well as on revenues and profitability. This can be summarized in a 2x2 matrix of solvency and liquidity conditions (Box Figure 1.1).

Box Figure 1.1. Corporate Risk Matrix



Source: Authors.

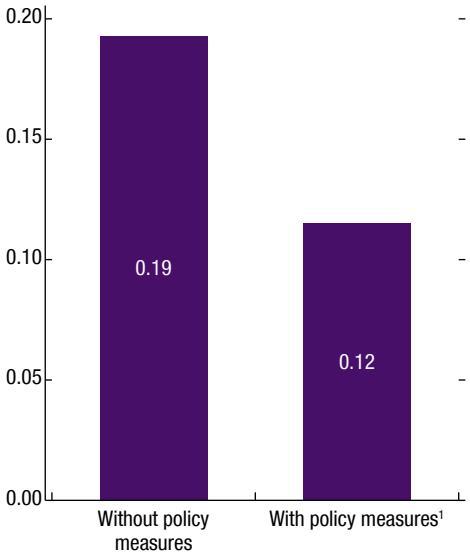
We first update the *Regional Economic Outlook* results with the January 2021 *World Economic Outlook Update* macroeconomic forecasts (IMF 2021a). This update uses historical growth elasticities (Box Figure 1.2). These estimates are then used to derive, for each sector and country, the change in each firm's "financial status," which is aggregated to the share of firms that are likely to default in 2020–21—with and without the risk mitigating impact of policy measures.

The exercise follows a two-step process:

- First, we determine the within-sector, debt-weighted share of firms that are likely to become illiquid *and* insolvent (Box Figure 1.3, panel 1), which define the sector-specific default rates—with and without policy measures—in each country. The share of firm debt in major European advanced economies that is estimated to be at risk of default ranges from 2 percent in Germany to 7 percent in Italy, reflecting

Box 1. Determining the Corporate Default Risk Shock *(continued)*

Box Figure 1.2. Euro Area: Elasticity of Estimated Firm Bankruptcies (Illiquid and Insolvent)
(Average percentage point change to 1 pp decrease of GDP growth)



Source: IMF staff estimates.
[1]Debt repayment relief (moratoria) for businesses and households, corporate credit guarantees, delayed insolvency proceedings, and dividend restrictions (only in 2020).

the structure of the economy (for example, tourism dependence), as well as initial financial conditions in the corporate sector. For illustrative purposes, the sectoral exposures have been grouped into "highly affected" and "other" sectors in each country.

- Second, we map these default rates to each bank's actual corporate exposure to each sector (Box Figure 1.3, panel 2) to determine the additional corporate default losses for each bank (Box Figure 1.3, panel 3). These losses feed into our model as an additional corporate shock in addition to the general deterioration of bank profitability and asset quality across all credit types.[1] We translate these estimated loan losses to bank-level loan write-offs, after accounting for existing loan loss coverage (including the flow of new provisions in 2020) and the average recovery value of collateral (proxied by public information on so-called "loss-given-default" for corporate exposures in each country).

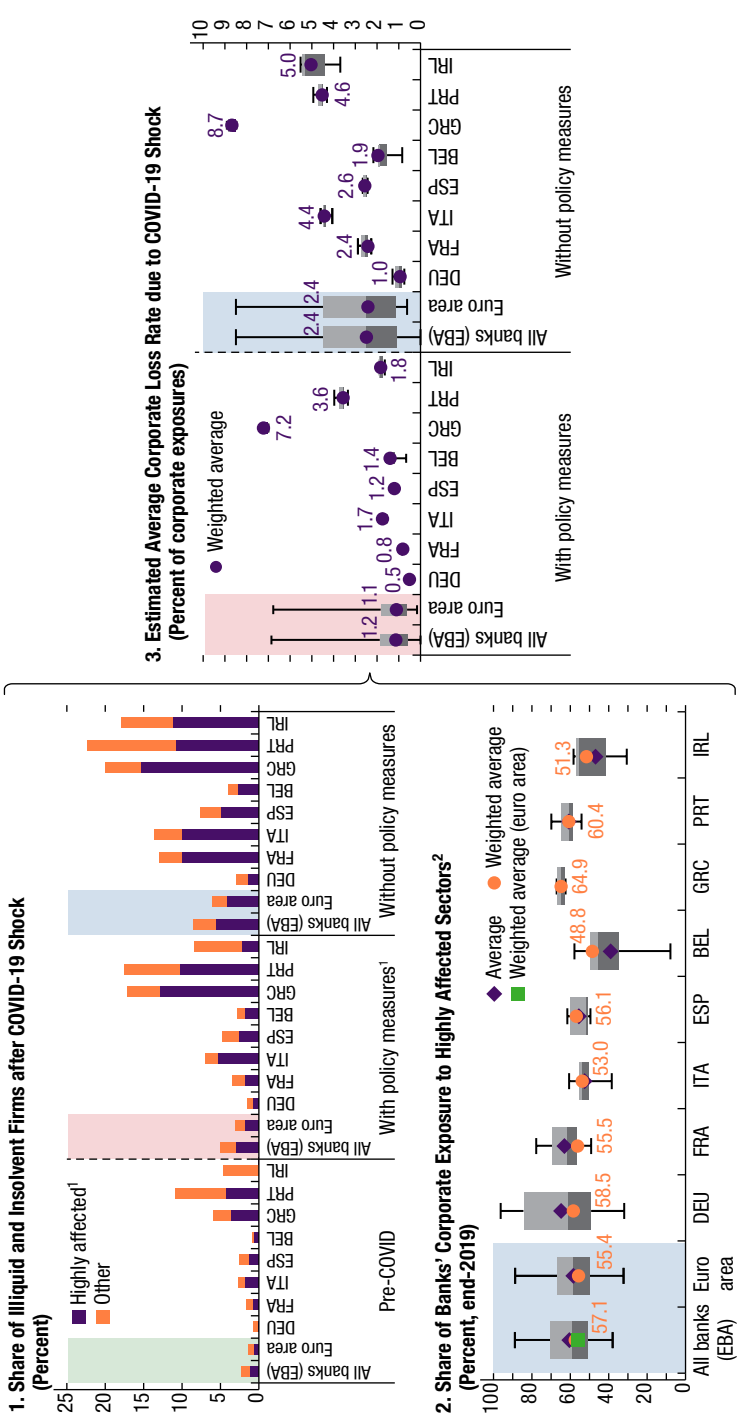
We find that policies can significantly mitigate the impact of the crisis on corporate risk and therefore on bank expectations of corporate loan defaults over the stress test horizon. There is also large variation across countries in the magnitude of the policy impact. For example, policies reduce loan losses by half in Germany and by two-thirds in France. Since we cover two time periods, 2020 and 2021, we control for the effect of deferred insolvency proceedings in many countries, which delays the materialization of corporate defaults (and the extent to which banks incur write-offs). On average, only 15 percent of the calculated corporate shock occurs in 2020, and the remainder spills over into the next year.

We further use other elements of the corporate risk matrix (Box Figure 1.1) to adjust the changes in profitability and risk weights related to banks' corporate exposures. For instance, the estimated increase of the share of liquid but insolvent firms (top right quadrant in Box Figure 1.1) raises specific provisions and informs the degree of potential under-provisioning of corporate loans subject to debt moratoria, applying the EBA transition probabilities between credit risk stages ("IFRS 9 staging"), as detailed in Annex 2.

[1]See Mojon, Rees, and Schmieder (2021) for a similar analysis using corporate exposures of banks in G-7 countries, Australia and China.

Box 1. Determining the Corporate Default Risk Shock *(continued)*

Box Figure 1.3. Mapping Corporate Vulnerability to Banks' Corporate Loan Default Risk



Sources: European Banking Authority; and IMF staff estimates.
Note: The grey shaded area of the boxplots shows the interquartile range (25th to 75th percentile), with whiskers at the 5th and 95th percentile of the distribution. Data labels in the figure use International Organization for Standardization (ISO) country codes.
[1]Debt repayment relief (moratoria) for businesses and households, corporate credit guarantees, delayed insolvency proceedings, and dividend restrictions (only in 2020).
[2]Highly affected sectors include construction, wholesale/retail trade, transport and storage, accommodation and food services, real estate activities,

CHAPTER

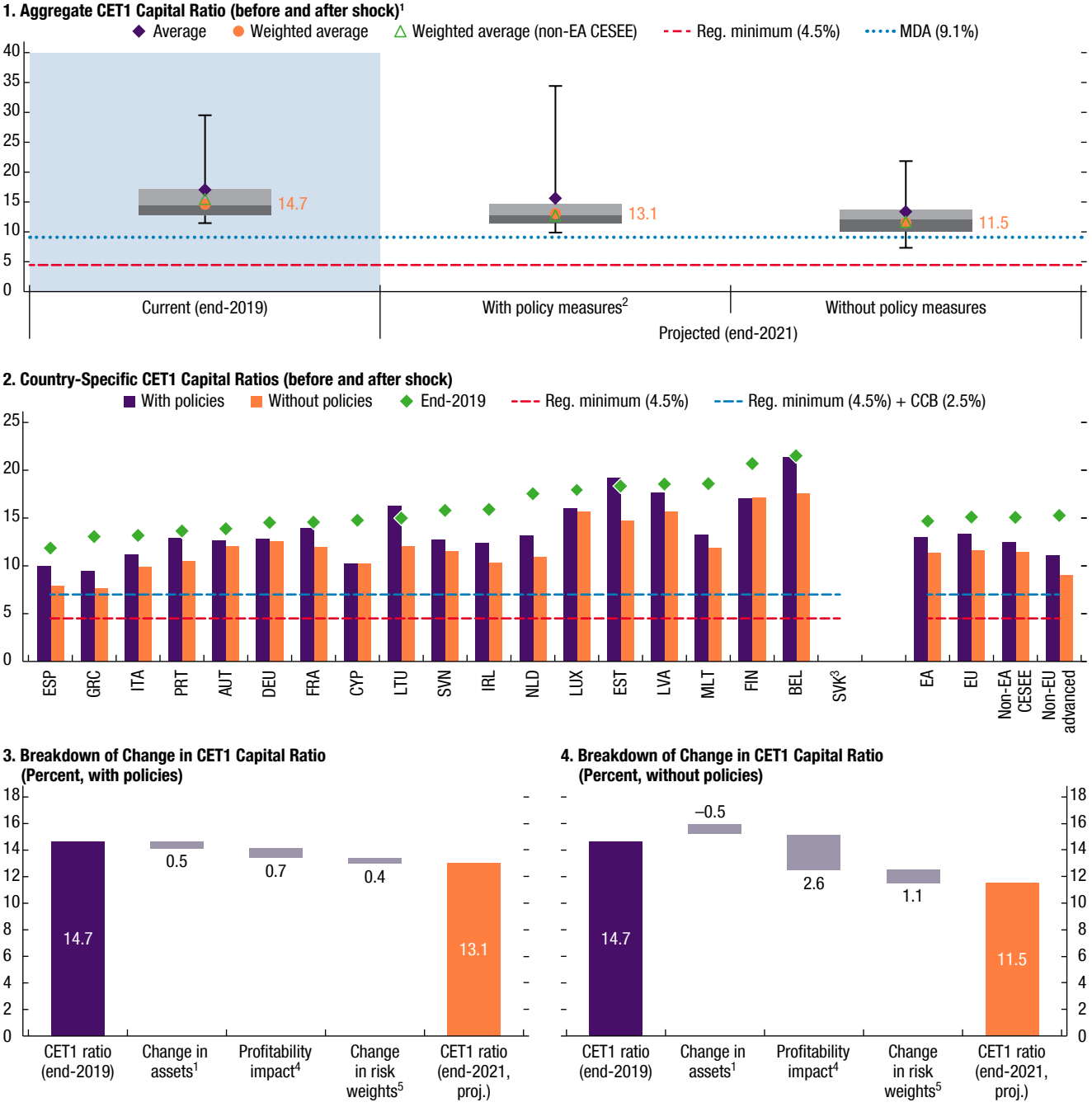
6 Results

Overall, the results suggest that banks are likely to remain resilient under the baseline scenario albeit with a sizeable narrowing of buffers. Under the baseline scenario, and accounting for granular borrower support measures, we find that the aggregate CET1 capital ratio for large euro area banks declines from 14.7 to 13.0 percent by the end of 2021 (Figure 18, panel 1). The capital erosion decreases by about one-third if banks continue to refrain from dividend distributions in 2021 (Figure 19).

Supportive policies significantly mitigate the impact on bank capital. Without supportive policies, capital erosion would be 1.7 percentage points larger, or roughly double the scale of capital depletion (Figure 18, panels 1 and 2). With supportive policies, the profitability channel is estimated to reduce the CET1 capital ratio by 0.7 percentage points, slightly larger than the impact from the asset and risk weight channels of 0.5 percentage points respectively (Figure 18, panels 3 and 4). Meanwhile, without policy measures, lower profitability explains most of the capital depletion, together with an increased contribution from higher credit risk weights. However, the asset channel now acts to slightly increase the capital ratio, with the reduction in lending (which mechanically lowers the denominator of the capital-asset ratio) dominating the impact of capital depletion from higher write-offs.

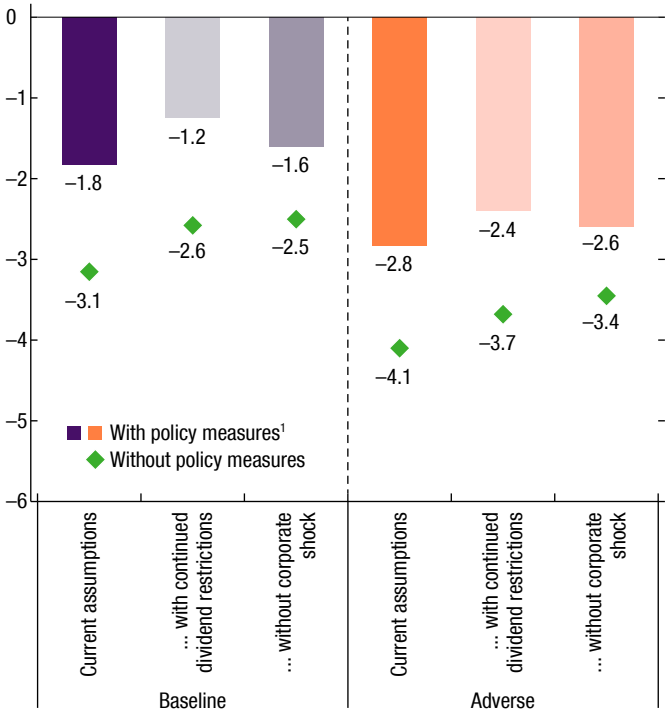
CET1 capital ratios are sensitive to both macroeconomic conditions and the initial health of the bank balance sheets. The pandemic shock to macroeconomic conditions (that is, GDP growth and unemployment rates) exerts its impact on banks' CET1 capital ratio through all the three channels discussed above (profitability, assets, and risk weights). In general, about half of the CET1 capital decline before policy support can be attributed to the macroeconomic shock. However, various initial conditions also influence the outcome. As expected, banks with better pre-stress asset quality (and to a smaller extent, those with higher profitability at the beginning of the crisis) are likely

Figure 18. Euro Area Banks: Solvency Stress Test—Baseline Scenario (EBA Coverage)
(Percent)



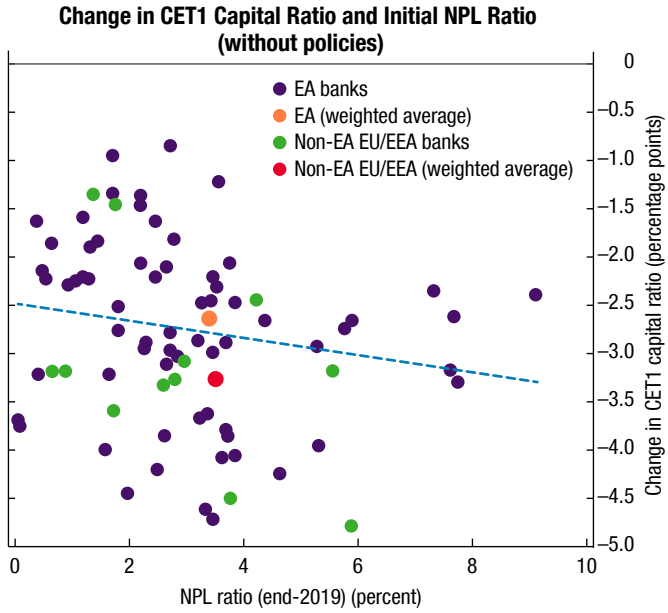
Sources: European Banking Authority; European Central Bank; European Systemic Risk Board; FitchConnect; S&P Global Market Intelligence; and IMF staff estimates.
Note: CCB = capital conservation buffer; CESEE = Central, Eastern, and Southeastern European economies; CET1 = common equity Tier 1; EA = euro area; EU = European Union; MDA = maximum distributable amount (weighted average). Data labels in the figure use International Organization for Standardization (ISO) country codes. The grey shaded area of the boxplots shows the interquartile range (25th to 75th percentile), with whiskers at the 5th and 95th percentile of the distribution. The analysis covers all three channels affecting the capital adequacy ratio under stress—profitability (net interest income and provisions), nominal assets (net lending and charge-offs after reserves), and risk exposure (changes in credit risk weights).
[1]Due to corporate write-offs and net lending—corporate write-offs of new debt-at-risk due to a higher share of illiquid and insolvent firms (weighted by outstanding debt and mapped to the sector-by-sector corporate exposure of sample banks).
[2]Debt repayment relief (moratoria) for businesses and households, corporate credit guarantees, delayed insolvency proceedings, and dividend restrictions (only in 2020).
[3]The Slovak Republic is not included in the EBA Transparency Exercise.
[4]Net profitability impact of policy measures (lower provisions for guaranteed loans to solvent corporates, some loss forbearance on eligible loans under moratoria, and decline in interest income due to duration of debt moratoria (households and businesses)) and change in net operating income after general provisions (including non-interest income and impairment charges for non-corporate exposures) due to lower GDP growth and higher unemployment rate.
[5]Increase of credit risk weights due to higher unexpected losses (derived from the increase of default risk implied by the projected increase of general provisions and specific provisions for additional corporate loan losses) and lower credit risk weights for guaranteed portion of corporate loans.

Figure 19. Euro Area Banks: Change of CET1 Capital Ratio under Different Assumptions
(Percentage points, end-2021 relative to end-2019)



Sources: European Banking Authority; European Central Bank; FitchConnect; S&P Global Market Intelligence; and IMF staff estimates.
Note: CET1 = common equity Tier 1.

Figure 20. European Banks (EBA Sample): Capital Impact and Pre-Stress Bank Asset Quality
(Percent)



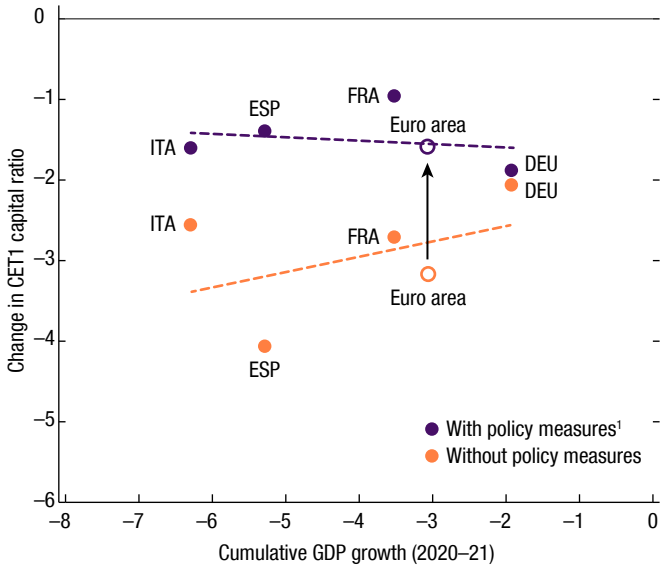
Sources: European Banking Authority; European Central Bank; FitchConnect; and IMF staff estimates.
Note: Excludes outlier banks with pre-stress NPL ratios of more than 10 percent as well as banks with a post-stress change in the CET1 capital ratio of more than 5 percentage points. CET1 = common equity Tier 1; NPL = nonperforming loan.

to experience smaller declines in their CET1 ratios (Figure 20). This illustrates that banks that have aggressively reduced their stocks of legacy NPLs and adopted measures to strengthen operational efficiency before the crisis seem to now benefit from greater resilience in times of stress.

There is no capital shortfall relative to the minimum capital requirement in our baseline results. No bank breaches the regulatory minimum of 4.5 percent even without policy support. However, several banks would breach a hurdle rate comprising both the regulatory minimum and capital conservation buffer (7 percent) without policy support. Policy support is expected to improve bank solvency, lifting the aggregate CET1 ratio to above the 7 percent threshold in all countries (see Figure 25).

Some banks are likely to fall below their threshold for the Maximum Distributable Amount (MDA) if policies do not operate as expected. About 14 percent of the largest (90) euro area banks are likely to breach their MDA

Figure 21. Euro Area Banks: Changes in Capital and Growth
(Baseline scenario [percent], EBA coverage)



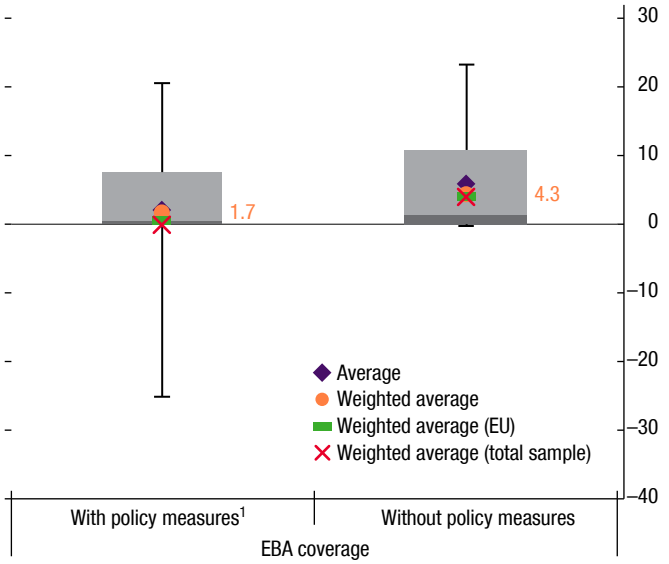
Sources: European Banking Authority; FitchConnect; and IMF staff calculations.
Note: Data labels in the figure use International Organization for Standardization (ISO) country codes. CET1 = common equity Tier 1; EBA = European Banking Authority.
[1]Debt repayment relief (moratoria) for businesses and households, public credit guarantees, deferred insolvency proceedings, and dividend restrictions (only in 2020).

threshold, which varies by bank but averages about 9 percent of risk-weighted assets; this would require €25 billion of new capital (or 1.7 percent of reported CET1 capital at the end of 2019). However, with supportive policies, only a few smaller euro area banks would struggle to clear the MDA hurdle rate. Importantly, banks that cannot meet their MDA would be forced to stop dividends, and then suspend coupon payments to hybrid capital, which could result in a significant funding shock and lower market valuations, while also triggering negative credit rating actions. For many large banks, hybrid capital—which is senior to and hence cheaper than equity capital—is likely to be an important element of a strategy to replenish aggregate capital levels at a time when many banks face a high cost of capital.[1]

Policy support also helps limit greater dispersion in capital levels across larger banks. With large variation in the macroeconomic impact of the pandemic across countries, and widely different initial liquidity/solvency conditions of firms, the shock to bank capital varies greatly across countries absent any mitigating policies, leading to a higher dispersion in CET1 ratios among banks in the bottom half of the distribution (Figure 18, panels 1 and 2). With policies, the hit to capital ratios is smaller, as is the dispersion in capital ratios within the lower half of the CET1 distribution. In fact, policy measures considerably weaken the link between the severity of the macro shock and the change in bank capital ratios (Figure 21). The role of policies in reducing dispersion operates mostly through dampening the increase in risk weights (Figure 22). With policies, average risk weights among euro area banks increase by an average of about 1.7 percent; without policies risk weights increase by more than 4 percent and exhibit slightly larger upside dispersion.

[1]At the end of 2020, close to one-quarter of the capital base of the large euro area banks comprised various forms of hybrid capital. This share is likely to increase as the European Commission has brought forward legislation to allow greater flexibility in the use of hybrid capital for Pillar 1 and 2 minimum capital requirements in its 2020 Banking Package.

Figure 22. Euro Area Banks: Dispersion of Change in Risk Weights
(Baseline scenario [percent], EBA coverage)

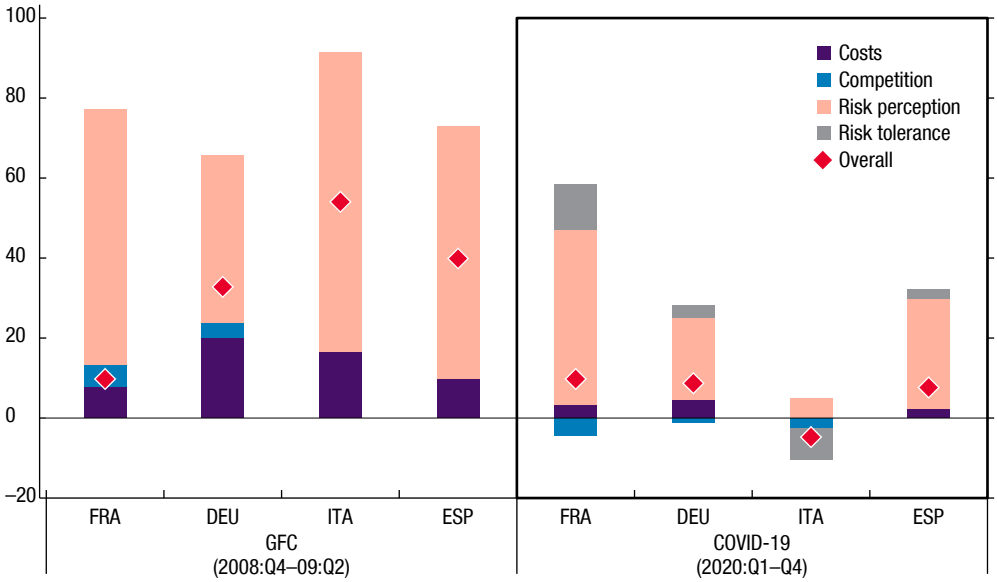


Sources: European Banking Authority; European Central Bank; FitchConnect; and IMF staff estimates.
Note: EBA = European Banking Authority. The grey shaded area of the boxplots shows the interquartile range (25th to 75th percentile), with whiskers at the 5th and 95th percentile of the distribution.
[1]Debt repayment relief (moratoria) for businesses and households, corporate credit guarantees, delayed insolvency proceedings, and dividend restrictions (only in 2020).

Our assessment of capital under baseline conditions with policy measures seems consistent with current developments. Banks' credit standards have not tightened commensurately with the outsized shock of the pandemic and compared to the GFC (Figure 23). But while regulatory flexibility and credit guarantees have cushioned the immediate impact of potential impairments, they have not altered the underlying increase in credit risk. Despite the still favorable credit standards, European banks' willingness to lend over the near term remains subdued across the board, particularly for consumer, corporate, and commercial real estate lending (EBA 2020f). Indeed, banks in vulnerable countries have increased their loan loss provisions on precautionary grounds, and already report a net tightening impact of higher NPL ratios as the effect of the initial pandemic-related containment measures on borrowers becomes increasingly apparent. Although NPL ratios have continued to decline recently, other asset quality metrics already show signs of weakening; notably, forborne exposures and loans classified as "Stage 2" under IFRS-9 have both increased markedly.

While the capital impact in the baseline appears manageable, the materialization of downside risks would significantly increase capital pressures. In an illustrative adverse scenario, we assume a slower pace of economic reopening across countries, with cumulative GDP growth over 2020–21 being 1.2 percentage points below the baseline forecast. This could increase the debt over-

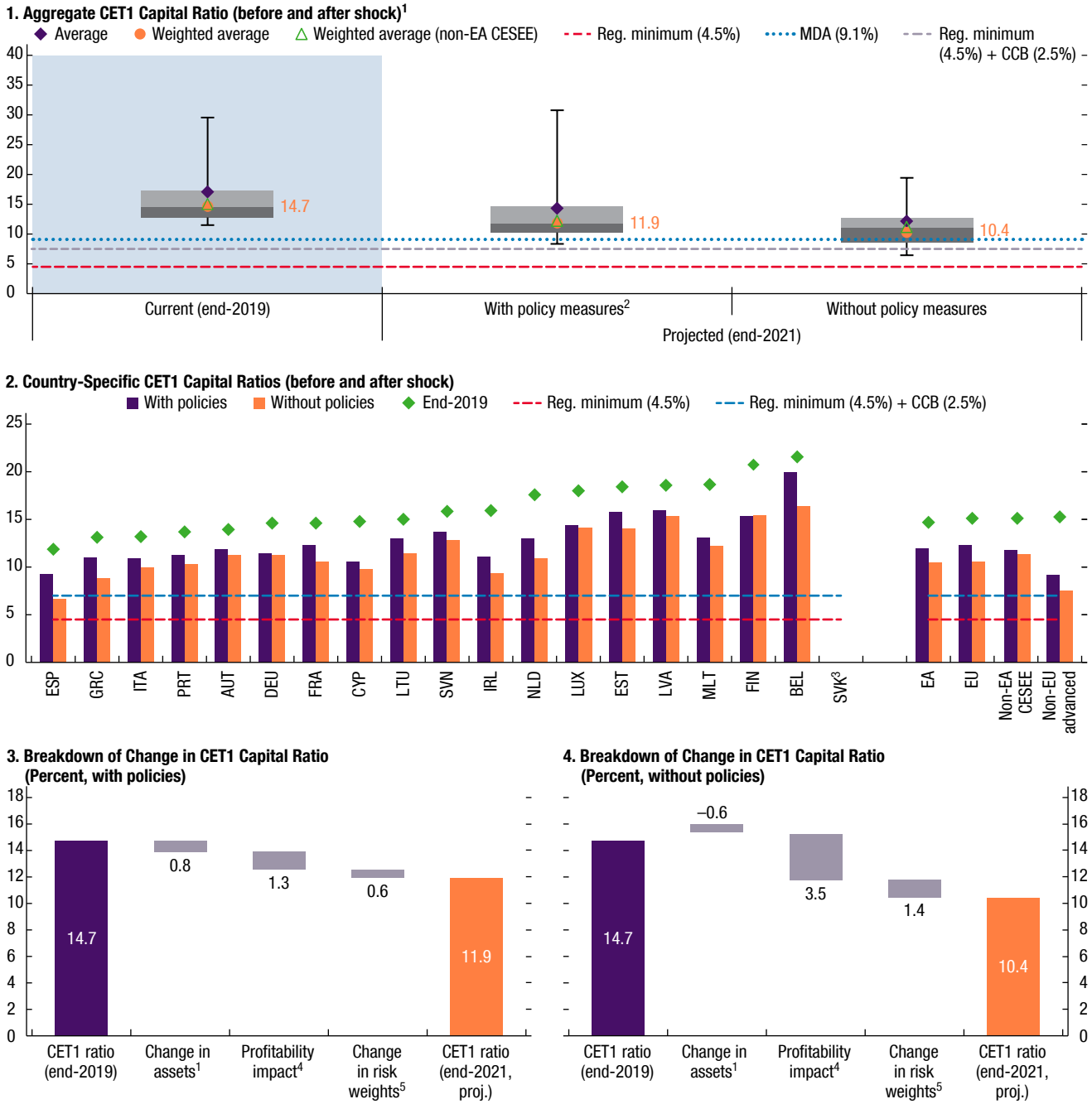
Figure 23. Selected Euro Area Countries: Change in NFC Credit Standards
(Net percentage change; +/= tightening)



Sources: European Central Bank; Haver Analytics; and IMF staff calculations.
Note: Data labels in the figure use International Organization for Standardization (ISO) country codes. GFC = global financial crisis; NFC = nonfinancial corporations. Changes in credit standards during the respective quarter(s) based on net percentages calculated as the difference between banks with tightening versus easing credit standards. Contributing factors do not add up to the overall assessment of credit standards. For the global financial crisis and COVID-19 crisis periods, the quarterly values are averaged.

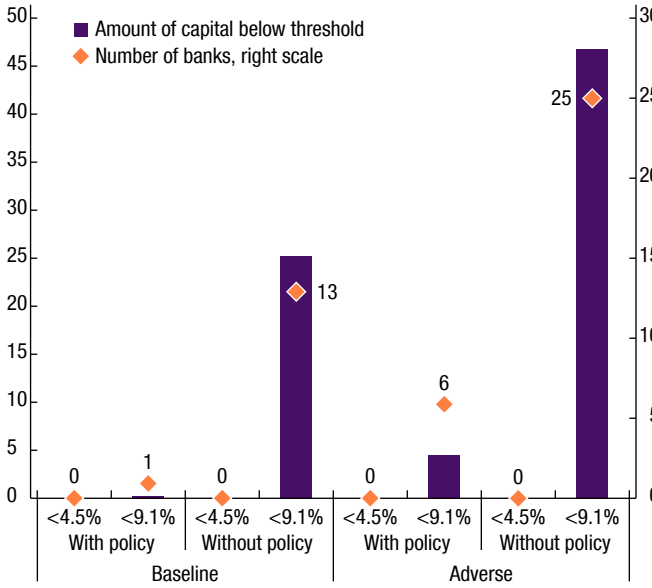
hang and lead to liquidity pressures for firms, especially in vulnerable sectors, resulting in larger credit losses for banks. The CET1 capital ratio would decline by an additional 1 percentage point by the end of 2021—even with current policy measures in place (Figure 24). There would still be no aggregate capital shortfall relative to the prudential minimum of 4.5 percent; however, more than five percent of the large euro area banks (6 banks), would see their CET1 capital ratio drop below the MDA threshold, and, thus, come under additional capital market pressure (Figure 25). These banks are concentrated in Italy, Portugal, and Spain (Figure 23, panel 2). Without policies, more than a quarter of larger euro area banks (25 banks) would breach the MDA threshold, generating a capital need of nearly €47 billion relative to that threshold (or 3.1 percent of reported CET1 capital at the end of 2019). Careful communication of buffer usability and capital relief policies are therefore even more crucial in dampening the hit to bank capital under the adverse scenario (Figure 26). Finally, we should note that the WEO adverse scenario is relatively mild. Increasing the severity of the adverse scenario (similar to the one the ECB examined in its Vulnerability Analysis [Box 2]) would triple the additional output loss over the stress test horizon to about 3 percent, one bank would fall below the prudential minimum of 4.5 percent

Figure 24. Euro Area Banks: Solvency Stress Test—Adverse Scenario (EBA Coverage)
(Percent)



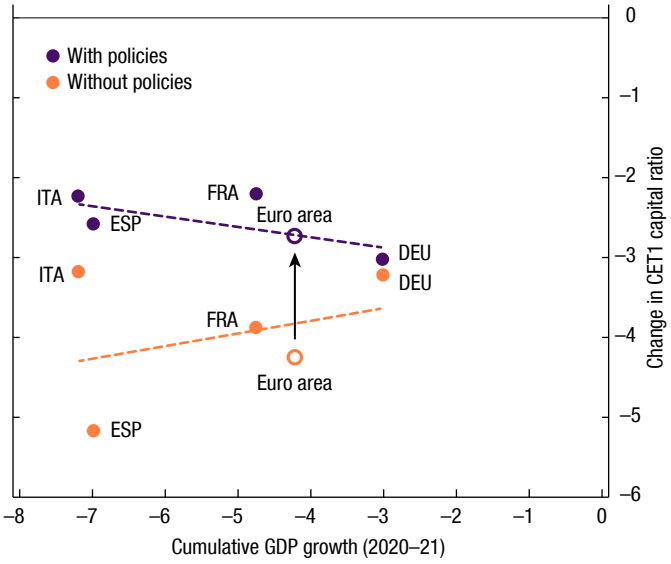
Sources: European Banking Authority; European Central Bank; European Systemic Risk Board; FitchConnect; S&P Global Market Intelligence; and IMF staff estimates.
Note: CCB = capital conservation buffer; CESEE = Central, Eastern, and Southeastern European economies; CET1 = common equity Tier 1; EA = euro area; MDA = maximum distributable amount (weighted average). Data labels in the figure use International Organization for Standardization (ISO) country codes. The grey shaded area of the boxplots shows the interquartile range (25th to 75th percentile), with whiskers at the 5th and 95th percentile of the distribution. The analysis covers all three channels affecting the capital adequacy ratio under stress—profitability (net interest income and provisions), nominal assets (net lending and write-offs after reserves), and risk exposure (changes in credit risk weights).
[1]Due to corporate write-offs and net lending—corporate write-offs are due to the rise of illiquid and insolvent firms (weighted by outstanding debt and mapped to the sector-by-sector corporate exposure of sample banks).
[2]Debt repayment relief (moratoria) for businesses and households, corporate credit guarantees, delayed insolvency proceedings, and dividend restrictions (only in 2020).
[3]The Slovak Republic is not included in the EBA Transparency Exercise.
[4]Net profitability impact of policy measures (lower provisions for guaranteed loans to solvent firms, loss forbearance on eligible loans under moratoria, and decline in interest income due to duration of debt moratoria (households and businesses)) and change in net operating income after general provisions and losses on other noninterest income due to lower GDP growth and higher unemployment rate, including impairment charges for noncorporate exposures.
[5]Increase of credit risk weights due to higher unexpected losses (derived from the increase of default risk implied by the projected increase of general provisions) and additional specific provisions for additional corporate loan losses.

Figure 25. Euro Area Banks—Potential Capital Need and Number of Banks below Thresholds (EBA Coverage)
(EUR billion/count)



Source: Authors' calculations.
Note: EBA = European Banking Authority. The thresholds of 4.5 and 9.1 percent represent the regulatory minimum for the common equity Tier 1 capital ratio (assuming the current capital relief) and the average threshold for the maximum distributable amount for euro area banks, respectively. Sample of 90 banks covered by the EBA Transparency Exercise ("EBA Coverage").

Figure 26. Euro Area Banks—Changes in Capital and GDP Growth, Adverse Scenario
(EBA sample)



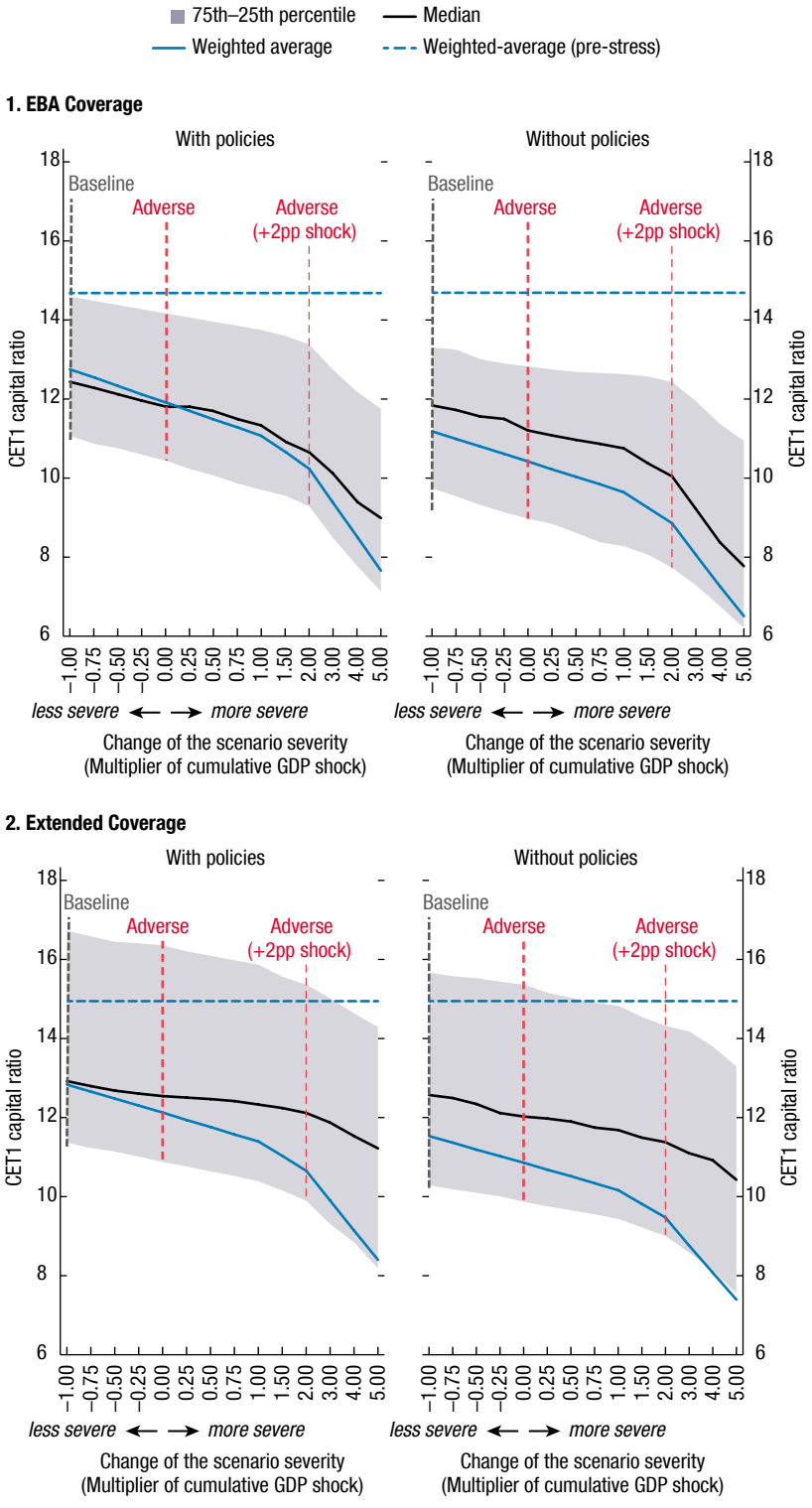
Sources: European Banking Authority; FitchConnect; and IMF staff calculations.
Note: Data labels in the figure use International Organization for Standardization (ISO) country codes. EBA = European Banking Authority.

and a quarter of the banks would be at or below the MDA threshold—even with effective policy measures in place (Figure 27).

Absent a material rise in profitability, replenishing bank capital buffers in an organic manner will take time. Assuming that banks revert to their long-term pre-crisis profitability of about 0.4 percent (without changing their leverage) and resume dividend payouts after this year, it would take them more than 2½ years on average to replenish their capital buffers by 1.6 percentage points (which corresponds to the expected capital depletion to a CET1 capital ratio of 13.1 percent at the end of this year) (Figure 28). However, if earnings capacity during the recovery phase were to be subdued, at about half the historical average, this would lengthen the duration of the capital replenishment path to more than five years. Alternatively, banks would need to nearly triple their long-term profitability to restore their pre-crisis CET1 capital ratio of 14.7 percent by the end of 2022.[2]

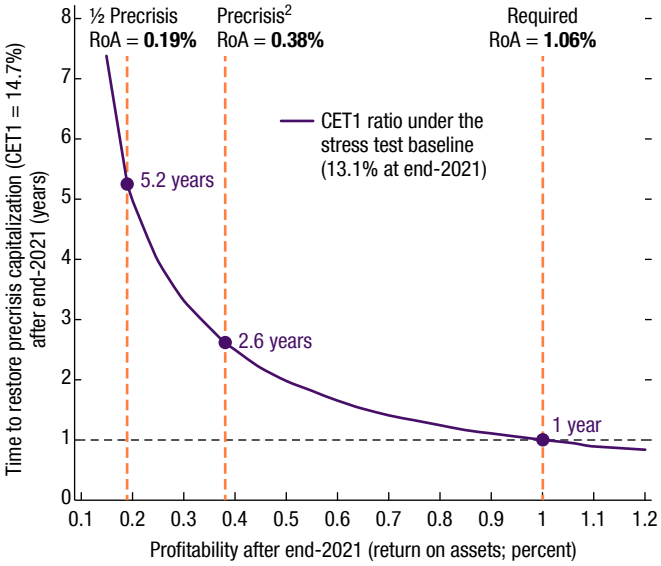
[2]Restoring capital buffers might also become more challenging in anticipation of the capital impact of impending regulatory changes. For instance, EBA estimates that banks' transition to the "Basel IV" regime (and the EU implementation in the Single Rulebook) could reduce average CET1 capital ratios by about 2 percentage points on average (with significant variation across banks) (EBA 2019).

Figure 27. Euro Area Banks: Sensitivity of Projected CET1 Capital Ratio to the Severity of the Adverse Scenario
(Percent)



Source: IMF staff estimates.
Note: CET1 = common equity Tier 1; EBA = European Banking Authority.

Figure 28. Euro Area Banks: Time to Restore Precrisis Capitalization (CET1 = 14.7%) through Profits after end-2021[1]
(Years)



Sources: European Central Bank; FitchConnect; and IMF staff calculations.
Note: CET1 = common equity Tier 1; RoA = return on assets.
[1]Long-term average until end-2019.
[2]Assumptions: average asset risk weight = 40 percent, taxes = 20 percent, dividend payout ratio = 15 percent.

Box 2. Comparison of Stress Test Results with the ECB Vulnerability Analysis

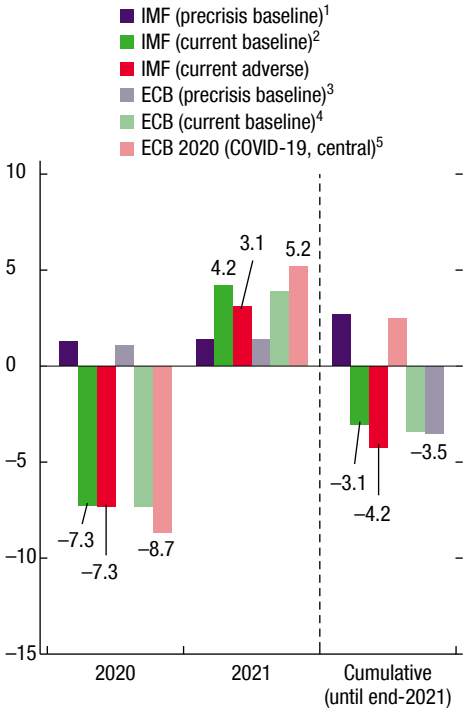
In July 2020, ECB Banking Supervision completed a Vulnerability Analysis (ECB, 2020a) of the largest euro area banks to the impact of the COVID-19 outbreak. The analysis focused on the early-stage impact of the crisis on the capital position of 86 banks directly supervised by the ECB and aimed to identify potential vulnerabilities over a three-year time horizon. The baseline scenario of this exercise ("central scenario") projected a decline of economic activity by 8.7 percent in 2020, followed by a dynamic recovery in the subsequent years, with real growth of 5.2 and 3.3 percent in 2021 and 2022, respectively (Box Figure 2.1). Relative to the pre-crisis baseline forecast in December 2019, the "central scenario" assumes a cumulative output loss of 6.0 percent during 2020–21, which is similar to the 5.8 percent-decline under the baseline exercise—and more severe than the adverse scenarios of system-wide stress tests the ECB completed as part of EBA's biannual exercise (Box Figure 2.2).[1]

The results from ECB's analysis are consistent with those from our exercise and provide an important source of cross-validation. The ECB found that banks can withstand pandemic-induced stress under baseline conditions but that under the adverse scenario, depletion of bank capital would be material and several banks would need to take action to maintain compliance with their minimum capital requirements. More specifically, the CET1 capital ratio of banks declines by 1.9 percentage points in the baseline scenario over a three-year time horizon (Box Figure 2.3). This is similar to the result from our exercise, which identifies a 1.7 percentage point capital impact over a two-year period (after considering all relevant policy measures). Some of the difference might be explained by our more comprehensive coverage of supervisory and fiscal relief measures taken in response to the coronavirus crisis, including borrower support in the form of debt repayment relief and deferred bankruptcy proceedings, which were excluded from the ECB's Vulnerability Analysis. We also find that the increase in the risk-weighting of credit sensitive assets would be considerably smaller than that projected by the ECB (assuming that the policy measures are effective) (Box Figure 2.4).

[1]The ECB analysis also included an adverse scenario incorporating a cumulative output loss of –9.3 percent (over the first two years of the stress test time horizon); this is considerably more severe than our adverse scenario and hence the results for capital ratios are not readily comparable with our exercise.

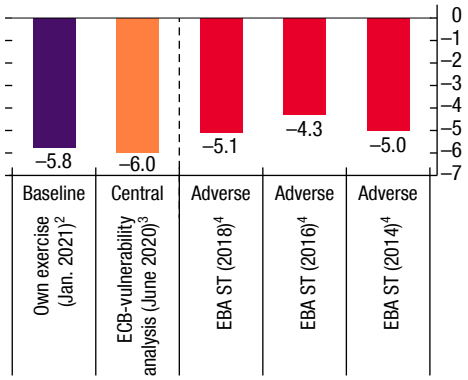
Box 2. Comparison of Stress Test Results with the ECB Vulnerability Analysis *(continued)*

Box Figure 2.1. GDP Growth
(Percent)



Sources: European Central Bank (ECB); and IMF staff calculations.
[1]January 2020 *World Economic Outlook Update*.
[2]January 2021 *World Economic Outlook Update*.
[3]ECB macroeconomic projections in December 2019.
[4]ECB macroeconomic projections in December 2020.
[5]ECB macroeconomic projections (baseline and adverse) in June 2020.

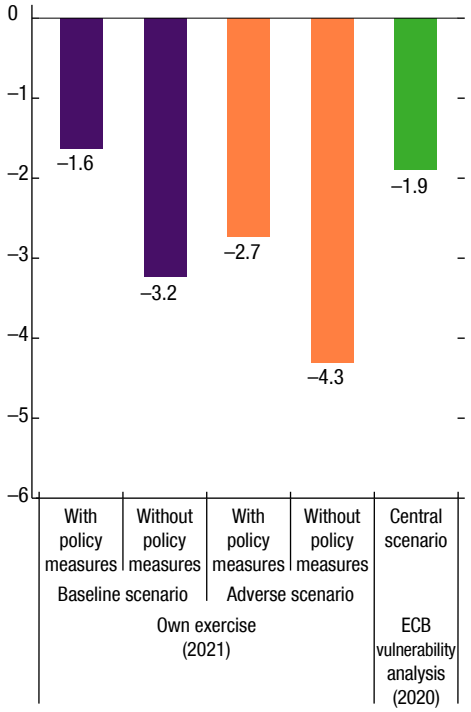
Box Figure 2.2. Comparison of Baseline Growth Shock in IMF and ECB Exercises Compared to Adverse Scenarios in EBA Stress Tests
(Percentage point deviation from [precrisis] baseline)[1]



Sources: European Banking Authority; European Central Bank; European Systemic Risk Board; and IMF staff calculations.
Note: EBA = European Banking Authority; ECB = European Central Bank; ST = stress test.
[1]Two-year cumulative deviation of real growth rate (for the ECB and EBA exercises, which cover three years, the first two years were chosen).
[2]Baseline projections based on IMF *World Economic Outlook* forecast in January 2021 for 2020 and 2021 (relative to precrisis forecast in January 2020).
[3]Based on ECB June 2020 baseline ("central") forecast for 2020 and 2021 (relative to ECB precrisis baseline forecast in December 2019).
[4]Based on deviation of growth rate in adverse scenario relative to baseline forecast for euro area in EBA system-wide stress tests in 2014, 2016, and 2018.

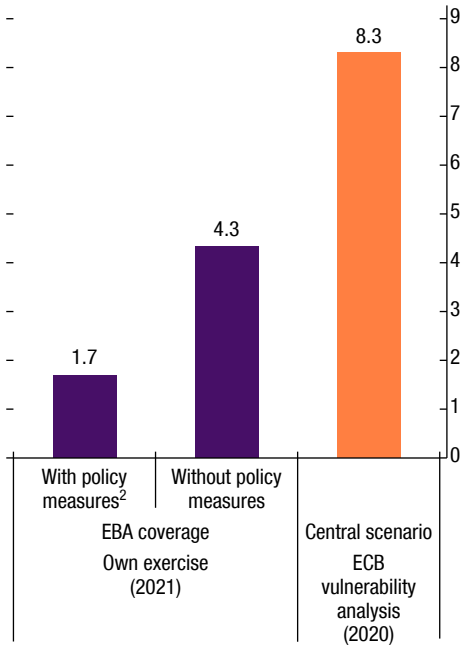
Box 2. Comparison of Stress Test Results with the ECB Vulnerability Analysis *(continued)*

Box Figure 2.3. Euro Area Banks: Projected Change of CET1 Capital Ratio
(Percentage points, end-2021 relative to end-2019)[1]



Sources: European Banking Authority; European Central Bank; S&P Global Market Intelligence; and IMF staff calculations.
Note: CET1 = common equity Tier 1; ECB = European Central Bank.
[1]Based on EBA coverage of 90 euro area banks ("EBA sample").

Box Figure 2.4. Euro Area Banks: Comparison of Average Change in Asset Risk Weights with ECB Vulnerability Analysis (Baseline Scenario)
(Percent)[1]



Sources: European Banking Authority; European Central Bank; FitchConnect; S&P Global Market Intelligence; and IMF staff estimates.
Note: ECB = European Central Bank.
[1]Averages weighted by assets.
[2]Debt repayment relief (moratoria) for businesses and households, corporate credit guarantees, delayed

CHAPTER

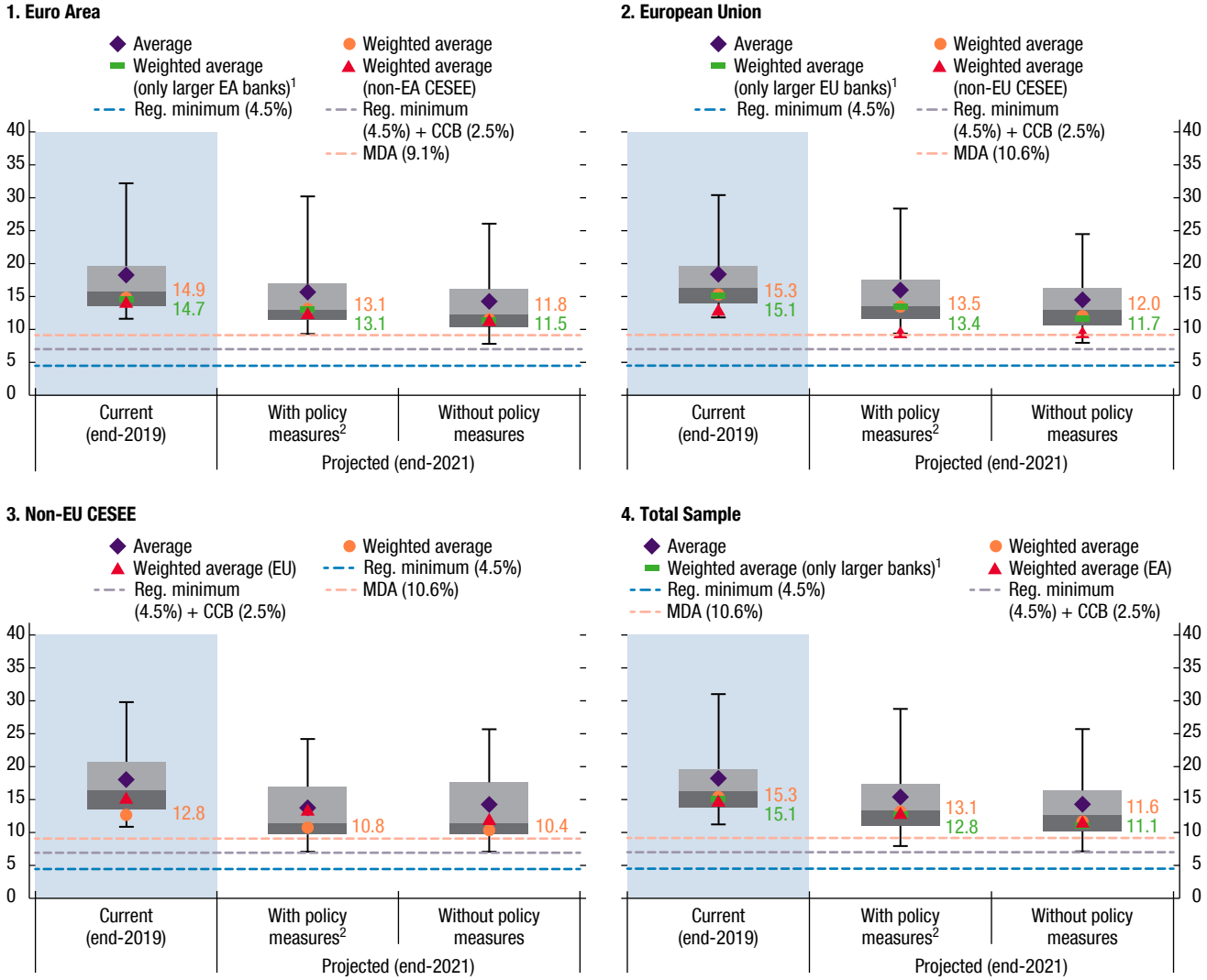
7 Expanding the Analysis Beyond Euro Area Banks

Expanding the empirical coverage of the analysis to a broader set of banks provides additional insights into the Europe-wide capital impact of the COVID-19 crisis. We supplement the coverage of 90 euro area banks included in the EBA Transparency Exercise (EBA 2020f) ("EBA coverage") with publicly available financial statement data from FitchConnect and S&P Market Intelligence. Increasing the original sample to 468 banks in 40 countries (Figure 13) provides for a more representative sample of banks and allows us to apply our methodology also to smaller euro area banks and European banks outside the euro area (that is, banks in non-euro area advanced economies and Central, Eastern and Southern European (CESEE) countries). The lack of information on granular bank-level sectoral exposure for banks that are not included in the EBA Transparency Exercise requires some approximations; for example, the sectoral exposure of smaller banks that are not included in the EBA Transparency Exercise is assumed to be same as the average sectoral exposure of banks included in the EBA Transparency Exercise in the same country.[1] However, the sensitivity of profitability and its components, NPLs, and loan growth to macroeconomic variables and bank-level characteristics are estimated with subsample-specific coefficients from the satellite model to account for this more heterogenous set of banks (Annex 2).

The findings from the extended sample are similar to those in our main exercise (Figure 29).

[1]For banks in non-EU/European Economic Area countries, which fall outside the scope of the EBA Transparency Exercise, banks' sectoral exposure is assumed to be the same as the average sectoral exposure in one or more neighboring countries whose banks are included in the EBA Transparency Exercise. For instance, the asset-weighted average exposure of Polish banks is used as proxy for the sectoral exposures of banks in the Czech Republic and the Slovak Republic. In practice, corporate losses could be larger for banks outside the EBA sample as smaller banks tend to lend more to highly affected firms (Diez and others 2021).

Figure 29. Solvency Stress Test—Dispersion of CET1 Capital Ratio (Baseline Scenario/Extended Coverage)
(Percent)



Sources: European Banking Authority; European Central Bank; European Systemic Risk Board; FitchConnect; S&P Global Market Intelligence; and IMF staff calculations.
Note: The grey shaded area of the boxplots shows the interquartile range (25th to 75th percentile), with whiskers at the 5th and 95th percentile of the distribution. CCB = capital conservation buffer; CESEE = Central, Eastern, and Southeastern European economies; CET1 = common equity Tier 1; MDA = maximum distributable amount (weighted average). The analysis covers all three channels affecting the capital adequacy ratio under stress—profitability (net interest income and provisions), nominal assets (net lending and write-offs after reserves), and risk exposure (changes in credit risk weights). The crisis-specific risk drivers of these channels are (1) write-offs due to the projected insolvency of illiquid and insolvent firms (weighted by outstanding debt and mapped to the sector-by-sector corporate exposure of sample banks); (2) the profitability impact of policy measures (lower provisions for guaranteed loans to solvent firms, loss forbearance on eligible loans under moratoria, and decline in interest income due to duration of debt moratoria); and (3) the increase in risk weights to the general increase of the default risk of mortgages and firms. In addition, there is a general change in net operating income after general provisions and losses on other noninterest income due to lower GDP growth and higher unemployment rate, including impairment charges for noncorporate exposures.
[1]Only larger banks covered by the EBA Transparency Exercise.
[2]Debt repayment relief (moratoria) for businesses and households, corporate credit guarantees, delayed insolvency proceedings, and dividend restrictions (only in 2020).

- *All euro area banks.* The impact on bank solvency for all euro area banks, with and without policy measures, is slightly higher than for larger euro area banks included in the EBA Transparency Exercise. However, given their slightly higher CET1 capital ratio at the end of 2019 (14.9 percent, compared to 14.7 percent), the projected CET1 capital ratio under stress is about the same (Annex Figures 1.3 and 1.5). Euro area banks in the expanded sample are likely to absorb the capital impact without breaching regulatory capital requirements under both adverse and baseline scenarios. However, even under baseline conditions, about 9 percent of all euro area banks covered in the expanded sample are likely to breach their MDA threshold if policies do not operate as expected; this would require €26 billion of new capital (or 1.7 percent of reported CET1 capital at the end of 2019) to avert capital market pressure. With supportive policies, only about 3 percent of all euro area banks in our extended sample would struggle to clear the MDA hurdle rate, generating a capital shortfall of €0.6 billion. In the adverse scenario, the number of banks that are likely to fall below their threshold for the MDA doubles relative to the baseline results, with and without policies (Annex Figures 1.10 and 1.11).
- *Non-EU CESEE banks.* Non-EU CESEE banks have a much lower CET1 capital ratio at end-2019 and are expected to suffer somewhat higher capital erosion than euro area banks, resulting in a projected CET1 capital ratio of 10.8 and 10.5 percent under the baseline and adverse scenarios, respectively (Annex Figures 1.12 and 1.13). Reflecting smaller policy space and associated less-generous support measures for borrowers and banks among non-EU CESEE countries, the cushioning effect of mitigation policies is estimated to be smaller than for euro area banks; mitigating policies lift CET1 capital ratios in non-EU CESEE banks by merely 0.4 percentage point, compared to around 1.3 percentage points among euro area banks covered by the EBA Transparency Exercise.[2]

Annex Figures 1.6 and 1.8 show that, similar to the largest banks in the EBA Transparency Exercise, banks in the expanded sample in the euro area and the EU would experience roughly balanced contributions from the three channels of transmission (profitability, assets, and risk weights) under the baseline policy scenario. Absent policies, the capital erosion among euro area and EU banks stemming from the profitability channel would become about three times larger, and twice as large from the risk weight channel in the baseline macro scenario. The relative importance of the profitability channel for the overall impact and policy responsiveness is preserved in the illustrative adverse scenario for the expanded euro area and EU banks sample, though absolute magnitudes of capital erosion are larger. In contrast, for non-EU

[2]Given the nascent implementation of the MDA concept in non-EU CESEE countries, the paper does not provide estimates of potential capital shortfalls to this hurdle rate.

CESEE banks covered in the expanded sample, the risk weight channel explains most of the decline in CET1 capital ratios (Annex Figures 1.10 and 1.11). The dominance of the risk weight channel reflects the low asset quality among many banks in the CESEE region, as a result of the rapid buildup of NPLs over recent years (Table 1), which exposes these banks to a disproportionate increase in unexpected losses and associated risk weights.

CHAPTER

8 Summary and Policy Implications

In summary, we find that European banks are likely to remain broadly resilient to the pandemic shock, but with considerable cross-country variation due to different macroeconomic paths, initial capital buffers, and levels of policy support. Most banks entered the pandemic with sizeable capital buffers, which helped cushion the direct effects of the crisis on asset quality. While bank capitalization remains appropriately high, a deterioration of asset quality is likely to adversely affect banks' already low profitability, especially for those with significant credit exposures to firms operating in vulnerable sectors. During the first lockdown and subsequent reopening, fiscal support limited the rise in unemployment rates and firm bankruptcies. Banks were able to slowly absorb rising impairments without a significant change in their capital ratios given continued borrower support and effective capital conservation measures. However, we find a larger capital impact on banks in countries that have been hit especially hard by the pandemic, and for banks with higher initial NPLs and large exposures to highly affected sectors.

Credit supply constraints might arise as capital buffers are depleted. Even though both profitability and capital improve during the recovery phase in 2021, there is likely to be considerable drag from higher NPLs (Aiyar and others 2015). An erosion of capital buffers, if left unaddressed, could reduce loan growth going forward. The longer the crisis lasts, the higher the risk that banks will experience a significant deterioration in asset quality in their loan portfolios. Subdued economic activity owing to a delayed reopening would exacerbate the liquidity problems of borrowers and increase debt overhang, especially in vulnerable sectors. This would result in potentially much higher loan loss provisions and larger credit losses. In turn, banks' diminishing capacity to lend would likely weigh on financing for consumption and investment at precisely the time when it is most needed. Lower capital buffers under the baseline scenario would force some banks to cut back lending to conserve capital. Estimates under the baseline scenario suggest that capital

constraints could reduce lending growth by about 1.6 percentage points next year. However, if policy measures do not fully operate as expected, credit growth could slow by about 3 percentage points—corresponding to the average credit growth of large euro area banks in 2019.

Under the adverse scenario, the erosion of bank capital becomes much larger, especially after support measures expire and default risk increases. While potential capital shortfalls remain small, more banks would be likely to de-leverage to preserve sufficient capital to prevent market pressures as their CET1 capital ratios approach the MDA threshold.

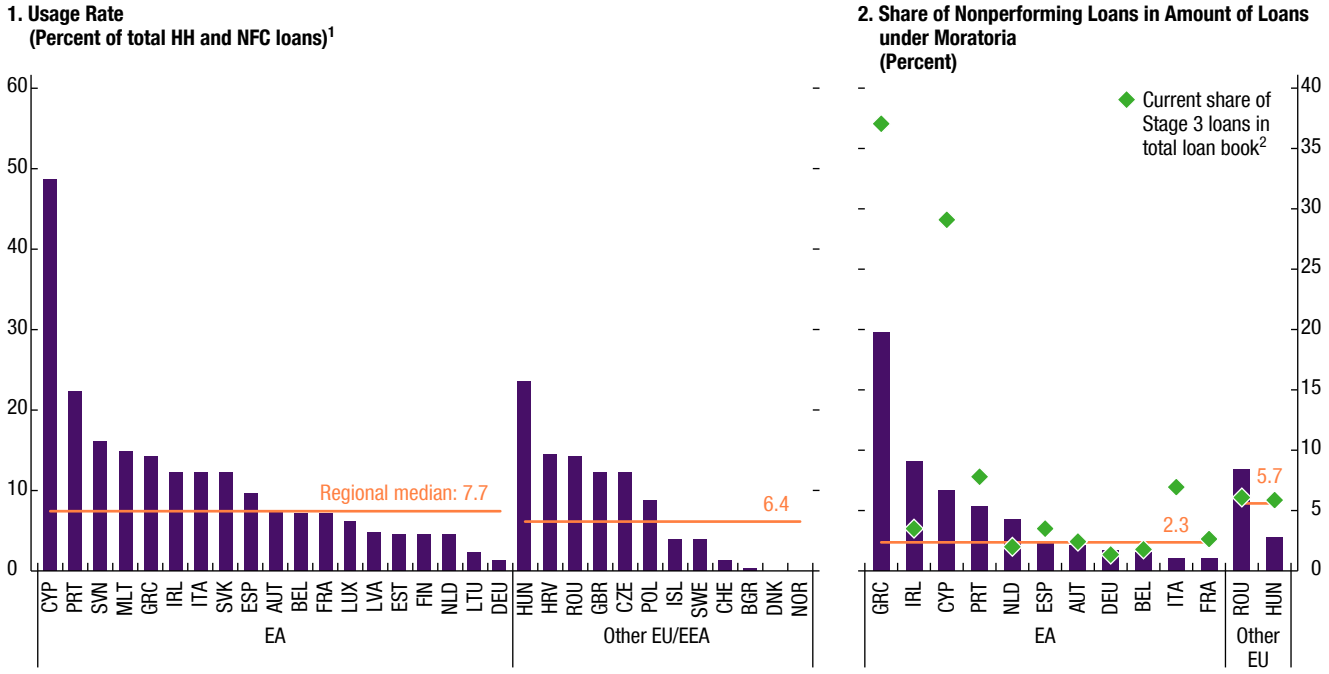
These results suggest a multi-pronged strategy, focusing on the following areas.

Borrower Support

In the near term, bankruptcies could start rising as insolvency moratoria phase out while the expiry of other borrower support measures could increase credit risk and cause lending conditions to tighten (Figure 30). Governments should ensure a smooth transition by continuing some direct support for firms, targeting those whose operations have been temporarily impaired by health risks or social distancing restrictions and firms that are crucial for the economy to function, while facilitating the exit of unviable ones. Implementing such triage is inherently difficult, given the uncertainty surrounding the post-pandemic landscape. At this stage policymakers should err on the side of caution, recognizing that it is better to preserve some firms that will ultimately prove to be unviable than to allow the wholesale closure of viable firms. As the recovery gains momentum, eligibility criteria should be tightened to better target illiquid but viable firms in the most affected sectors and the most vulnerable households, while preventing credit misallocation and the rise of "zombie" firms. The following considerations should influence the trade-offs related to the scale and duration of borrower support measures:

- *Debt repayment relief.* Under normal circumstances, the best form of debt-service relief is a tailored package offered by banks to a stressed but potentially viable borrower. Such operations should remain a core element of banks' toolkits—to pre-empt missed payments or, failing that, to restore loans to performing status if current arrears are temporary and regular payments are expected to resume over a reasonable time horizon. The crisis has demonstrated that broadly available lifelines, such as general debt moratoria, can be effective in preventing widespread insolvencies of otherwise viable (but temporarily illiquid) borrowers. However, moratoria are not sustainable over a longer time horizon, since they defer banks' accrued

Figure 30. European Banks: COVID-19 Pandemic-Related Repayment Relief—Usage Rate and Share of Nonperforming Loans



Sources: European Banking Authority; and IMF staff calculations.
Note: Data labels in the figure use International Organization for Standardization (ISO) country codes. EA = euro area; EEA = European Economic Area; HH = households; NFC = nonfinancial corporations; NPL = nonperforming loans.
[1]The usage rate refers to the share of the outstanding stock of loans that have been reported as being subject to debt repayment relief via legislated or non-legislated moratoria (based on as of the end of June 2020 values).
[2]Under IFRS 9 classification.

interest income, putting pressure on net operating income and potentially distorting asset valuations through inappropriate loan classification and loan loss provisions. Blanket moratoria also operate indiscriminately, raising questions of fairness and compensation for bank claimants, and potentially weakening the repayment culture. As the recovery takes hold, better targeting illiquid but viable firms and the most vulnerable households would make moratoria more effective and efficient. Available moratoria should be extended only if they do not risk distorting classification and provisioning requirements, while banks should be encouraged to restructure the debts of illiquid but likely viable borrowers.

- *Credit guarantees.* As a tool for targeted support, public sector credit guarantees may be preferable to a mandatory blanket moratorium (Bhatia and others, forthcoming). The design of guarantees should ensure that banks' incentives to select and service borrowers are aligned with the public sector interest of limiting losses beyond what is required to address any market failure ("skin in the game"). The realization of contingent liabilities could

result in additional public debt and potentially increase the sovereign-bank nexus, especially in fiscally more vulnerable countries and less capitalized banking sectors (Lozano Guerrero, Metzler, and Scopelliti 2020).[1]

Capital Relief and Conservation Measures

- *Clarify the effective availability of capital buffers.* Many banks have been reluctant to dip into capital buffers (ECB 2020b) since effective hurdle rates, such as the MDA, are much higher than the current prudential minimum.[2] Supervisors encouraged banks to use their capital buffers (Figure 8; ECB 2021c). However, any breach of the combined buffer requirement, which forms a significant part of the MDA, will lead to restrictions on dividend distributions and coupon payments on hybrid capital.[3] Since there is considerable overlap between the MDA and capital that in principle could be used to withstand stress, supervisors need to clearly convey to banks and investors the extent to which capital buffers can be used to avert market pressures.[4] Beyond the specific concern about the MDA, there is a more general question as to whether the current "stacking" of banks' capital provides sufficient flexibility to create releasable capital buffers during times of stress (Schmitz and others 2021).

- *Adopt a realistic timetable for replenishing capital buffers.* Supportive financial sector measures, including restrictions on dividend payouts and share buybacks, should be maintained until the recovery is well underway.[5] This would allow the gradual rebuilding of capital and liquidity buffers without impairing the capacity to lend. Current supervisory guidance states that capital buffers can be used through the end of 2021, and that the capital add-on under Pillar 2 Guidance does not need to be replenished until after

[1]Looking forward, it is also important to note that some policy measures will have a permanent effect on bank capital even after borrower eligibility has expired. While the effect of debt moratoria will fade over time, in most cases, credit guarantees will remain effective until the maturity date of covered loans, which will permanently reduce LGDs, and, thus, lower expected and unexpected losses reflected in the determination of loan loss coverage through provisions and credit risk weights.

[2]In addition to the MDA, the minimum required eligible liabilities (MREL) and the introduction of a binding leverage ratio in 2021 may also constrain the use of capital buffers.

[3]The EU-proposed "parallel stacking" as a new approach to determining the output floor for the calculation of the minimum capital requirement could reduce the amount of capital buffers banks would need to replenish; but lowering the minimum capital requirement is also likely to make the MDA more binding for banks (EBA 2020g).

[4]The large price decline of European banks' hybrid capital instruments at the onset of the COVID-19 crisis underscores the importance of the MDA hurdle for the market valuation of banks and their cost of capital during times of stress.

[5]This is in line with the ECB's recent recommendation (ECB, 2020e) on the very restricted resumption of dividend payments; banks are generally encouraged to refrain from or limit shareholder payouts until September 2021.

2022 (ECB 2021b). However, it is not clear when banks are expected to start restoring their capital buffers, and which ones should be restored. Banks may be cautious about using their capital buffers because they can take a long time to replenish (Figure 28). The starting point and desired speed of the replenishment path of capital should be state dependent, seeking to preserve lending capacity subject to evolving macroeconomic conditions. A strategy overly focused on quick and early replenishment could discourage buffer use and slow the recovery (Borsuk, Budnik, and Volk 2020).

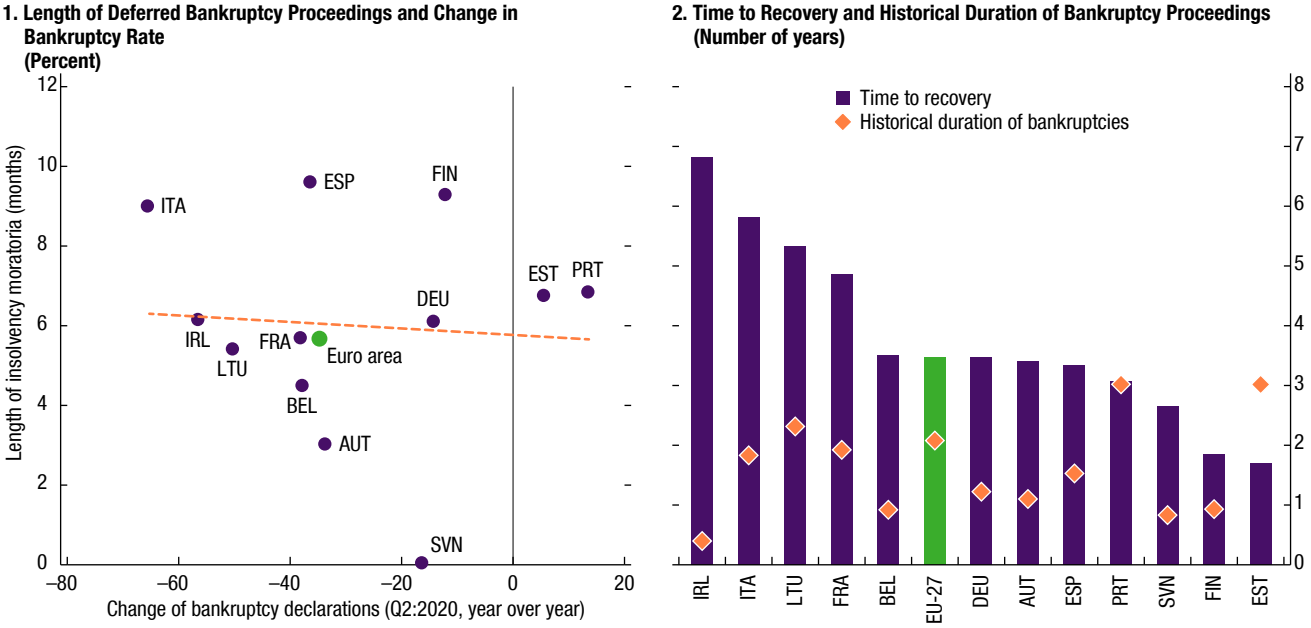
NPL Management and Bank Resolution Frameworks

- *NPL management.* As the recovery takes hold, prudential standards should be normalized—and clearly communicated—to incentivize timely recognition of problem assets through greater balance sheet transparency and upgraded reporting. Supervisors should enhance NPL monitoring to ensure that banks have the capacity to adequately provision for impaired loans.[6] Keeping banks' balance sheets transparent and implementing credible NPL reduction strategies will help avoid cliff effects once supportive policies are phased out. Fostering the development of secondary markets for distressed assets would also facilitate the disposal of NPLs, particularly for smaller banks. In some countries and for some types of loans, asset management companies (AMCs) could help offload NPLs. But this would need to proceed with care and be subject to appropriate safeguards, since NPL sales during times of stress are likely to entail losses that need to be borne by either the banks' shareholders (potentially amplifying capital pressures) or governments, if public support is required to attract private investors (Aiyar and others 2015).[7]
- *Insolvency proceedings.* The deferral of insolvency proceedings in many countries has delayed defaults (Figure 31, panel 1) but also created a legacy risk of pent-up creditor claims and reduced asset recovery prospects. Historically, bankruptcy proceedings have taken about one to three years, but with substantial heterogeneity among countries (Figure 31, panel 2). There is an urgent need to provide EU-level benchmarks for upgrading insolvency regimes in Member States to reduce the the time and cost of insolvency proceedings (Bhatia and others 2019, EBA 2020a). Such improvements would not only facilitate economic restructuring in the years ahead but also reduce fragmentation and strengthen the euro area's resilience to future

[6]In 2017, ECB-Banking Supervision called for clearly defined internal criteria to identify indicators of unlikeliness to pay (UTP). Banks should ensure that the definition of NPLs and the criteria for identifying UTP are implemented uniformly in all parts of banking groups (ECB, 2017).

[7]See also Boot and others (2021) for an overview of potential policy measures to address the rising risk of corporate insolvencies and their impact on the banking sector in Europe.

Figure 31. Selected Euro Area Countries: Bankruptcy Build-up and Precrisis Length of Insolvencies



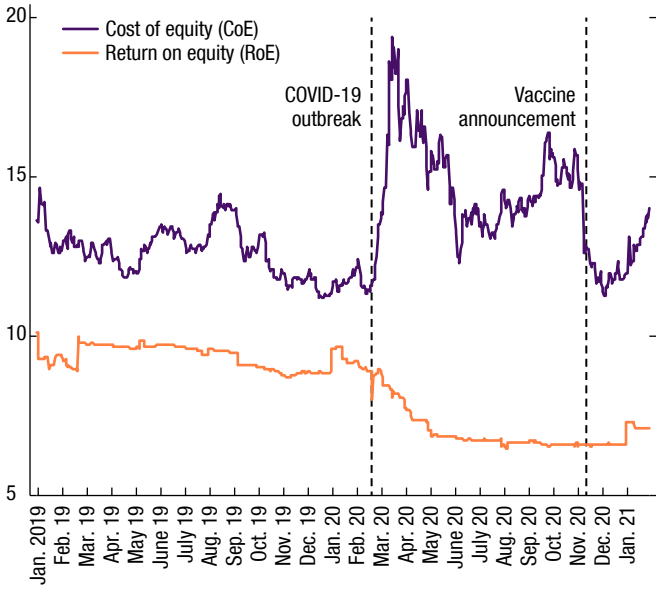
Sources: CEIC; European Banking Authority; Eurostat; Haver Analytics; KPMG; Linklaters; Organisation for Economic Co-operation and Development; and IMF staff calculations.
Note: Data labels in the figure use International Organization for Standardization (ISO) country codes. The historical duration of bankruptcy proceedings for the EU-27 is a simple average across all member states. The time to recovery is defined as the duration in years of the recovery period (as part of the recovery rate process, from the start of the formal enforcement status to the date of ultimate recovery from the formal enforcement procedures). The recovery rates represent a simple average of the EBA-reported values for corporate and SME loans. For Belgium and Lithuania, the time to recovery applies to SMEs only. For Germany, the time to recovery for corporates is proxied by commercial real estate loans. EBA = European Banking Authority; SME = small and medium enterprise.

shocks (Aiyar and others 2019). Countries should address potential administrative constraints and fast-track court procedures to support debt restructuring. They should also put in place efficient out-of-court workouts with separate tracks for firms, SMEs and households, which have often proved to be quicker and less costly than court-led procedures.

- *Bank capital planning and resolution.* To the extent that banks experience a significant depletion of capital buffers and conditions are unfavorable to raise fresh capital from markets, taxpayer-funded capital injections might become necessary. The EU authorities should use the current system-wide stress test (EBA 2020e, 2021a), expected to be completed in July 2021, to assess banks' potential recapitalization needs under a realistic adverse scenario. Precautionary recapitalizations could then occur using the flexibility provided by the Temporary State Aid Framework (EC, 2020) for public financial support to vulnerable banks. The results from such an exercise could also help supervisors challenge banks' capital projections in the supervisory review and evaluation process (SREP), foster consistency in the assessment of risks, and promote prudent provisioning policies

(ECB 2020a, EC 2021a). The current flexibility in providing public support could also provide impetus to strengthening the EU's crisis resolution framework (IMF 2018, EC 2021a).

Figure 32. European Bank Performance Metrics
(Percent)



Sources: Bloomberg Finance L.P.; and IMF staff calculations.
Note: 2022 consensus EPS forecasts are used for the market-implied cost of equity, with consensus expectations used for return on equity.

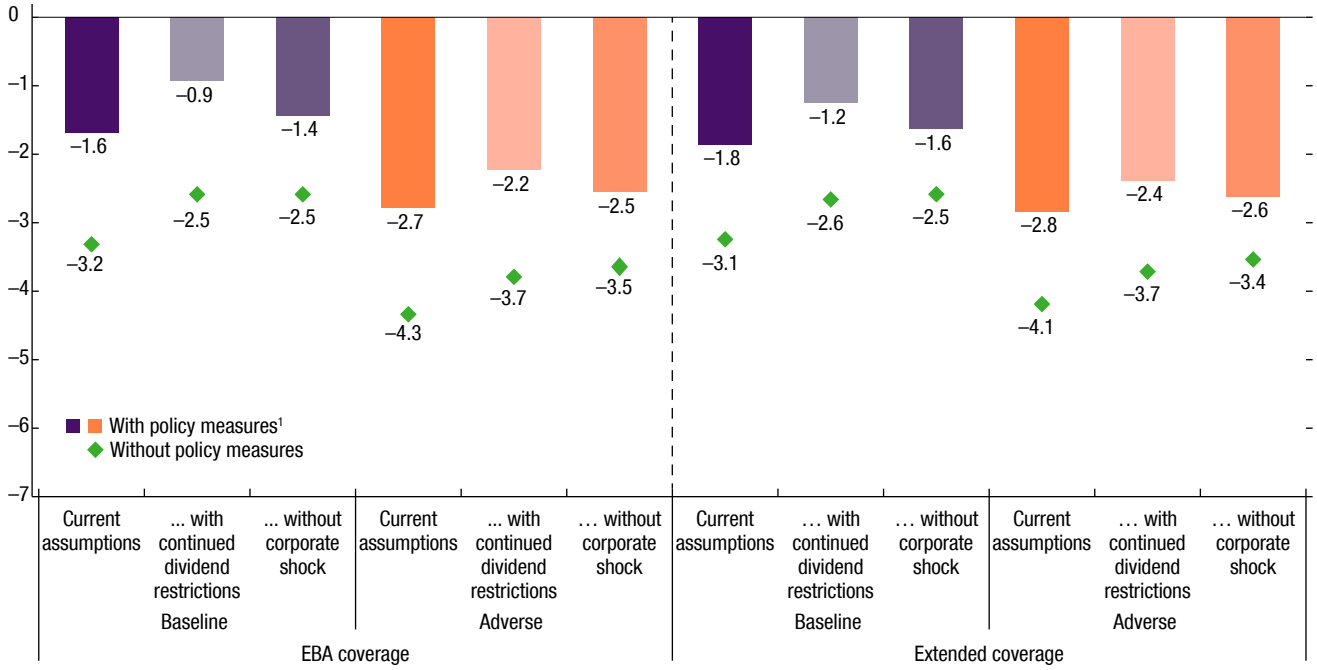
Tackling Chronic Low Profitability

Over the medium term, addressing banks' structurally low profitability will be essential to permit "self-healing" once the recovery has gained traction. Earnings capacity is likely to remain subdued over the medium term, limiting the ability of banks to restore capital buffers organically. In addition to new pressures from rising impairments and provisions, legacy cost structures weigh on profitability. An increasing number of banks are now reporting earnings below their cost of capital (Figure 32; IMF 2021b).[8] While many banks have started investing in digital technologies to reduce structural margin and cost pressures, this adds to short-term expenses. Further consolidation of banking groups through domestic and cross-border mergers and acquisitions could improve banks' efficiency and improve cross-border risk sharing, as reflected in the ECB's increasing supervisory focus on business model sustainability (ECB 2021a). In this context, the recent ECB guidance on the use of supervisory tools to facilitate sustainable consolidation is timely and helpful (ECB 2021b). Any remaining prudential and legal obstacles to cross-border integration of banking activities should be eliminated.

[8]Note that Figure 32 covers a wide range of European banks. Altavilla and others (2021) find that the cost of equity for ECB-supervised euro area banks is lower.

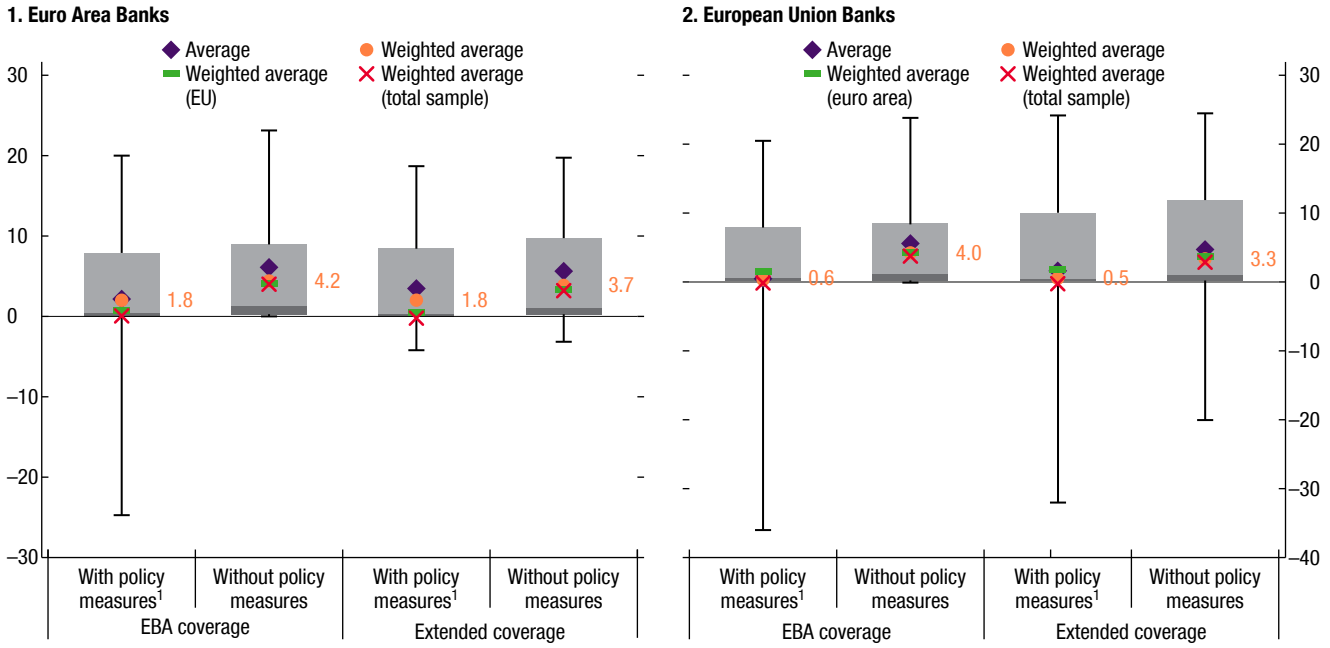
Annex 1. Additional Figures

Annex Figure 1.1. Euro Area Banks: Change of CET1 Capital Ratio under Different Assumptions
(Percentage points, end-2021 relative to end-2019)



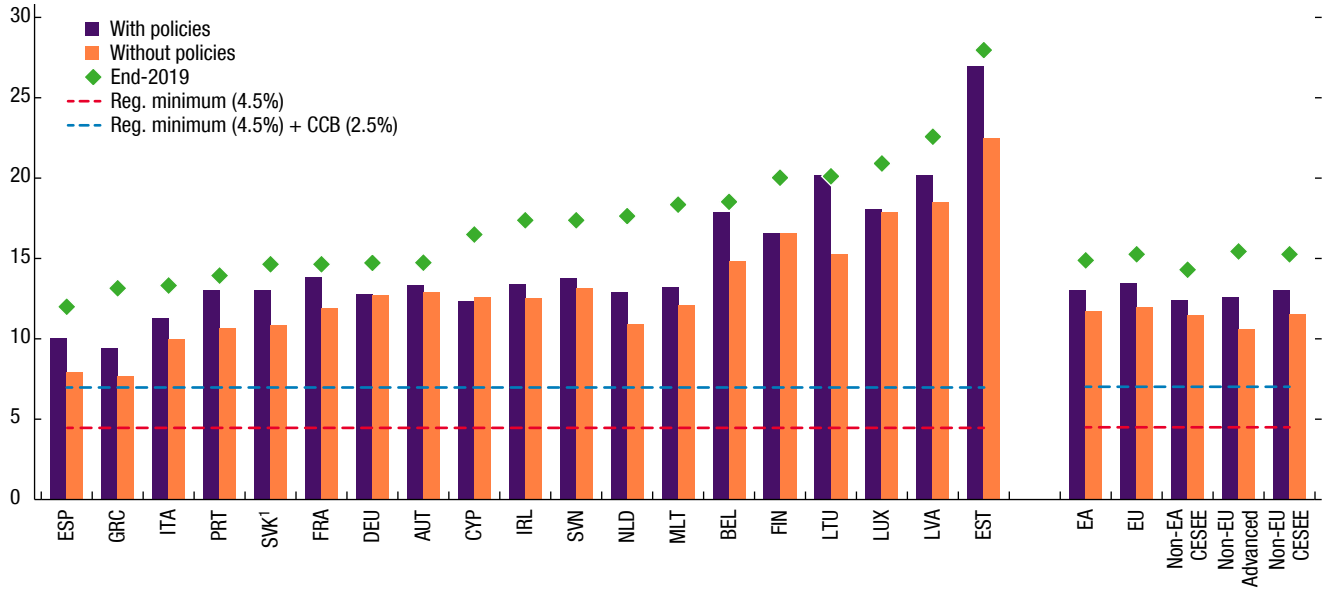
1Sources: European Banking Authority; European Central Bank; FitchConnect; S&P Global Market Intelligence; and IMF staff calculations.
Note: CET1 = common equity Tier 1; EBA = European Banking Authority.
[1]Debt repayment relief (moratoria) for businesses and households, corporate credit guarantees, delayed insolvency proceedings, and dividend restrictions (only in 2020).

Annex Figure 1.2. Dispersion of Change in Asset Risk Weights (Baseline Scenario)
(Percent)



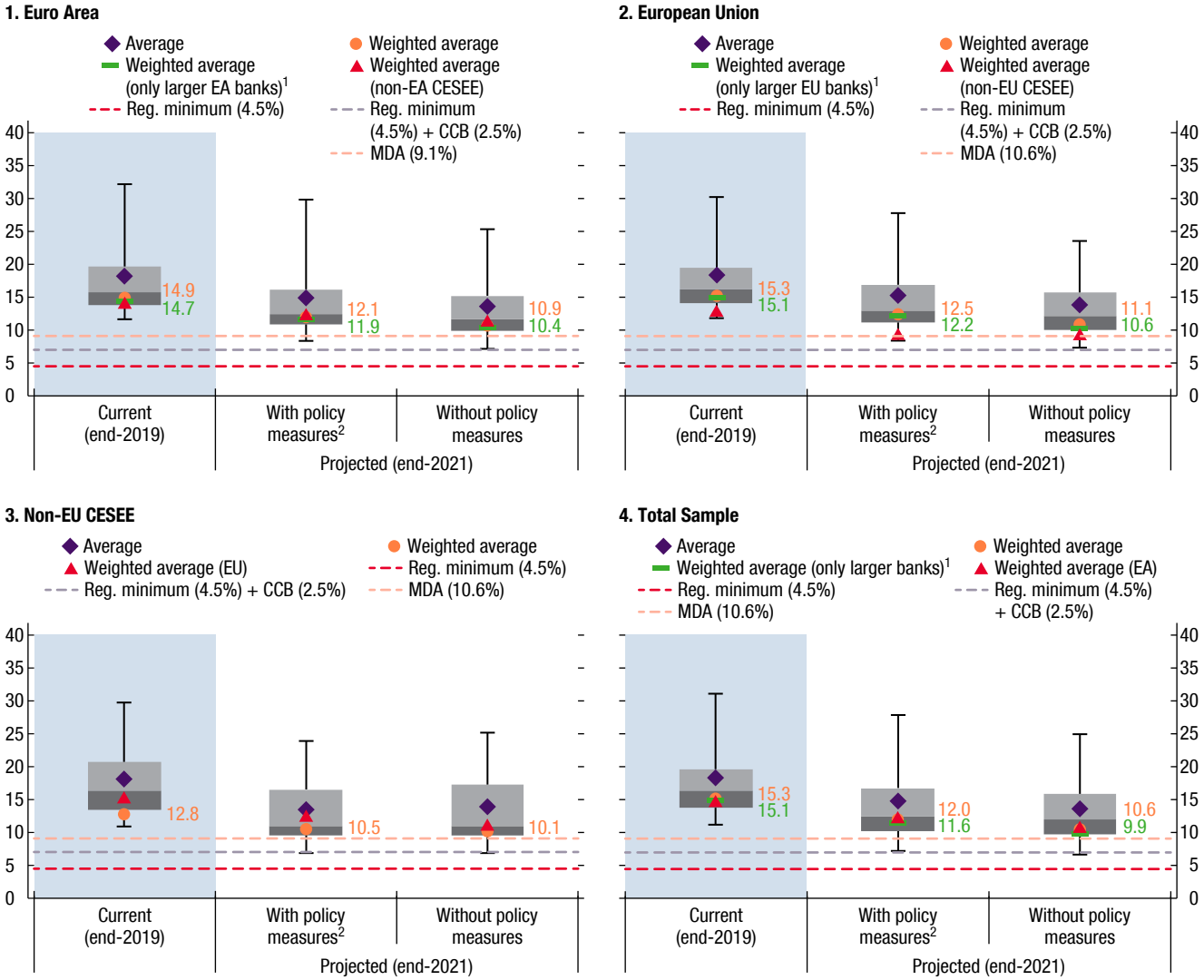
Sources: European Banking Authority; European Central Bank; FitchConnect; S&P Global Market Intelligence; and IMF staff estimates.
Note: The grey shaded area of the boxplots shows the interquartile range (25th to 75th percentile), with whiskers at the 5th and 95th percentile of the distribution. EBA = European Banking Authority.
[1]Debt repayment relief (moratoria) for businesses and households, corporate credit guarantees, delayed insolvency proceedings, and dividend restrictions (only in 2020).

Annex Figure 1.3. Euro Area Banks: CET1 Capital Ratio (Baseline Scenario), Extended Coverage
(Percent)



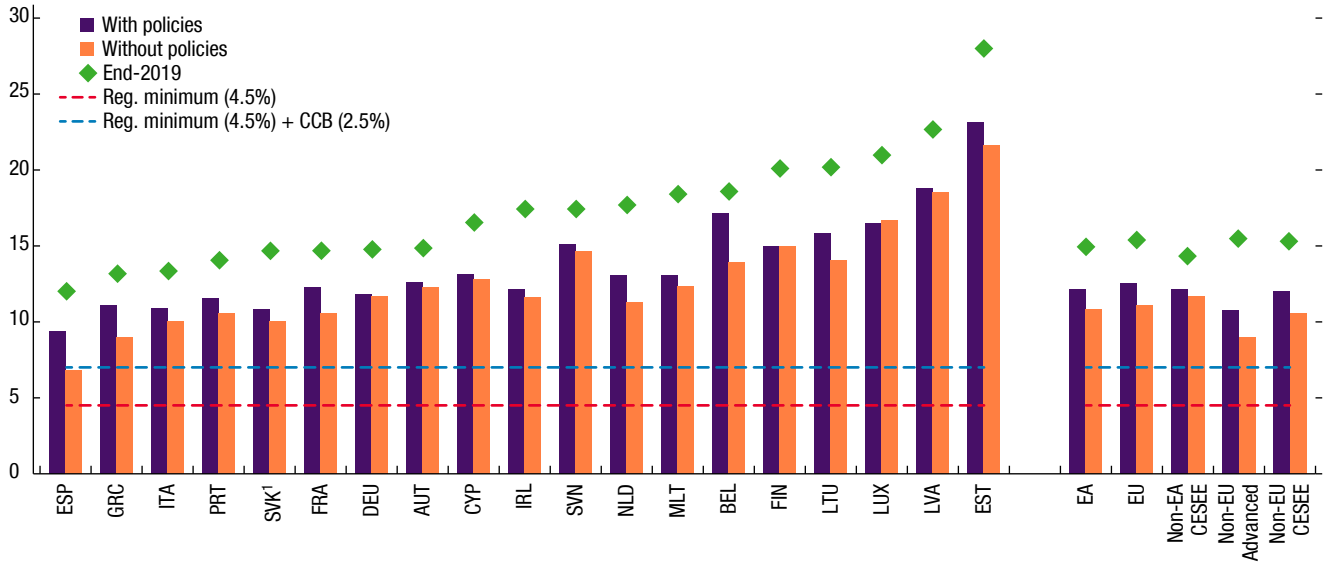
Sources: European Banking Authority; FitchConnect; and authors' calculations.
Note: Data labels in the figure use International Organization for Standardization (ISO) country codes. CCB = capital conservation buffer; CESEE = Central, Eastern, and Southeastern European economies; CET1 = common equity Tier 1; EA = euro area.
[1]The Slovak Republic is not included in the EBA Transparency Exercise.

Annex Figure 1.4. Solvency Stress Test—Dispersion of CET1 Capital Ratio (Adverse Scenario/Extended Coverage)
(Percent)



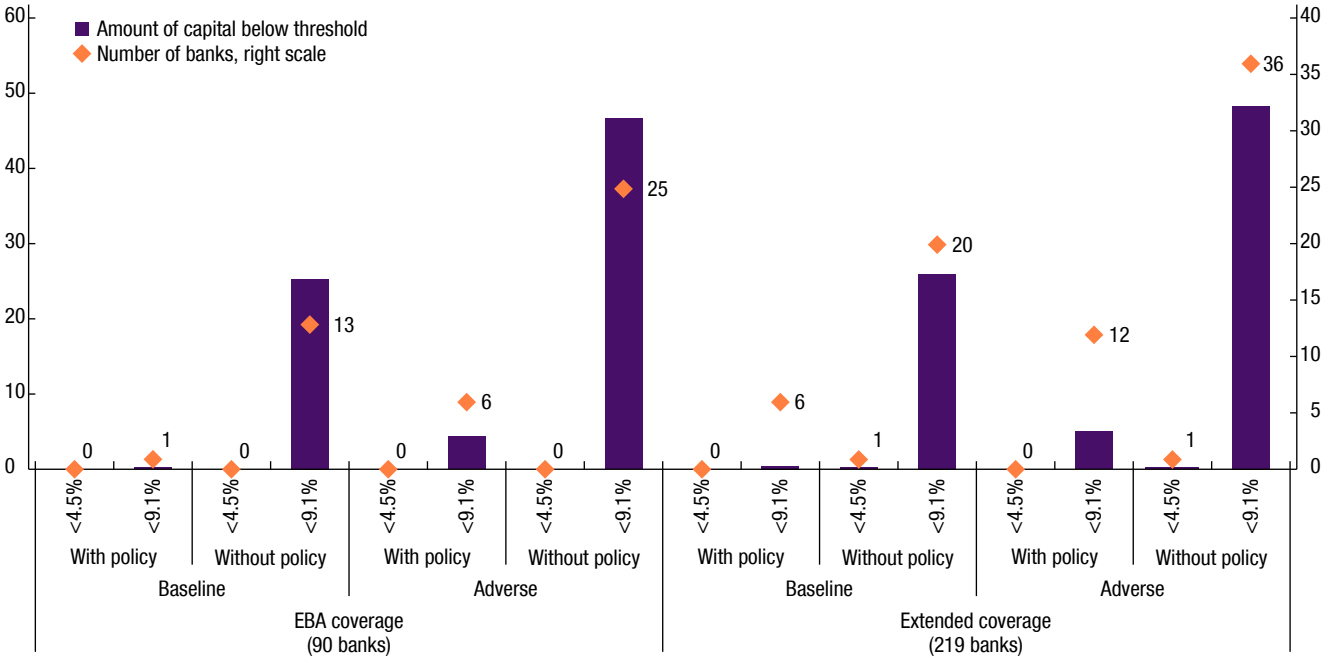
Sources: European Banking Authority; European Central Bank; European Systemic Risk Board; FitchConnect; S&P Global Market Intelligence; and IMF staff estimates.
Note: CCB = capital conservation buffer; CESEE = Central, Eastern, and Southeastern European economies; CET1 = common equity Tier 1; MDA = maximum distributable amount (weighted average). The grey shaded area of the boxplots shows the interquartile range (25th to 75th percentile), with whiskers at the 5th and 95th percentile of the distribution. The analysis covers all three channels affecting the capital adequacy ratio under stress—profitability (net interest income and provisions), nominal assets (net lending and write-offs after reserves), and risk exposure (changes in credit risk weights). The crisis-specific risk drivers of these channels are (1) write-offs due to the projected insolvency of illiquid and insolvent firms (weighted by outstanding debt and mapped to the sector-by-sector corporate exposure of sample banks); (2) the profitability impact of policy measures (lower provisions for guaranteed loans to solvent firms, loss forbearance on eligible loans under moratoria, and decline in interest income due to duration of debt moratoria); and (3) the increase in risk weights to the general increase of the default risk of mortgages and firms. In addition, there is a general change in net operating income after general provisions and losses on other noninterest income due to lower GDP growth and higher unemployment rate, including impairment charges for noncorporate exposures.
[1]Only larger banks covered by the EBA Transparency Exercise.
[2]Debt repayment relief (moratoria) for businesses and households, corporate credit guarantees, delayed insolvency proceedings, and dividend restrictions (only in 2020).

Annex Figure 1.5. Euro Area Banks: CET1 Capital Ratio (Adverse Scenario), Extended Coverage
(Percent)



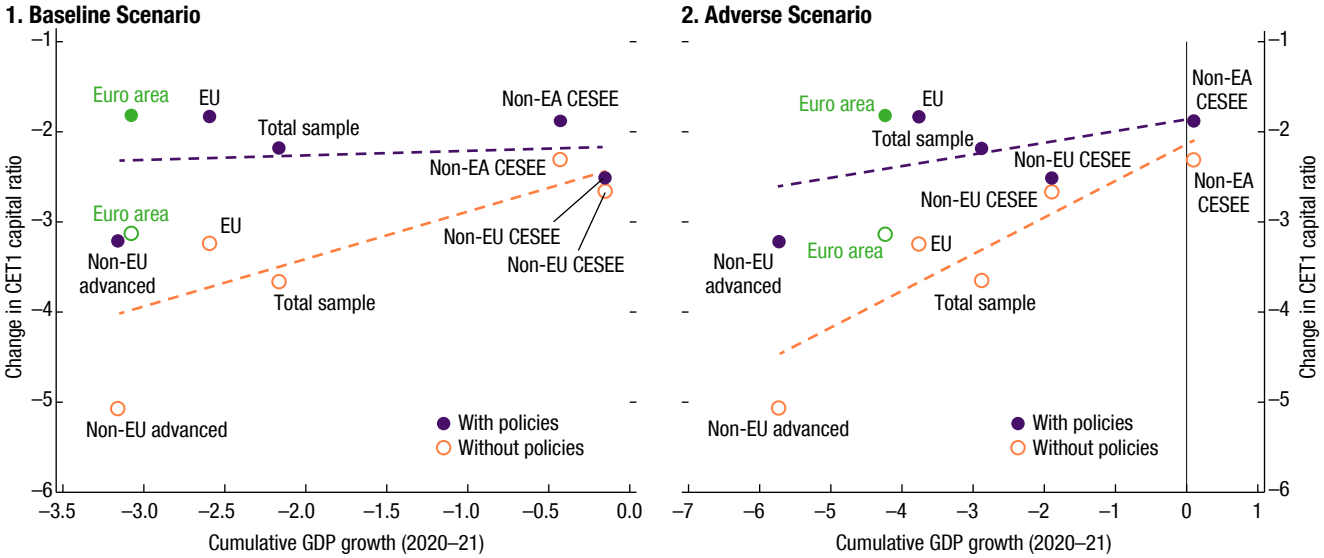
Sources: European Banking Authority; FitchConnect; and authors' calculations.
Note: Data labels in the figure use International Organization for Standardization (ISO) country codes. CCB = capital conservation buffer; CESEE = Central, Eastern, and Southeastern European economies; CET1 = common equity Tier 1; EA = euro area.
[1]The Slovak Republic is not included in the EBA Transparency Exercise.

Annex Figure 1.6. Euro Area: Potential Capital Need and Number of Banks below Thresholds
(EUR billion/count)



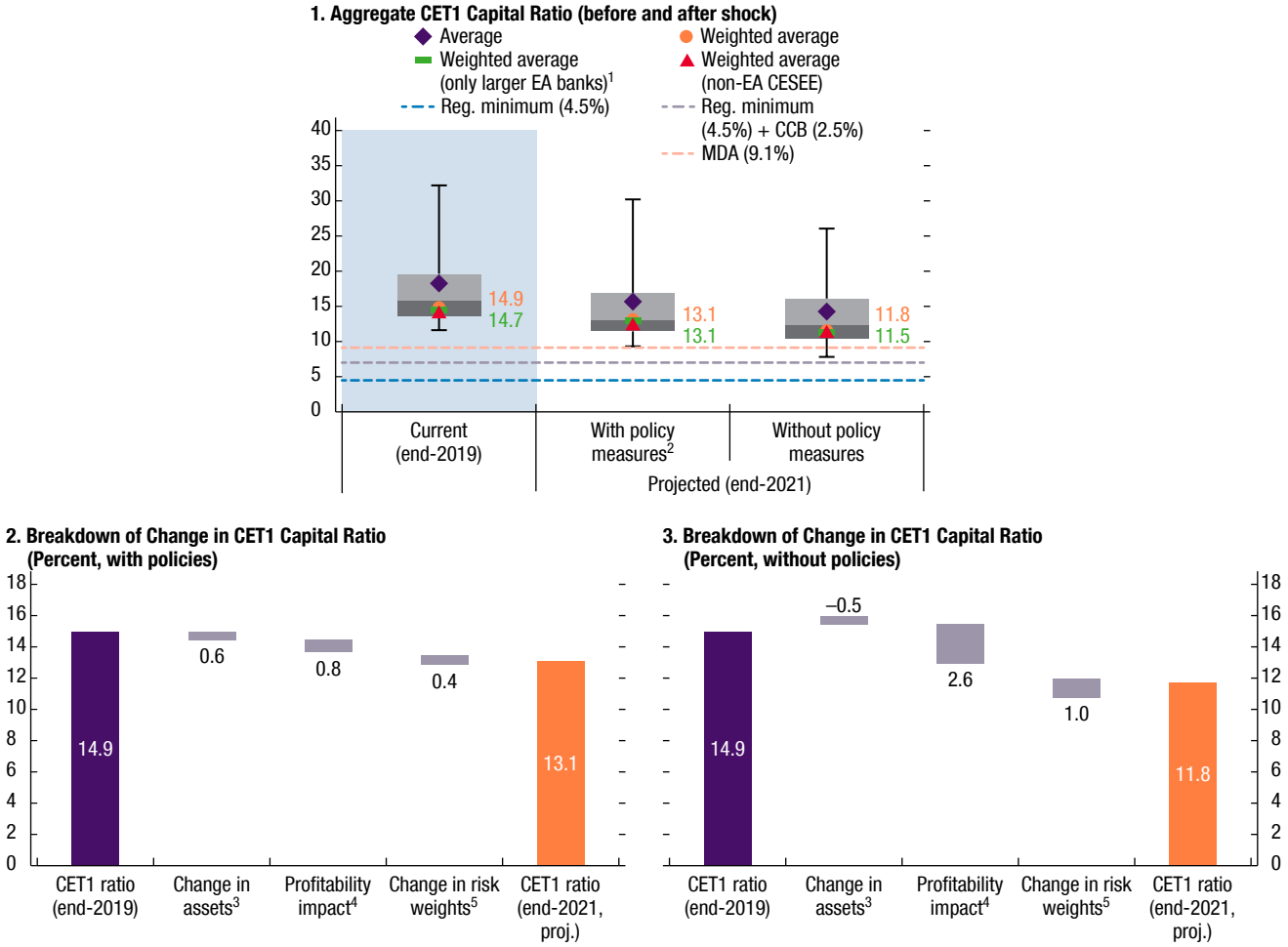
Source: Authors' calculations.
Note: The thresholds of 4.5 and 9.1 percent represent the regulatory minimum for the CET1 capital ratio (assuming the current capital relief) and the average threshold for the maximum distributable amount (MDA) for euro area banks, respectively. CET1 = common equity Tier 1; EBA = European Banking Authority.

Annex Figure 1.7. European Banks: Changes in Capital Ratio and GDP Growth, Extended Coverage
(Percent)



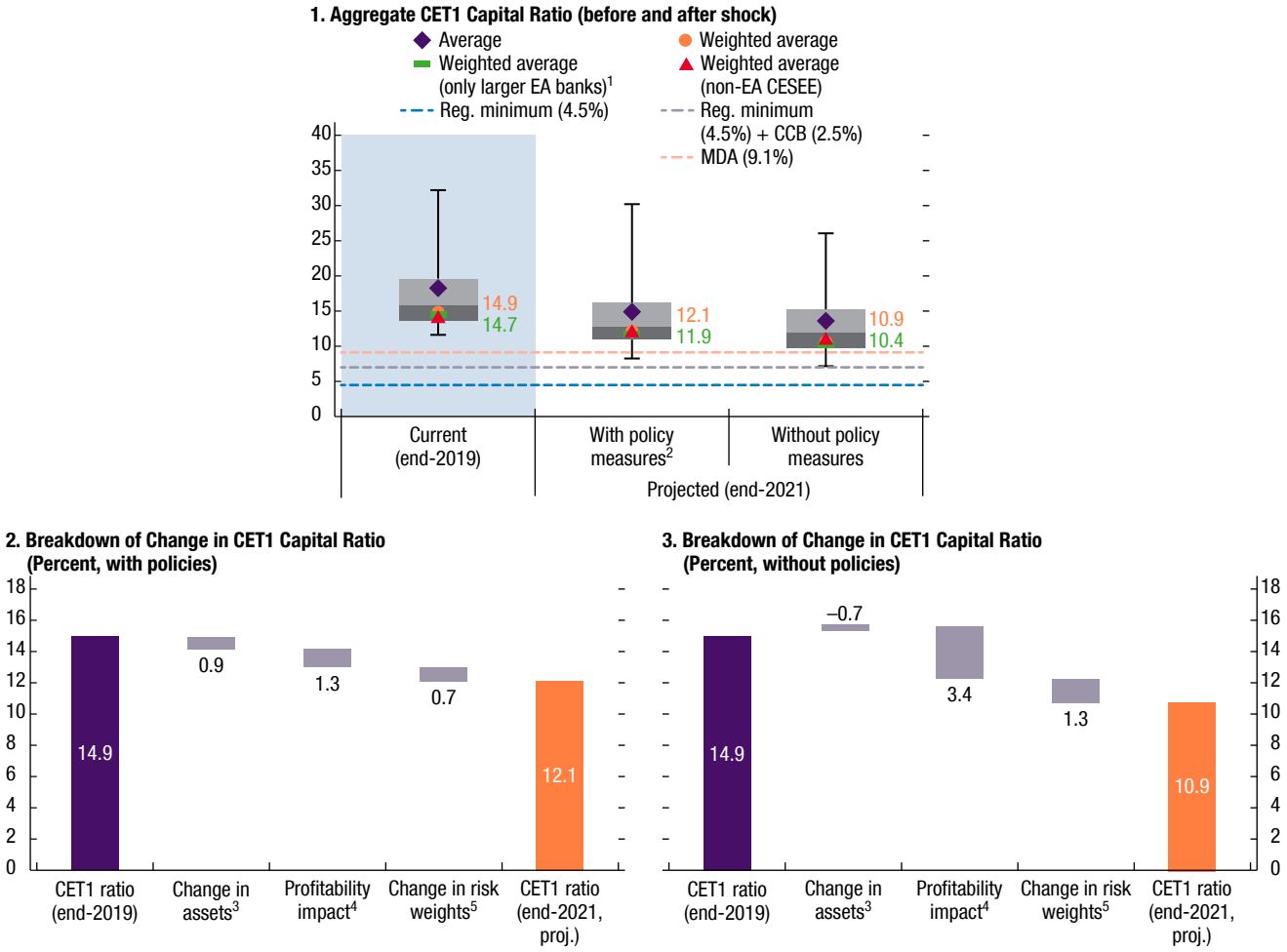
Source: Authors' calculations.
Note: CESEE = Central, Eastern, and Southeastern European economies; CET1 = common equity Tier 1; EA = euro area. Policies within the scope of the stress test exercise, that is, demand- and supply-side measures to support lending (guarantees, debt moratoria, insolvency stays) and financial sector policies (capital relief and conservation).

Annex Figure 1.8. Euro Area Banks (Extended Coverage): Solvency Stress Test—Baseline Scenario
(Percent)



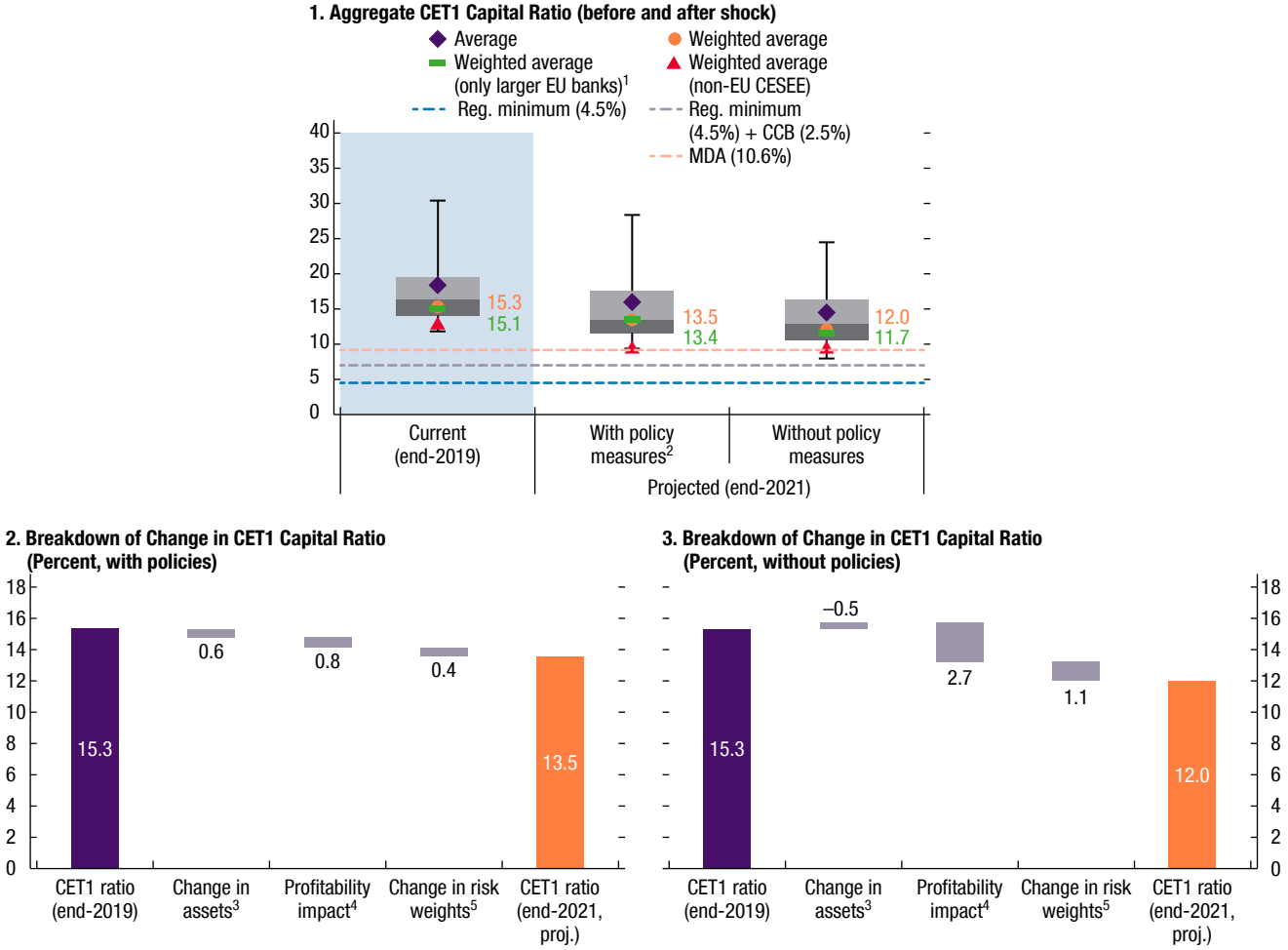
Sources: EBA; ECB; ESRB; FitchConnect; S&P Market Intelligence; and IMF staff estimates.
Note: CCB = capital conservation buffer; CET1 = common equity Tier 1; MDA = maximum distributable amount (weighted average). The grey shaded area of the boxplots shows the interquartile range (25th to 75th percentile), with whiskers at the 5th and 95th percentile of the distribution.
The analysis covers all three channels affecting the capital adequacy ratio under stress—profitability (net interest income and provisions), nominal assets (net lending and write-offs after reserves), and risk exposure (changes in credit risk weights).
[1]Only larger banks covered by the EBA Transparency Exercise.
[2]Debt repayment relief (moratoria) for businesses and households, corporate credit guarantees, delayed insolvency proceedings, and dividend restrictions (only in 2020).
[3]Due to corporate write-offs and net lending—corporate write-offs are due to the rise of illiquid and insolvent firms (weighted by outstanding debt and mapped to the sector-by-sector corporate exposure of sample banks).
[4]Net profitability impact of policy measures (lower provisions for guaranteed loans to solvent corporates, loss forbearance on eligible loans under moratoria, and decline in interest income due to duration of debt moratoria (households and businesses)) and change in net operating income after general provisions and losses on other noninterest income due to lower GDP growth and higher unemployment rate, including impairment charges for non-corporate exposures.
[5]Increase of credit risk weights due to higher unexpected losses (derived from the increase of default risk implied by the projected increase of general provisions) and additional specific provisions for additional corporate loan losses.

Annex Figure 1.9. Euro Area Banks (Extended Coverage): Solvency Stress Test—Adverse Scenario
(Percent)



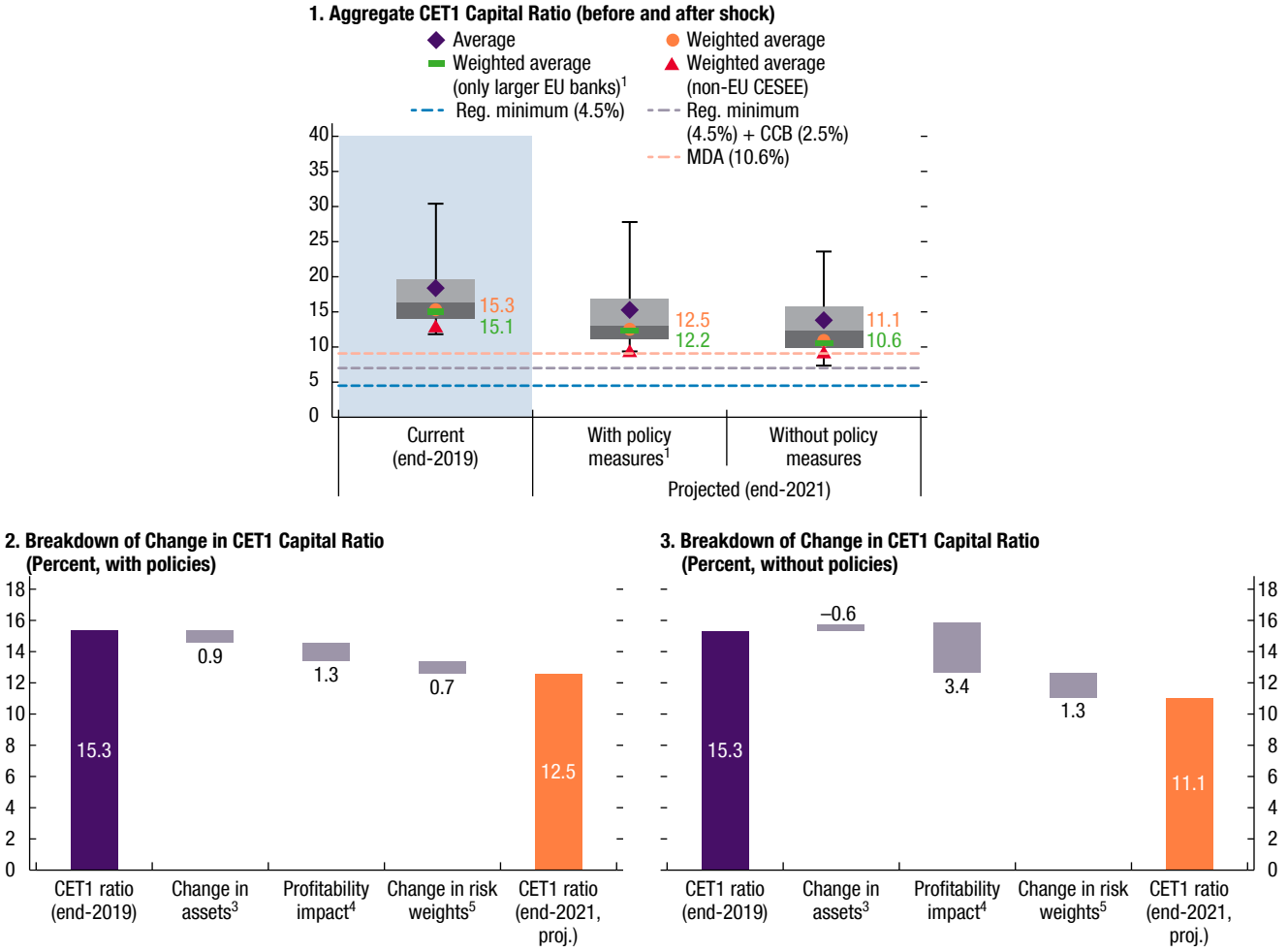
Sources: European Banking Authority; European Central Bank; European Systemic Risk Board; FitchConnect; S&P Market Intelligence; and IMF staff estimates.
Note: CCB = capital conservation buffer; CET1 = common equity Tier 1; MDA = maximum distributable amount (weighted average). The grey shaded area of the boxplots shows the interquartile range (25th to 75th percentile), with whiskers at the 5th and 95th percentile of the distribution.
[1]Only larger banks covered by the EBA Transparency Exercise.
[2]Debt repayment relief (moratoria) for businesses and households, corporate credit guarantees, delayed insolvency proceedings, and dividend restrictions (only in 2020).
[3]Due to corporate write-offs and net lending—corporate write-offs are due to the rise of illiquid and insolvent firms (weighted by outstanding debt and mapped to the sector-by-sector corporate exposure of sample banks).
[4]Net profitability impact of policy measures (lower provisions for guaranteed loans to solvent firms, loss forbearance on eligible loans under moratoria, and decline in interest income due to duration of debt moratoria (households and businesses)) and change in net operating income after general provisions and losses on other noninterest income due to lower GDP growth and higher unemployment rate, including impairment charges for noncorporate exposures.
[5]Increase of credit risk weights due to higher unexpected losses (derived from the increase of default risk implied by the projected increase of general provisions) and additional specific provisions for additional corporate loan losses.

Annex Figure 1.10. EU Banks (Extended Coverage): Solvency Stress Test—Baseline Scenario
(Percent)



Sources: European Banking Authority; European Central Bank; European Systemic Risk Board; FitchConnect; S&P Market Intelligence; and IMF staff estimates.
Note: CCB = capital conservation buffer; CET1 = common equity Tier 1; MDA = maximum distributable amount (weighted average). The grey shaded area of the boxplots shows the inter-quartile range (25th to 75th percentile), with whiskers at the 5th and 95th percentile of the distribution. The analysis covers all three channels affecting the capital adequacy ratio under stress—profitability (net interest income and provisions), nominal assets (net lending and write-offs after reserves), and risk exposure (changes in credit risk weights).
[1]Only larger banks covered by the EBA Transparency Exercise.
[2]Debt repayment relief (moratoria) for businesses and households, corporate credit guarantees, delayed insolvency proceedings, and dividend restrictions (only in 2020).
[3]Due to corporate write-offs and net lending—corporate write-offs are due to the rise of illiquid and insolvent firms (weighted by outstanding debt and mapped to the sector-by-sector corporate exposure of sample banks);
[4]Net profitability impact of policy measures (lower provisions for guaranteed loans to solvent corporates, loss forbearance on eligible loans under moratoria, and decline in interest income due to duration of debt moratoria (households and businesses)) and change in net operating income after general provisions and losses on other noninterest income due to lower GDP growth and higher unemployment rate, including impairment charges for non-corporate exposures;
[5]Increase of credit risk weights due to higher unexpected losses (derived from the increase of default risk implied by the projected increase of general provisions) and additional specific provisions for additional corporate loan losses.

Annex Figure 1.11. EU Banks (Extended Coverage): Solvency Stress Test—Adverse Scenario
(Percent)



Sources: European Banking Authority; European Central Bank; European Systemic Risk Board; FitchConnect; S&P Market Intelligence; and IMF staff estimates.
Note: CCB = capital conservation buffer; CET1 = common equity Tier 1; MDA = maximum distributable amount (weighted average). The grey shaded area of the boxplots shows the interquartile range (25th to 75th percentile), with whiskers at the 5th and 95th percentile of the distribution. The analysis covers all three channels affecting the capital adequacy ratio under stress—profitability (net interest income and provisions), nominal assets (net lending and write-offs after reserves), and risk exposure (changes in credit risk weights).
[1]Only larger banks covered by the EBA Transparency Exercise.
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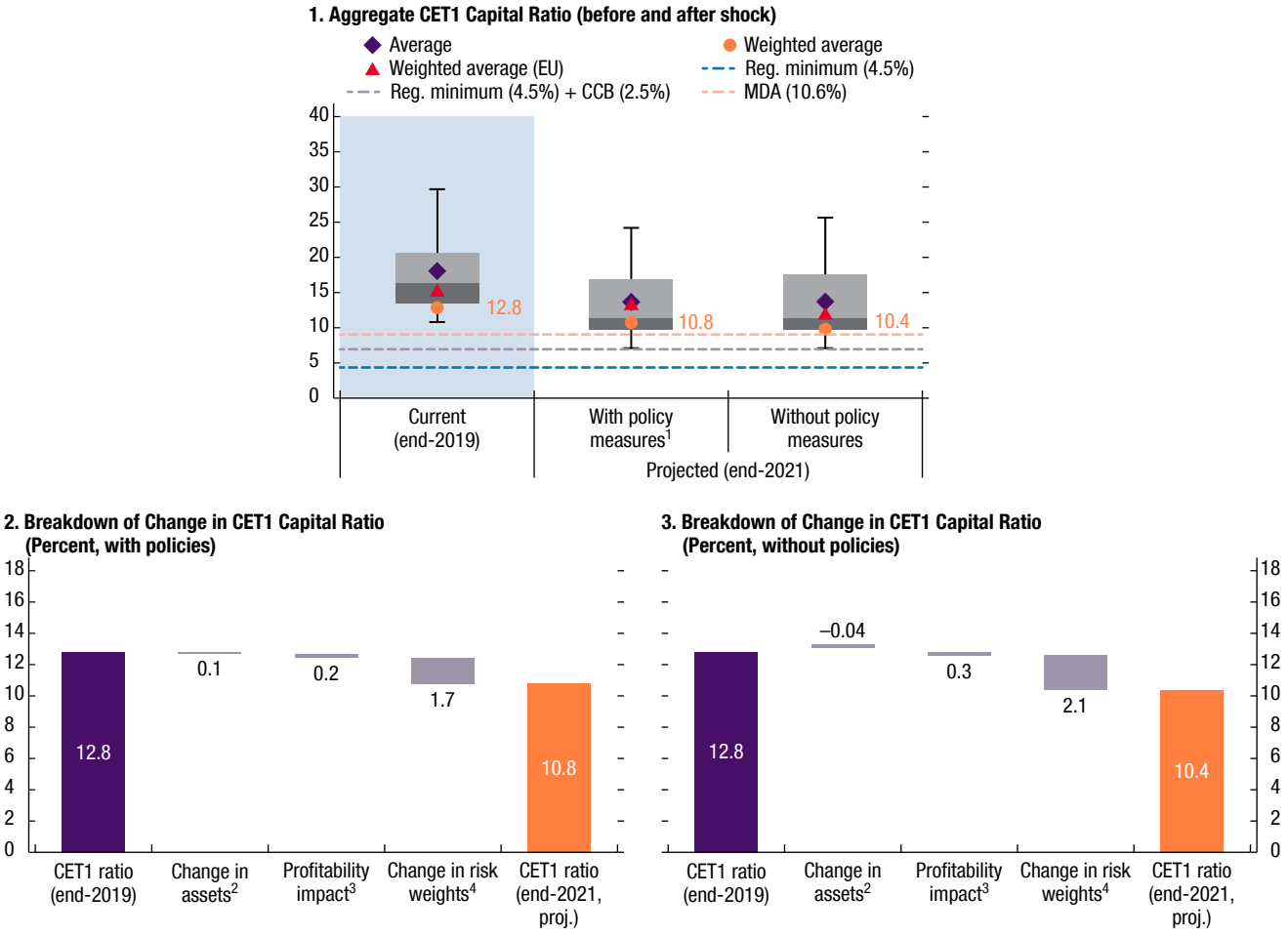
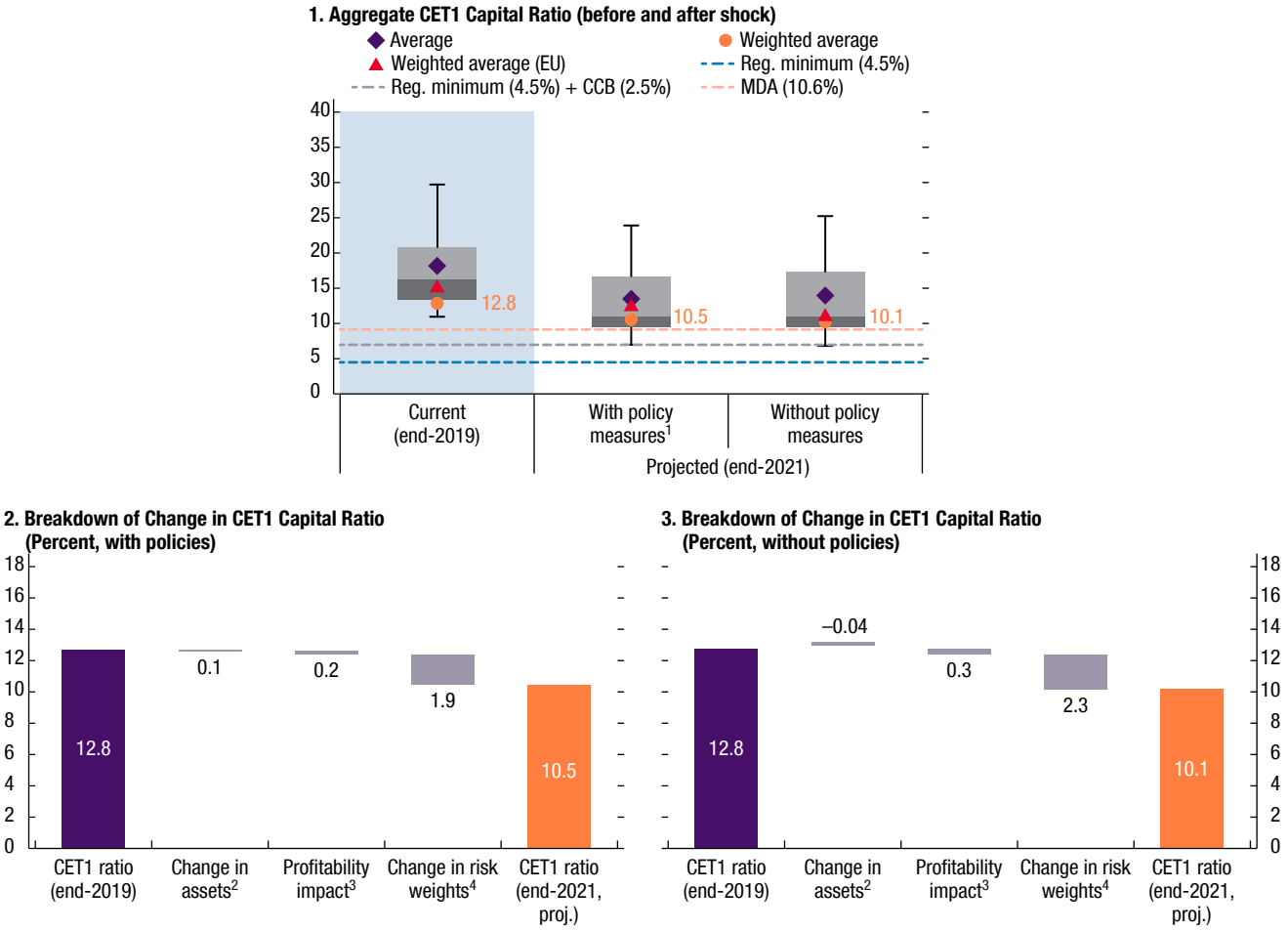
[3]Due to corporate write-offs and net lending—corporate write-offs are due to the rise of illiquid and insolvent firms (weighted by outstanding debt and mapped to the sector-by-sector corporate exposure of sample banks);
[4]Net profitability impact of policy measures (lower provisions for guaranteed loans to solvent corporates, loss forbearance on eligible loans under moratoria, and decline in interest income due to duration of debt moratoria (households and businesses)) and change in net operating income after general provisions and losses on other noninterest income due to lower GDP growth and higher unemployment rate, including impairment charges for non-corporate exposures;
[3]Increase of credit risk weights due to higher unexpected losses (derived from the increase of default risk implied by the projected increase of general provisions) and additional specific provisions for additional corporate loan losses.

Annex Figure 1.12. Non-EU CESEE Banks (Extended Coverage): Solvency Stress Test—Baseline Scenario
(Percent)



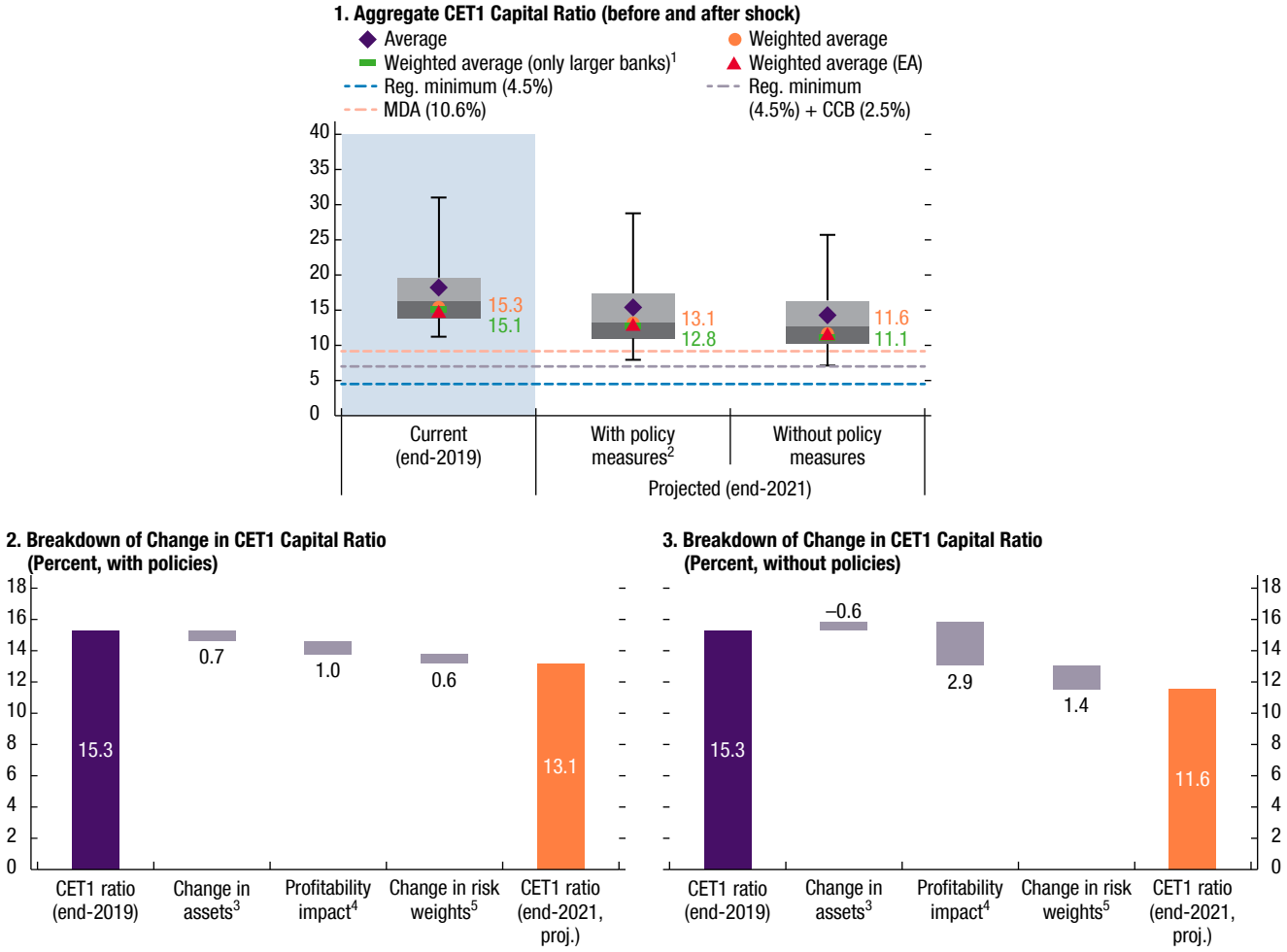
Sources: European Banking Authority; European Central Bank; European Systemic Risk Board; FitchConnect; S&P Market Intelligence; and IMF staff estimates.
Note: CCB = capital conservation buffer; CESEE = Central, Eastern, and Southeastern European economies; CET1 = common equity Tier 1; MDA = maximum distributable amount (weighted average). The grey shaded area of the boxplots shows the interquartile range (25th to 75th percentile), with whiskers at the 5th and 95th percentile of the distribution. The analysis covers all three channels affecting the capital adequacy ratio under stress—profitability (net interest income and provisions), nominal assets (net lending and write-offs after reserves), and risk exposure (changes in credit risk weights).
[1]Debt repayment relief (moratoria) for businesses and households, corporate credit guarantees, delayed insolvency proceedings, and dividend restrictions (only in 2020).
[2]Due to corporate write-offs and net lending—corporate write-offs are due to the rise of illiquid and insolvent firms (weighted by outstanding debt and mapped to the sector-by-sector corporate exposure of sample banks).
[3]Net profitability impact of policy measures (lower provisions for guaranteed loans to solvent corporates, loss forbearance on eligible loans under moratoria, and decline in interest income due to duration of debt moratoria (households and businesses)) and change in net operating income after general provisions and losses on other noninterest income due to lower GDP growth and higher unemployment rate, including impairment charges for non-corporate exposures.
[4]Increase of credit risk weights due to higher unexpected losses (derived from the increase of default risk implied by the projected increase of general provisions) and additional specific provisions for additional corporate loan losses.

Annex Figure 1.13. Non-EU CESEE Banks (Extended Coverage): Solvency Stress Test—Adverse Scenario
(Percent)



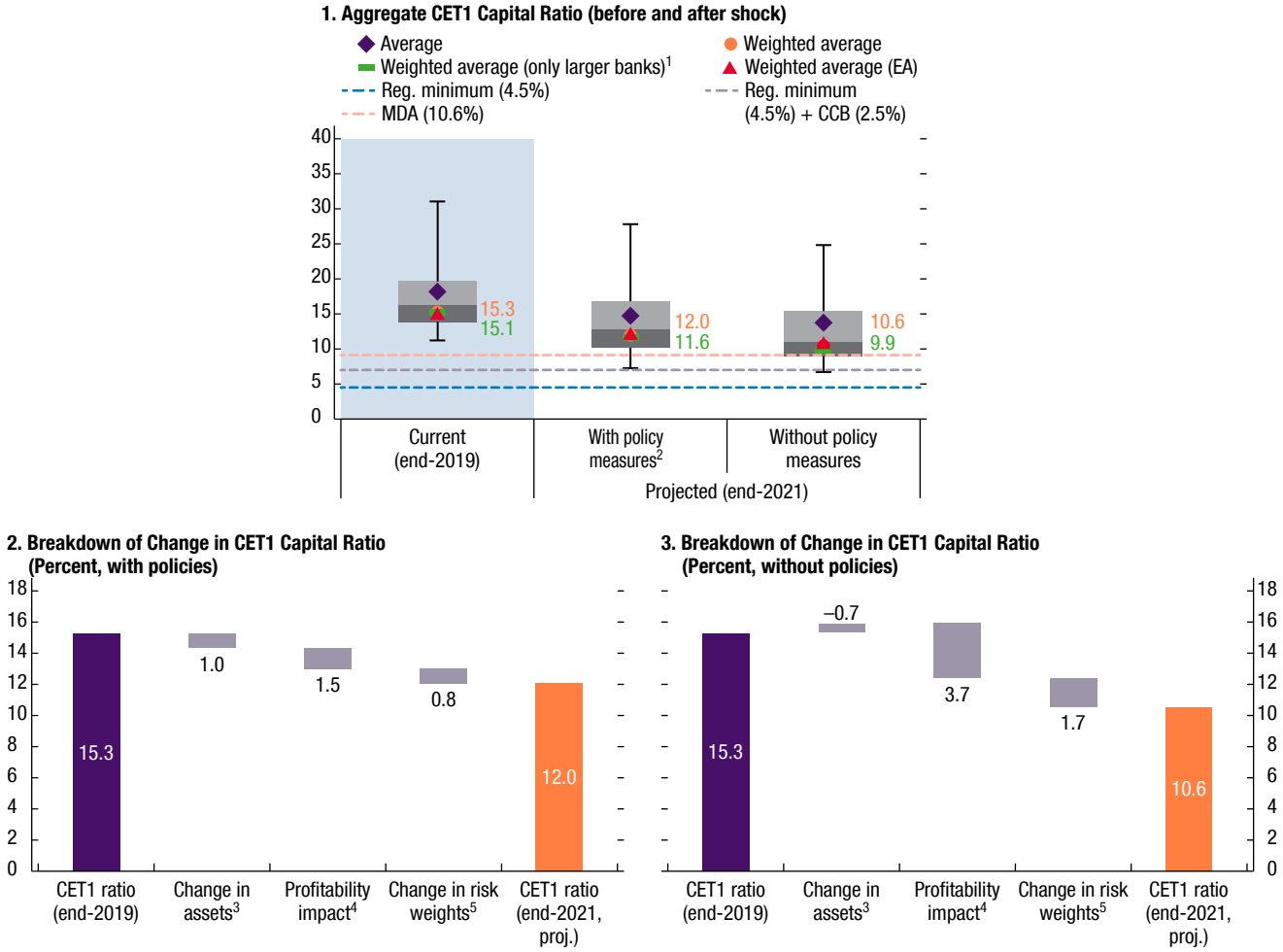
Sources: European Banking Authority; European Central Bank; European Systemic Risk Board; FitchConnect; S&P Market Intelligence; and IMF staff estimates.
Note: CCB = capital conservation buffer; CESEE = Central, Eastern, and Southeastern European economies; CET1 = common equity Tier 1; MDA = maximum distributable amount (weighted average). The grey shaded area of the boxplots shows the interquartile range (25th to 75th percentile), with whiskers at the 5th and 95th percentile of the distribution. The analysis covers all three channels affecting the capital adequacy ratio under stress—profitability (net interest income and provisions), nominal assets (net lending and write-offs after reserves), and risk exposure (changes in credit risk weights).
[1]Debt repayment relief (moratoria) for businesses and households, corporate credit guarantees, delayed insolvency proceedings, and dividend restrictions (only in 2020).
[2]Due to corporate write-offs and net lending—corporate write-offs are due to the rise of illiquid and insolvent firms (weighted by outstanding debt and mapped to the sector-by-sector corporate exposure of sample banks).
[3]Net profitability impact of policy measures (lower provisions for guaranteed loans to solvent firms, loss forbearance on eligible loans under moratoria, and decline in interest income due to duration of debt moratoria (households and businesses)) and change in net operating income after general provisions and losses on other noninterest income due to lower GDP growth and higher unemployment rate, including impairment charges for noncorporate exposures.
[4]Increase of credit risk weights due to higher unexpected losses (derived from the increase of default risk implied by the projected increase of general provisions) and additional specific provisions for additional corporate loan losses.

Annex Figure 1.14. All Banks (Extended Coverage): Solvency Stress Test—Baseline Scenario
(Percent)



Sources: European Banking Authority; European Central Bank; European Systemic Risk Board; S&P Market Intelligence; and IMF staff estimates.
Note: CCB = capital conservation buffer; CET1 = common equity Tier 1; MDA = maximum distributable amount (weighted average). The grey shaded area of the boxplots shows the interquartile range (25th to 75th percentile), with whiskers at the 5th and 95th percentile of the distribution. The analysis covers all three channels affecting the capital adequacy ratio under stress—profitability (net interest income and provisions), nominal assets (net lending and write-offs after reserves), and risk exposure (changes in credit risk weights).
[1]Only larger banks covered by the EBA Transparency Exercise.
[2]Debt repayment relief (moratoria) for businesses and households, corporate credit guarantees, delayed insolvency proceedings, and dividend restrictions (only in 2020).
[3]Due to corporate write-offs and net lending—corporate write-offs are due to the rise of illiquid and insolvent firms (weighted by outstanding debt and mapped to the sector-by-sector corporate exposure of sample banks);
[4]Net profitability impact of policy measures (lower provisions for guaranteed loans to solvent corporates, loss forbearance on eligible loans under moratoria, and decline in interest income due to duration of debt moratoria (households and businesses)) and change in net operating income after general provisions and losses on other noninterest income due to lower GDP growth and higher unemployment rate, including impairment charges for non-corporate exposures;
[5]Increase of credit risk weights due to higher unexpected losses (derived from the increase of default risk implied by the projected increase of general provisions) and additional specific provisions for additional corporate loan losses.

Annex Figure 1.15. All Banks (Extended Coverage): Solvency Stress Test—Adverse Scenario
(Percent)



Sources: European Banking Authority; European Central Bank; European Systemic Risk Board; FitchConnect; S&P Market Intelligence; and IMF staff estimates.
Note: CCB = capital conservation buffer; CET1 = common equity Tier 1; MDA = maximum distributable amount (weighted average). The grey shaded area of the boxplots shows the interquartile range (25th to 75th percentile), with whiskers at the 5th and 95th percentile of the distribution. The analysis covers all three channels affecting the capital adequacy ratio under stress—profitability (net interest income and provisions), nominal assets (net lending and write-offs after reserves), and risk exposure (changes in credit risk weights).
[1]Only larger banks covered by the EBA Transparency Exercise.
[2]Debt repayment relief (moratoria) for businesses and households, corporate credit guarantees, delayed insolvency proceedings, and dividend restrictions (only in 2020).
[3]Due to corporate write-offs and net lending—corporate write-offs are due to the rise of illiquid and insolvent firms (weighted by outstanding debt and mapped to the sector-by-sector corporate exposure of sample banks).
[4]Net profitability impact of policy measures (lower provisions for guaranteed loans to solvent firms, loss forbearance on eligible loans under moratoria, and decline in interest income due to duration of debt moratoria (households and businesses)) and change in net operating income after general provisions and losses on other noninterest income due to lower GDP growth and higher unemployment rate, including impairment charges for noncorporate exposures.
[5]Increase of credit risk weights due to higher unexpected losses (derived from the increase of default risk implied by the projected increase of general provisions) and additional specific provisions for additional corporate loan losses.

Annex 2. Methodology

Our paper examines how the implications of the current crisis for bank-specific and general macroeconomic conditions impact banks' capitalization over time. And we do so by considering a wide range of COVID-19-related policy measures that support credit supply (that is, financial sector policies, such as greater supervisory and regulatory flexibility, providing banks with more headroom to lend through capital easing) and credit demand (for example, debt moratoria, credit guarantees) (Figure 16). These "bank-facing" measures work in tandem with other (fiscal) measures, such as grants, wage subsidies, commercial rate reductions, and tax deferrals, which indirectly affect banks by mitigating potential liquidity and/or solvency risks of borrowers, especially highly affected firms and households in areas where lockdowns have a higher impact on employment.

We project the crisis impact on bank's solvency by considering three channels: profitability, the amount and types of its assets, and their associated riskiness. We take the Common Equity Tier 1 (CET1) capital ratio at the end of 2019 as starting point and estimate how it changes over time due to retained earnings from projected profits (net of taxes and dividend payouts), after adjusting for the net change in assets and their associated riskiness under baseline and adverse conditions (Figure 14). More specifically, we assess (1) the impact of projected GDP growth and unemployment under the current WEO projections on the return on assets (ROA) and its components (that is, net interest income, fee/commission income, operating expenses, and loan loss provisioning) ("profitability channel"); (2) the impact of write-offs (or write-offs) for actual losses (in excess of available provisions), lowering the book value of the stock of assets (net of estimated new lending) ("asset channel"); and (3) the impact of higher credit risk-weights to account for rising default risk ("risk channel").

For each component, we account for the specific impact of crisis-related policy measures and shocks:

- For the *profitability channel*, we consider lower provisions for guaranteed loans to solvent firms, some loss forbearance on eligible loans under debt moratoria, and the decline in accrued interest income due to duration of debt moratoria.
- For the *asset channel*, we account for the potential surge of corporate defaults (as single factor shock) in the form of additional write-offs due to the projected insolvency of illiquid and insolvent firms (weighted by outstanding debt and mapped to the sector-by-sector corporate exposure of sample banks), in addition to impairment charges for noncorporate exposures.
- For the *risk channel*, we recognize the loss mitigating impact of public sector guarantees, which should reduce the marginal credit risk weight of new corporate loans to solvent borrowers (up to the availability of such guarantees).

In the following section, we discuss the technical specification of each component, including how the impact of policy measures and the single-factor corporate shock are incorporated.

Profitability Channel[1]

Specification and Estimation

We measure bank profitability based on the reported ROA. ROA contributes to organic capital growth during each reporting period after adjusting for changes in assets (due to credit losses and valuation changes) and net of dividends and taxes over a two-year time horizon, where $t \in \{2020, 2021\}$.

In the simplest form, the impact of bank profits on capital can be shown using the capital-to-asset ratio as a simplified representation of bank leverage,

$$\frac{K_{i,t}}{A_{i,t}} = \frac{K_{i,t-1}}{A_{i,t-1}} \left(1 + ROA_{i,t} | \Delta \mathrm{B}_{j,t} \Delta \mathrm{C}_{i,k,t} \right)(1 - \tau)(1 - d_t), \tag{A2.1}$$

in which ROA_{it} is the return on total assets A of bank i at time t, K is total capital, ΔB and ΔC are 1 – $(1xj)$ and $(1xk)$ vectors of one-period changes in bank-specific variables and macro-financial factors (which apply to all banks

[1]For simplicity, the country-specific index is omitted from all equations.

within a specific country), respectively, τ is the time-invariant tax rate, and d_t is the dividend payout ratio.[2] Thus, we re-write equation (A2.1) above in risk-weighted terms to derive the capital-generating impact of profitability. We use CET1 as the most junior (and most risk-sensitive) form of capital to define the contribution of retained earnings to the change of the capital adequacy ratio (CAR) as

$$\frac{CET1_{i,t}}{A_{i,t}RW_{i,t}} = \frac{CET1_{i,t-1}}{A_{i,t-1}RW_{i,t-1}} + \left(ROA_{i,t}|\Delta B_{j,t}\Delta C_{i,k,t}\frac{1}{RW_{i,t}}\right)(1-\tau)(1-d_t), \quad \text{(A2.2)}$$

in which $RW_{i,t}$ is the average risk weight of total assets A.

Policy Impact

Since policy measures affect various elements of the profit and loss statement, we also determine the components of ROA (in percent of total assets, $A_{i,t}$) so that

$$ROA_{i,t} = NII_{i,t} + Noninterest\ Income_{i,t} - LLP_{i,t} - Other^{*}_{i,t} \quad \text{(A2.3)}$$

and $Other^{*}_{i,t}$ comprises operating expenses and write-offs of NPLs, where $NII_{i,t}$ and $LLP_{i,t}$ denote the net interest income and loan loss provisioning expenses, respectively.

If policy measures operate as intended, these sub-components are adjusted as follows:

- *Debt moratoria.* Different countries have allowed for repayment relief on household loans and/or corporate loans together with greater regulatory flexibility in the classification and provisioning rules. The negative impact of moratoria on net interest income, $NII_{i,t}$, is modeled as

$$\widetilde{NII}_{i,t} = \widehat{NII}_{i,t}\left(1 - \frac{m}{12} \times \theta^{M}_{t} \times \begin{Bmatrix} S^{H}_{i,t} \\ S^{C}_{i,t} \end{Bmatrix}\right), \quad \text{(A2.4)}$$

  in which $\frac{m}{12}$ is the share of accrued but non-paid interest income (in which m denotes the duration in months), multiplied by the projected average usage rate of moratoria across all eligible loans in a given country,[3] θ^{M}_{t}, and

[2]The minimum leverage ratio of 3 percent serves a backstop to the more relevant CAR and is not yet fully applicable for EU banks until the end of June 2021.

[3]The usage rate of moratoria applies to all banks uniformly in a country and is not sector-specific.

the bank-specific share of household loans, s^H, and/or corporate loans, s^C, in total loans. We also assume that suspending the automatic classification of impaired loans under IFRS-9 in favor of a case-by-case assessment entails some sluggishness in how provisions adjust to deteriorating credit quality. Thus, we update the estimate provisioning expenses, $\widehat{LLP}_{i,t}$, to

$$\widetilde{LLP}_{i,t} = \widehat{LLP}_{i,t} - (LLP_t^{IFRS9} - \omega_{t-1})\left(\widehat{\Delta L}_{i,t}^C + \widehat{\Delta L}_{i,t}^H\right)\left(\frac{m}{12} \times \theta_t \times \begin{Bmatrix} S_{i,t}^H \\ S_{i,t}^C \end{Bmatrix}\right) \quad \text{(A2.5)}$$

in which $\Delta L_{i,t}^C$ and $\Delta L_{i,t}^H$ denote the change in the total amount of corporate and household loans (consumer and mortgage lending), ω_{t-1} is the historical, bank-specific coverage ratio (at end-2019), and ΔLLP_t^{IFRS9} is the implied increase of provisions based on the expected migration of impaired loans from "Stage 1" to "Stage 2" as well as "Stage 2" to "Stage 3" according to the automatic loan classification under IFRS-9 (EBA 2020e; Annex 4). Given that this approach assumes a certain degree of under-provisioning of moratoria loans (as banks can no longer use non-payment as a signal of deteriorating borrower quality), the capital add-back of provisioning expenses under the transitional arrangement for the implementation of IFRS-9 is not considered.

- *Public sector guarantees.* In addition, public sector guarantees for corporate loans reduce the amount of provisions proportionate to the share of expected losses covered by the government. The available amount of guarantees is allocated proportionate to each bank's share of corporate lending within a given country, subject to the larger of (1) the estimated loan growth, $\widehat{\Delta L}_{i,t}^C$ (see equation (A2.23) below), by the share of solvent firms, $\mu_{i,t}^C$, and (2) the projected usage rate of guarantees, θ_t^G, relative to the total stock of corporate loans, $L_{i,t}^C$. For most countries, the size of the envelope for guarantee programs exceeds the amount of likely corporate credit growth over the time period covered by the stress test. Governments cover losses up to φ percent of guaranteed loans uniformly across all banks within a country but loss coverage differs across countries. Thus, we can further refine equation (A2.5) above to

$$\widetilde{LLP}_{i,t} = \widehat{LLP}_{i,t} - (LLP_t^{IFRS9} - \omega_{t-1})\left(\Delta L_{i,t}^C + \Delta L_{i,t}^H\right)\left(\frac{m}{12} \times \theta_t \times \begin{Bmatrix} S_{i,t}^H \\ S_{i,t}^C \end{Bmatrix}\right)$$

$$- (\varphi - \omega_{t-1})max\left(\mu_{i,t}^C \Delta L_{i,t}^C,\ \theta_t^G L_{i,t}^C\right), \quad \text{(A2.6)}$$

and re-state equation (A2.3) as

$$\widetilde{ROA}_{i,t} = \widetilde{NII}_{i,t} + Noninterest\ Income_{i,t} - \widetilde{LLP}_{i,t} - Other_{i,t}^{*} \quad \text{(A2.7)}$$

- *Dividend payouts.* In addition, regulators have encouraged banks to suspend distribution of dividends and share buybacks to conserve capital but have recently began to lift these restrictions. For instance, on December 2020, the ECB, after an assessment of the macroeconomic outlook, financial stability, and reliability of banks' capital planning, has issued guidance that would allow banks to resume dividend payouts within strict limits (until end-September 2021). We incorporate the conditionality of remaining restrictions into the specification of equation (A2.2) above and set the dividend payout ratio $d_{2020} = 0$,and, for 2021, $d_{2021} = min(0.2 \times \sum_t^{2020} ROA_{i,t-1} A_{i,t-1}, 0.0015 \times CET1_{i,t})$.

Estimation

We estimate ROA and its sub-components using annual time series data from the statutory annual filings of 3,421 banks in 41 European countries (2008–19) on a consolidated reporting basis. The bank-specific data from FitchConnect are combined with macroeconomic data for each country from the *World Economic Outlook* (WEO) database. ROA is most sensitive to real GDP growth, y_t, the unemployment rate, UR_t, and the lagged NPL ratio, $NPL_{i,t-1}$ (Jobst and Weber 2016; Elekdag, Malik, and Mitra 2020). The NPL ratio captures the legacy impact of accumulated impaired loans on banks' profit generating capacity during different points in the economic cycle. Thus, we can estimate the panel regression as

$$ROA_{i,t} = \alpha_0^{ROA} + \beta_1^{ROA} y_t + \beta_2^{ROA} UR_t + \beta_3^{ROA} NPL_{i,t-1} + \sum_{j=1}^{5} \gamma_j^{ROA} \mathbf{B}_{j,i,t-1} + Bank\ FE + Year\ FE + \varepsilon_{i,t}^{ROA} \quad \text{(A2.8)}$$

where **B** is a $(1xj)$-vector of bank-specific variables: total assets, leverage, the share of loans and deposits relative to total assets, and operational efficiency. Bank and year fixed effects are included, and the standard errors are clustered by country*year.[4]

Annex Table 2.1 shows the estimation results for five different samples of banks corresponding to the following (also summarized in Table 2 in the main text): (1) "SSM," that is, the largest euro area banks that fall within the perimeter of the Single Supervisory Mechanism (SSM) and are directly supervised by the ECB, (2) euro area banks without SSM banks, (3) banks in non-euro area EU countries, (4) banks in central and eastern European (CESEE) countries that are not EU member states, and (5) all banks

[4]The choice of clustering at the country-year level does not consider differences in business model by the banks in the same countries. Clustering also assumes that observations of banks within countries are interdependent for a given year but are independent in the year after.

Annex Table 2.1. European Banks: ROA Satellite Models—Estimation Results

	Model					
Dependent Variable Return on Assets	**(1) SSM**	**(2) EA ex SSM**	**(3) EU ex SSM**	**(4) CESEE**	**(5) EBA**	**(6) All Banks**
Real GDP growth	**0.270*** **	**0.141*** **	**0.109** **	**0.386*** **	**0.197** **	**0.0752** **
	(0.0754)	(0.0505)	(0.0455)	(0.107)	(0.0921)	(0.0375)
Unemployment rate	**−0.208** **	**−0.0789***	**−0.0685***		**−0.171*** **	**−0.0557**
	(0.0815)	**(0.0465)**	**(0.0396)**		**(0.0531)**	**(0.0416)**
NPL ratio (−1)	**−0.0155**	**−0.0391*** **	**−0.0401*** **	**−0.0326** **	**−0.0418** **	**−0.0295***
	(0.0344)	(0.0142)	(0.0124)	(0.0163)	(0.0203)	(0.0175)
Deposit-to-asset (−1)	1.051	1.258	1.317**	−1.183	1.019	3.936**
	(1.581)	(0.780)	(0.646)	(1.999)	(0.776)	(1.588)
Total assets (log) (−1)	−1.447***	−0.0509	−0.120	0.545	−0.253	−0.936*
	(0.471)	(0.218)	(0.191)	(0.739)	(0.299)	(0.536)
Equity-to-asset (−1)	−0.0501	0.0442	0.0430*	0.0579	0.0252	0.0375
	(0.0981)	(0.0303)	(0.0260)	(0.0467)	(0.0774)	(0.0361)
Loans-to-asset (−1)	−0.0198	−0.0108*	−0.0140**	0.0123	−0.0110	−0.0333
	(0.0180)	(0.00631)	(0.00565)	(0.0153)	(0.0133)	(0.0251)
Cost-to-income (−1)	−0.00101***	−0.000435	−0.000509	−0.000251	−0.00077**	0.00070
	(0.00037)	(0.00039)	(0.00035)	(0.00025)	(0.00034)	(0.00092)
Constant	20.05***	1.497	2.243	−4.396	4.935	9.079*
	(6.284)	(2.272)	(1.994)	(5.858)	(3.912)	(5.354)
Observations	*425*	*2,590*	*3,262*	*1,300*	*596*	*6,029*
R-squared	*0.635*	*0.662*	*0.664*	*0.473*	*0.610*	*0.437*

Source: IMF staff estimates.

Note: CESEE = Central, Eastern, and Southeastern European economies; EA = euro area; EBA = European Banking Authority; SSM = Single Supervisory Mechanism. Bank and year fixed effects included; standard errors clustered by country*year (in parentheses). ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Annex Table 2.2. European Banks: NPL Ratio Model—Estimation Results

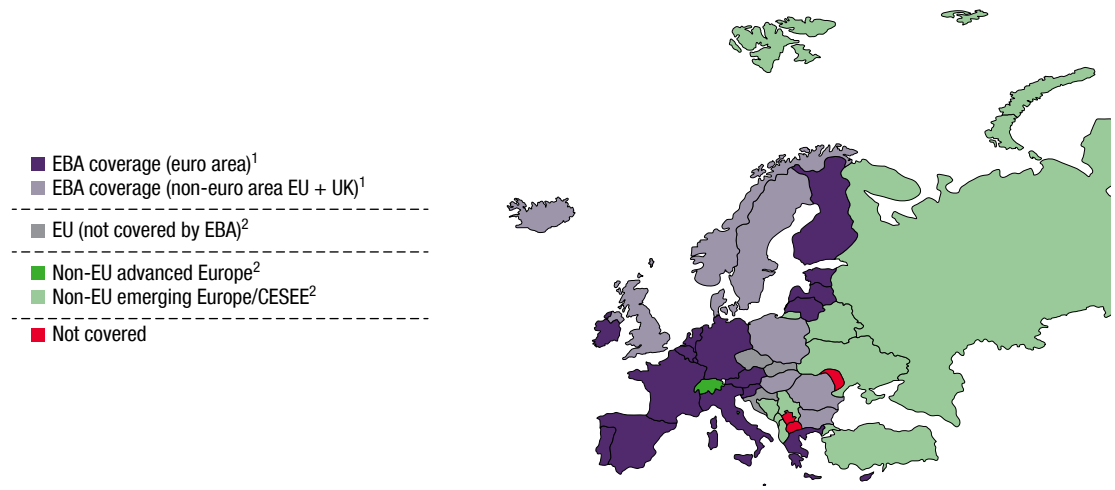
	Model			
Dependent Variable NPL Ratio	**(1) EA**	**(2) EBA**	**(3) CESEE**	**(4) All Banks**
Real GDP growth	**0.393*** **	**0.477*** **	**0.280*** **	**0.698*** **
	(0.158)	(0.117)	(0.123)	(0.0901)
Unemployment rate	**−0.543*** **	**−0.153**	**0.0589** **	−0.0308
	(0.107)	(0.112)	(0.101)	(0.0680)
NPL ratio (−1)	**0.728*****	**0.659*** **	**0.473*** **	**0.431*** **
	(0.0932)	(0.0861)	(0.0434)	(0.0541)
Loans-to-asset (−1)	0.0212	0.0511*	0.0986***	0.0531***
	(0.0233)	(0.0309)	(0.0298)	(0.0198)
Constant	−2.066	−4.510**	−1.842	−4.429***
	(2.014)	(2.110)	(2.299)	(1.451)
Observations	*414*	*593*	*3,065*	*6,186*
R-squared	*0.961*	*0.935*	*0.815*	*0.816*

Source: IMF staff estimates.

Note: CESEE = Central, Eastern, and Southeastern European economies; EA = euro area; EBA = European Banking Authority; NPL = nonperforming loans. Bank and year fixed effects included; standard errors clustered by country*year (in parentheses). ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

included in the EBA Transparency Exercise, which is used for projecting bank profitability in non-EU advanced economies (Annex Figure 2.1). For example, for the largest euro area banks, the coefficients for Model 1 are applied, that is, $\beta_1 = 0.27, \beta_2 = -0.21, \text{and} \beta_3 = -0.02$.

Annex Figure 2.1. Sample Coverage
(As of end-2019)



Source: Authors.
Note: EBA = European Banking Authority; ECB = European Central Bank.
[1]Bank data from EBA, ECB, and FitchConnect.
[2]Bank data from S&P Market Intelligence.

The NPL ratio and unemployment rate are highly correlated, with the estimated effect being more persistent for the former. Thus, in some samples, the impact of the NPL ratio is statistically small once the unemployment rate is included in the regression. Monetary conditions, such as the short-term interest rates and the slope of the country-specific yield curve, seem to have little explanatory power for predicting ROA beyond their impact on growth and unemployment.

For each bank, the estimated model coefficients above are used to estimate profitability, $\widehat{ROA}_{i,t}$, of each bank at the end of period $t \in \{2020; 2021\}$. Assuming that bank-specific factors remain unchanged over the two-year stress test horizon, the estimated ROA at the end of 2020 would be calculated as

$$\widehat{ROA}_{i,2020}|\mathbf{B}_{i,2019} = ROA_{i,2019} + \beta_1^{ROA}\Delta y_{2020} + \beta_2^{ROA}\Delta UR_{2020} + \beta_3^{ROA}\Delta NPL_{i,2019} \quad \text{(A2.9)}$$

For the subsequent period, the NPL ratio is no longer observable and can be derived separately via a satellite model (whose coefficients have

Annex Table 2.3. Satellite Models for Components of Return on Assets—Estimation Results[1]

	Dependent Variable		
	Net Interest Income	**Non-interest Income**	**Loan Loss Provisions**
Real GDP growth	**0.00656**	**0.0273***	**−0.209*****
	(0.0101)	(0.0145)	(0.0548)
Unemployment rate	**0.00535**	**0.0254***	**0.198*****
	(0.0145)	(0.0145)	(0.0706)
NPL ratio (−1)	**0.000242**	**−0.00923**	**−0.00194**
	(0.00469)	(0.0154)	(0.0286)
Deposit-to-asset (−1)	0.271	−0.00115	−1.732
	(0.255)	(0.500)	(1.499)
Total assets (log) (−1)	−0.666***	−0.236*	0.882*
	(0.165)	(0.121)	(0.464)
Equity-to-asset (−1)	0.0498***	0.0195*	0.0749
	(0.0121)	(0.0108)	(0.105)
Loans-to-asset (−1)	−0.00009	−0.0105*	0.0181
	(0.00399)	(0.00595)	(0.0144)
Cost-to-income (−1)	−0.00018***	−0.000116	0.00071**
	(0.00006)	(0.00010)	(0.0003)
Constant	8.989***	3.992**	−12.00*
	(2.058)	(1.673)	(6.227)
Observations	*425*	*425*	*425*
R-squared	*0.952*	*0.763*	*0.674*

Source: IMF staff estimates.

Note: ECB = European Central Bank; SSM = Single Supervisory Mechanism. Bank and year fixed effects included; standard errors clustered by country*year (in parentheses). ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

[1] Only euro area banks directly supervised by the ECB (SSM).

been estimated similar to the specification in the equation above; Annex Table 2.2) so that[5]

$$\widehat{NPL}_{i,2020}|\mathbf{B}_{i,2019} = NPL_{i,2019} + \beta_1^{NPL}\Delta y_{2020} + \beta_2^{NPL}\Delta UR_{2020} + \beta_3^{NPL}\Delta NPL_{i,2019}, \quad \text{(A2.10)}$$

and

$$\widehat{ROA}_{i,2021}|\mathbf{B}_{i,2020} = \widehat{ROA}_{i,2020} + \beta_1^{ROA}\Delta y_{2021} + \beta_2^{ROA}\Delta UR_{2021} + \beta_3^{ROA}\widehat{NPL}_{i,2020}|\mathbf{B}_{i,2019}. \quad \text{(A2.11)}$$

The main additive components of ROA—net interest income, non-interest income, and loan loss provisions (as specified in equation (A2.3) above), all expressed as a share of total assets—are estimated as well. For instance, the expected level of provisioning expenses can be specified as

[5]We find that under the baseline, the amount of NPLs of euro area banks could increase to more than €900 billion by 2021 (up from about €500 billion in 2019), which would increase the NPL ratio to more than 6 percent.

$$LLP_{i,t} = \alpha_0^{LLP} + \beta_1^{LLP} y_t + \beta_2^{LLP} UR_t + \beta_3^{LLP} NPL_{i,t-1} + \sum_{j=1}^{5} \gamma_j^{LLP} \mathbf{B}_{j,i,t-1} + Bank\ FE + Year\ FE + \varepsilon_{i,t}^{LLP}, \quad \text{(A2.12)}$$

where **B** is a $(1xj)$-vector of the same bank-specific variables as in equation (A2.8) above. Annex Table 2.3 shows the estimated parameter coefficients for all banks covered by the EBA Transparency Exercise, which has been applied to all sample banks. Thus, the new flow of provisions at the end of the first period of the stress test is estimated as

$$\widehat{LLP}_{i,2020} = \beta_1^{LLP} \Delta y_{2020} + \beta_2^{LLP} \Delta UR_{2020} + \gamma_1^{LLP} loans\_to\_asset_{i,2019}, \quad \text{(A2.13)}$$

and analogously for interest income, $NII_{i,2020}$, and non-interest income, $NoninterestIncome_{i,2020}$. The estimation of $\widehat{LLP}_{i,2021}$, for the next period (end-2021) follows the same specification, with relevant bank-specific explanatory variables, such as $loans\_to\_asset_{i,2020}$ being determined endogenously based on each bank's interim (end-2020) balance sheet.

Thus, the estimated ROA with effective policy measures in 2020 and 2021 would be defined as

$$\widetilde{ROA}_{i,2020} = \widehat{ROA}_{i,2020} | \mathbf{B}_{i,2019} + (\widetilde{NII}_{i,2020} - \widehat{NII}_{i,2020}) - (\widetilde{LLP}_{i,2020} - \widehat{LLP}_{i,2020}) \quad \text{(A2.14)}$$

and

$$\widetilde{ROA}_{i,2021} = \widehat{ROA}_{i,2021} | \mathbf{B}_{i,2020} + (\widetilde{NII}_{i,2021} - \widehat{NII}_{i,2021}) - (\widetilde{LLP}_{i,2021} - \widehat{LLP}_{i,2021}), \quad \text{(A2.15)}$$

respectively.

Impact of Corporate Shock

The estimated profitability also needs to be adjusted by the impact of the corporate shock on loan loss provisions. Given the outsized impact of the pandemic on the "highly-affected" sectors, the analysis distinguishes between banks' corporate exposures to "highly-affected" and other sectors using granular data from the 2020 EBA Transparency Exercise (Box 1). For banks in non-EU/EEA countries, which fall outside the scope of the EBA Transparency Exercise, banks' sectoral exposure is assumed to be the same as the average sectoral exposure in one or the average of a few neighboring countries whose banks are included in the EBA Transparency Exercise.[6] For each

[6]For instance, the asset-weighted average exposure of Polish banks is used as proxy for the sectoral exposures of banks in the Czech Republic and the Slovak Republic. For other countries, the following proxies (in parentheses) have been chosen: Slovenia (for Bosnia-Herzegovina, Croatia, Montenegro, Serbia), Bulgaria and Romania (for Albania, Belarus, Russia, Turkey, Ukraine), Germany (for Switzerland), and Italy (for San Marino).

sector and each country in the sample, we determine the average share of firms (weighed by outstanding debt) that experience a deterioration of their "financial status" in terms of liquidity and solvency, resulting in four categories in the corporate matrix described in Box Figure 1.1 in the main text—solvent-liquid (green), insolvent-liquid (pink), insolvent-illiquid (red), and solvent-illiquid (yellow).

Provisions increase relative to corporate loans for borrowers that have become either insolvent-liquid or solvent-illiquid. In addition, the incidence of insolvent-illiquid borrowers determines the scale and timing of write-offs of corporate loans, which releases provisions up to the average coverage ratio. Thus, we can amend the specification of loan loss provisions without considering policy measures as

$$\widehat{LLP}_{i,t} = \left(1 + \rho^{C}_{liquid,insolvent} + \rho^{C}_{illiquid,solvent} - \rho^{C}_{illiquid,insolvent}\omega_{t-1}v_t\right)\frac{L^{C}_{i,t}}{L_{i,t}} \left(\beta^{LLP}_{1}\Delta y_t + \beta^{LLP}_{2}\Delta UR_t + \gamma^{LLP}_{1} loans\_to\_asset_{i,t-1}\right), \quad \text{(A2.16)}$$

and with policies as

$$\widetilde{LLP}_{i,t} = \left(1 + \rho^{C\,[with\ policy]}_{liquid,insolvent} + \rho^{C\,[with\ policy]}_{illiquid,solvent} - \rho^{C\,[with\ policy]}_{illiquid,insolvent}\omega_{t-1}v_t\right)\frac{L^{C}_{i,t}}{L_{i,t}}$$

$$\left(\beta^{LLP}_{1}\Delta y_t + \beta^{LLP}_{2}\Delta \mathrm{URt} + \gamma^{LLP}_{1} loans_{to_{asset_{i,t-1}}}\right)$$

$$-(LLP^{IFRS9}_{t} - \omega_{t-1})(\Delta L^{C}_{i,t} + \Delta L^{H}_{i,t})\left(\frac{m}{12} \times \theta_t \times \begin{Bmatrix} S^{H}_{i,t} \\ S^{C}_{i,t} \end{Bmatrix}\right)$$

$$-(\varphi - \omega_{t-1})max\left(\mu^{C}_{i,t}\Delta L^{C}_{i,t},\ \theta^{G}_{t}L^{C}_{i,t}\right), \quad \text{(A2.17)}$$

in which $\nu_t = min(\frac{9}{m}; 1)$ indicates the share of write-offs that occur in this period (and the remainder, $1 - \nu_t$, in the subsequent period) for the duration of deferred bankruptcies of m months [since end-March 2020]) within the two-year stress test time horizon (see the specification of the corporate shock impact on the asset channel below). Note that corporate shock has been defined in aggregate to avoid complex notation. Consistent with the description in Box 1, the three relevant categories in the corporate matrix are in fact implemented on a sector-by-sector basis so that

Annex Table 2.4. Satellite Models for Loan Growth—Estimation Results[1]

	Model					
Dependent Variable Loan Growth	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Loan growth (−1)		−0.196				
		(0.119)				
CET1 capital ratio (−1)	**0.468***	**0.197**	**0.599***	**0.583****		
	(0.242)	(0.355)	(0.319)	(0.267)		
NPL ratio (−1)			**−0.178**			
			(0.440)			
CET1 capital buffer (−1)					0.583**	
					(0.267)	
Leverage ratio gap (−1)						2.575***
						(0.503)
Bank FE	Y	Y	Y	Y	Y	Y
Country-Year FE	N	N	N	Y	Y	Y
Observations	*2,135*	*924*	*1,847*	*2,059*	*2,059*	*886*
R-squared	*0.281*	—[2]	*0.374*	*0.430*	*0.430*	*0.675*

Source: IMF staff estimates.

Note: CET1 = common equity Tier 1; ECB = European Central Bank; FE = fixed effects; NPL = nonperforming loan; SSM = Single Supervisory Mechanism.Bank and year fixed effects included; standard errors clustered by country*year (in parentheses). Standard errors clustered by country*year (in parentheses). ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

[1] Only euro area banks directly supervised by the ECB (SSM) with values reported on a consolidated basis.

[2] Model 2 is estimated using the Arellano Bond GMM dynamic panel model, for which an R-squared is not available (since it would not be the correct measure of model fit).

$$\rho^{C}_{liquid,insolvent} L^{C}_{i,t} = \prod^{S}_{s=0} \rho^{C,s}_{liquid,insolvent} L^{C,s}_{i,t} \tag{A2.18}$$

$$\rho^{C}_{iliquid,solvent} L^{C}_{i,t} = \prod^{S}_{s=0} \rho^{C,s}_{illiquid,solvent} L^{C,s}_{i,t} \tag{A2.19}$$

$$\rho^{C}_{iliquid,insolvent} L^{C}_{i,t} = \prod^{S}_{s=0} \rho^{C,s}_{iliquid,insolvent} L^{C,s}_{i,t} \tag{A2.20}$$

where $s \in S$ denotes the total number of sectors in the economy of each sample country.

Given that the write-offs of corporate loans will also reduce total assets (see equation (A2.25) below),[7] accounting for the asset channel impact of the corporate shock, estimated ROA with effective policy measures in 2020 and 2021 would be defined as

[7]Note that this assumes that loans are not fully provisioned after accounting for the net present value of collateral, that is, banks carry the loans at positive net asset value.

$$\widehat{ROA}_{i,2020} = \widehat{ROA}_{i,2020}\Big|\mathbf{B}_{i,2019} \times \frac{A_{i,2019}}{\hat{A}_{i,2020}} + \left(\widehat{NII}_{i,2020} - \widehat{NII}_{i,2020}\right) - \left(\widehat{LLP}_{i,2020} - \widehat{LLP}_{i,2020}\right) \quad \text{(A2.21)}$$

and

$$\widehat{ROA}_{i,2021} = \widehat{ROA}_{i,2021}\Big|\mathbf{B}_{i,2020} \times \frac{\hat{A}_{i,2020}}{\hat{A}_{i,2021}} + \left(\widehat{NII}_{i,2021} - \widehat{NII}_{i,2021}\right) - \left(\widehat{LLP}_{i,2021} - \widehat{LLP}_{i,2021}\right), \quad \text{(A2.22)}$$

respectively.

Asset Channel

Specification and Estimation

We assume that total assets of banks change in response to net lending and write-offs of impaired exposures after considering available provisions and the recovery value of collateral. We estimate lending growth based on the credit supply equation for the total stock of loans $L_{i,t}$ as

$$\frac{\Delta L_{i,t}}{L_{i,t-1}} = \alpha_0^L + \beta_1^L CET1_{i,t-1} + \beta_2^L NPL1_{i,t-1} + Bank\ FE + \varepsilon_{i,t}^L \quad \text{(A2.23)}$$

which accounts for the initial capital position (lagged CET1 capital ratio), the lagged NPL ratio, and previous year's loan growth at the bank level while demand conditions are absorbed by the country-year fixed effect. The predicted loan growth is only applied to banks whose CET1 capital ratio clears the MDA threshold of 9.1 percent as the average across all euro area banks (and 10.6 percent for non-euro area European banks). Thus, we can project each bank's change of total assets as

$$\hat{A}_{i,t} = (1 - \delta)L_{i,t-1} + \widehat{\Delta L_{\cdot,t}} \text{ if } CET1_{i,t} \geq 0.091, \quad \text{(A2.24)}$$

in which the estimated loan growth is uniform across all major asset classes so that $\frac{\widehat{\Delta L_{i,t}}}{L_{i,t-1}} = \frac{\widehat{\Delta L_{i,t}^C}}{L_{i,t}^C} = \frac{\widehat{\Delta L_{i,t}^H}}{L_{i,t}^H}$ (with $\Delta L_{i,t}^C$ and $\Delta L_{i,t}^H$ denoting new corporate and mortgage lending [see equation (A2.5) above]), and δ is the average amortization rate of total outstanding loans, which is derived as reciprocal of the weighted

average of the uniform maturities of corporate and mortgage loans M^C and M^H in all countries.

Impact of Corporate Shock

In addition, we explicitly model the write-offs of corporate exposures due to the significant impact of the crisis on default risk across sectors and the mitigating impact of supportive policy measures (Box 1). Thus, equation (A2.24) above can be augmented so that

$$\acute{A}_{i,t} = (1 - \delta)L_{i,t-1} - L^C_{i,t-1}\rho^C_{illiquid,insolvent}LGD^C(1 - \omega_i) + \widehat{\Delta L_{\iota,t}}, \quad \text{(A2.25)}$$

in which $\rho^C_{illiquid,insolvent}$ denotes the write-off rate, which is defined as the expected increase of the debt-weighed share of illiquid and insolvent corporate borrowers in each sector relative to the pre-crisis situation (Box 1), ω reflects the average provisioning coverage ratio, and LGD^C is the average country-specific loss given default for corporate loans (after accounting for the recovery value of available collateral), which was obtained as quarterly risk parameters from the EBA Risk Dashboard (EBA 2021a).

The write-offs are also added to the change in $\Delta NPL_{i,2020}$ for estimating the bank profitability in equation (A2.9) above, so that the satellite model-derived NPL ratio at the end of the first period in equation (A2.10) now reads as

$$\widehat{NPL}_{i,2020}\Big|\mathbf{B}_{i,2019} = NPL_{i,2019} + \beta_1^{NPL}\Delta y_{2020} + \beta_2^{NPL}\Delta UR_{2020} + \beta_3^{NPL}\Delta NPL_{i,2019} + L^C_{i,t-1}\rho^C_{illiquid,insolvent}LGD^C(1 - \omega_i) + \widehat{\Delta L_{\iota,t}}. \quad \text{(A2.26)}$$

Consequently, equation (A2.11) for estimating the ROA at the end of 2021 becomes

$$\widehat{ROA}_{i,2021} = \widehat{ROA}_{i,2020} + \beta_1^{ROA}\Delta y_{2021} + \beta_2^{ROA}\Delta UR_{2021} + \beta_3^{ROA}\widehat{NPL}_{i,2020}\Big|\mathbf{B}_{i,2019}. \quad \text{(A2.27)}$$

Impact of Policy Measures

With policy measures in place, public sector guarantees for corporate loans influence the specification of loan growth as well as the scale and timing

of corporate default (and associated write-offs). More specifically, we revise equation (A2.25) above to

$$\tilde{A}_{i,t} = (1 - \delta)L_{i,t-1} - L^{C}_{i,t-1}\rho^{C[with\ policy]}_{illiquid,insolvent}LGD^{C}(1 - \omega_i)(1 + \varphi\theta^{G}_{t}) + \widehat{\Delta L_{\iota,t}} + \widehat{\Delta L^{C}_{\iota,t}} + max\left(\mu^{C}_{i,t}\widehat{\Delta L^{C}_{\iota,t}}, \theta^{G}_{t}L^{C}_{i,t}\right), \quad \text{(A2.28)}$$

in which $\rho^{C[with\ policy]}_{illiquid,insolvent}$ recognizes the mitigating impact of borrower support on the default risk of illiquid and insolvent corporate borrowers on the availability of borrower support, and φ is the uniform loss coverage provided by the public sector proportionate to the relative share of corporate lending of each bank within a particular country. The availability of guarantees also influences new corporate lending to the extent that corporate borrowers are eligible to receive them (that is, they are solvent); thus, credit demand from firms is the larger of (1) the share of solvent firms, $\mu^{C}_{i,t}$, relative to estimated credit demand and (2) the projected usage rate of guarantees, θ^{G}_{t} relative to the total stock of corporate loans, $L^{C}_{i,t}$ (which is also taken into account the estimated provisions in equation (A2.6) above).

Since deferred bankruptcy proceedings (Figure 31) delay the realization of losses from defaults (on the assumption of some under-provisioning), we split the write-offs between 2020 and 2021 according to the duration of insolvency stays. Thus, the estimated size of each bank's balance sheet at $t = 2020$ becomes

$$\tilde{A}_{i,t} = (1 - \delta)L_{i,t-1} - L^{C}_{i,t-1}\rho^{C[with\ policy]}_{illiquid,insolvent}LGD^{C}(1 - \omega_i)(1 + \varphi\theta^{G}_{t})v_t + \widehat{\Delta L_{\iota,t}} + \widehat{\Delta L^{C}_{\iota,t}} + max\left(\mu^{C}_{i,t}\widehat{\Delta L^{C}_{\iota,t}}, \theta^{G}_{t}L^{C}_{i,t}\right), \quad \text{(A2.29)}$$

where $\nu_t = min(\frac{9}{m}; 1)$ indicates the share of write-offs that occur in this period (and the remainder, $1 - \nu_t$, in the subsequent period) for the duration of deferred bankruptcies of m months (since end-March 2020) within the two-year stress test time horizon.

The delayed write-offs in $t = 2021$ are added to the change in $\Delta NPL_{i,2020}$ for estimating the bank profitability with effective policy measures in equation (A2.11) above, so that after considering the policy impact on interest income and loan loss provisioning, equation (A2.15) becomes

$$\widehat{ROA}_{i,2021} = \widehat{ROA}_{i,2020} + \beta^{ROA}_{1}\Delta y_{2021} + \beta^{ROA}_{2}\Delta UR_{2021} + \beta^{ROA}_{3}\widehat{NPL}_{i,2020}\Big|\mathbf{B}_{i,2019} + \left(\widehat{NII}_{i,2021} - \widehat{NII}_{i,2021}\right) - \left(\widehat{LLP}_{i,2021} - \widehat{LLP}_{i,2021}\right), \quad \text{(A2.30)}$$

where the NPL ratio at the end of the first period in equation (A2.26) now reads as

$$\widehat{NPL}_{i,2020}\Big|\mathbf{B}_{i,2019} = NPL_{i,2019} + \beta_1^{NPL}\Delta y_{2020} + \beta_2^{NPL}\Delta UR_{2020} + \beta_3^{NPL}\Delta NPL_{i,2019} + L_{i,t-1}^{C}\rho_{illiquid,insolvent}^{C[with\ policy]} LGD^{C}(1-\omega_i)(1+\varphi\theta_t^{G})v_t + \widehat{\Delta L_{\iota,t}}. \quad \text{(A2.31)}$$

Risk Channel

Specification and Estimation

The riskiness of banks' assets is defined by risk weights (RWs), which determine the required capital for an exposure relative to the prudential minimum consistent with the current Basel regulatory framework. For a bank operating exactly at the minimum CAR, a risk weight of 100 percent implies that 8 percent of the nominal amount of existing exposures are covered by total capital on average. Risk weights are calibrated to the amount of unexpected losses of an exposure (that is, losses that exceed the expected level with a certain degree of statistical confidence).

The modeling of the "risk channel" is focused on the sensitivity of credit risk weights, which define the amount of unexpected losses from a credit-sensitive assets. Higher risk weights increase the denominator of the capital ratio (while impairment charges and higher provisioning expenses decrease the numerator).

In our analysis, we evaluate how of a bank's credit risk weights would change during times of stress by shocking the default risk of its corporate and mortgage loans. We specify this shock consistent with the expected loan loss coverage using a satellite model for provisioning (including the impact of the corporate sector shock, see below). The shocked default risk is then used to update the credit risk weights for corporate and mortgage loans, which are then combined to derive the stressed overall credit risk weight (based on the share of the risk-weighted amounts of corporate and mortgage loans held by each bank).

The capital requirement (K) limits a bank's leverage based on the riskiness of their exposure to ensure that available capital is enough to cover unexpected losses above the level of provisions. We assume that all sample banks apply the advanced internal ratings-based (IRB) approach for credit risk (BCBS

2017) to determine expected losses of a bank's credit-sensitive exposures based on the one-year PD, the LGD, and the *exposure-at-default* (EAD). The capital requirement (*K*)—based on the underlying specification of an asymptotic single risk factor model—is defined as:

$$K = \left(LGD \times \Phi \underbrace{\left(\frac{1}{\sqrt{1-R}} \Phi^{-1}(PD) + \sqrt{\frac{R}{1-R}} \times \Phi^{-1}(a) \right)}_{\text{stressed default rate}} - PD \times LGD \right) \times \underbrace{\frac{1+(M-2.5)b}{1-1.5b}}_{\text{full maturity adjustment}} \quad \text{(A2.32)}$$

in which PD is the default rate over one year, with statistical confidence (single-sided) $a = 0.999$ (that is, 99.9 percent) assuming standard normal cumulative distribution function $\Phi(\cdot)$, effective maturity $M = \sum_t t \times CF_t / \sum_t CF_t$,[8] in which CF_t denotes the cash flows (principal, interest payments, and fees) contractually payable by the borrower in period t, maturity adjustment $b = (0.11852 - 0.05478 \times ln(PD))^2$, and correlation factor

$$R = 0.12 \times \frac{1-exp(1-50\times PD)}{1-exp(-50)} + 0.24 \times \left(1 - \frac{1-exp(-50\times PD)}{1-exp(-50)}\right). \quad \text{(A2.33)}$$

This specification is derived from a single risk factor model, which assumes that the obligor's asset value follows a lognormal distribution, so we can write

$$dA = \mu A\, dt + \sigma A\, dx \quad \text{(A2.34)}$$

in which x is a random stochastic process ("white noise"), so that at any time t in the future

$$\ln A(t) = \ln A(0) + \mu t - \frac{\sigma^2}{2} t + \sigma\sqrt{t}\, X(t), \quad \text{(A2.35)}$$

in which X~$\Phi(0,1)$ is a standard normal random variable. It is assumed that

$$X(t) = \sqrt{R}\, Y(t) + \sqrt{1-R}\, Z(t), \quad \text{(A2.36)}$$

[8]This calculation of effective maturity applies if any element of the advanced IRB approach is used. If the effective maturity cannot be calculated according to the specification above, a more conservative measure of M may be chosen, so that M equals the maximum remaining time (in years). However, national supervisors may allow the effective maturity to be fixed at 2.5 years (that is, "fixed maturity treatment") for facilities to certain smaller domestic corporate borrowers.

in which Y is a single, global risk factor, Z is an obligor-specific, idiosyncratic risk factor, and R is the correlation of the obligor to the global risk factor, where $Y, Z \sim \Phi(0,1)$ are independent of each other. Thus, the stressed default rate at statistical confidence of 99.9 percent, $a = 0.999$, in the IRB formula of the Basel III framework in equation (A2.32), with the asset process in equation (A2.34), is derived from

$$\begin{aligned}
&Pr\left(X(t) < \Phi^{-1}(PD) \middle| Y(t) = \Phi^{-1}(a)\right) \\
&= Pr\left(\begin{array}{c} \sqrt{R}\,Y(t) \\ +\sqrt{1-R}\,Z(t) < \Phi^{-1}(PD) \end{array} \middle| Y(t) = \Phi^{-1}(a) \right) \\
&= Pr\left(Z(t) < \frac{\Phi^{-1}(PD) - \sqrt{R}\,\Phi^{-1}(a)}{\sqrt{1-R}} \right) \\
&= \Phi\left(\frac{\Phi^{-1}(PD) - \sqrt{R}\,\Phi^{-1}(a)}{\sqrt{1-R}} \right) \qquad \text{(A2.37)}
\end{aligned}$$

Since the degree of capital adequacy depends on the riskiness of exposures relative to available capital, K, the risk-weighted amount of capital implies a leverage ratio of 12.5 at the minimum capital requirement, CAR = 8.0 percent and EAD at unity. Given that $RW = \frac{1}{CAR} \times K$, we can derive the implicit risk-weight from equation (A2.32) above as

$$RW = \left(LGD \times \Phi \left(\begin{array}{c} \frac{1}{\sqrt{1-R}}\,\Phi^{-1}(PD) \\ +\sqrt{\frac{R}{1-R}} \times \Phi^{-1}(a) \end{array} \right) - PD \times LGD \right) \times \frac{1 + (M - 2.5)b}{1 - 1.5b} \times 12.5, \qquad \text{(A2.38)}$$

if each component of the banks' exposures contributes uniformly to the minimum CAR of 8.0 percent.

Thus, for each bank, we can derive the one-year default risk, $PD^{C}_{i,t-1}$ and $PD^{H}_{i,t-1}$, implied by observed risk weights for corporate and mortgage loans, $RW^{C}_{i,t-1}$and $RW^{H}_{i,t-1}$,

$$\begin{aligned}
RW^{\{C;H\}}_{i,t-1} = \Bigg(& LGD^{\{C;H\}}_{i} \times \Phi\left(\frac{\Phi^{-1}\left(PD^{\{C;H\}}_{i,t-1}\right) + \sqrt{R}\,\Phi^{-1}(a)}{\sqrt{1-R}} \right) \\
& - PD^{\{C;H\}}_{i,t-1}\, LGD^{\{C;H\}}_{i} \Bigg) 0.08 M^{\{C;H\}} \qquad \text{(A2.39)}
\end{aligned}$$

assuming that corporate and mortgage loans have average maturities of $M^{C} = 6.3[years]$ and $M_{H} = 22.0[years]$, respectively, and loss-given default

(LGD) rates, LGD_i^C and LGD_i^H, which vary across countries.[9] Corporate and mortgage loans are also assigned a bank-specific and time-varying maturity adjustment, $b_{i,t-1}^C$ and $b_{i,t-1}^H$, as well as correlation factors, $R_{i,t-1}^C$ and $R_{i,t-1}^H$, which are calculated using equations (A2.32) and (A2.33) above. The LGDs were derived as the lower of the net recovery rate (as reported in EBA's benchmarking exercise [EBA 2020c]) and the LGDs for corporate and retail exposures published in the risk parameter statistics of EBA's Risk Dashboard (EBA 2020a).[10] Both $PD_{i,t-1}^C$ and $PD_{i,t-1}^H$ were cross-validated with general PDs reported by EBA for corporate and retail exposures and increased by up to 50 percent of their estimated value in cases where EBA-reported values were significantly higher.

We can then determine the change of $PD_{i,t-1}^{\{C;H\}}$ in each period under stress consistent with the change in loan loss provisions after accounting for the change in non-performing loans (using the respective satellite models that capture change in macroeconomic and bank-specific conditions; see equations (A2.10), (A2.13), and (A2.16) above) so that

$$\widehat{PD}_{i,t}^{\{C;H\}} = PD_{i,t-1}^{\{C;H\}} \times \left(1 + \frac{max\left(\widehat{LLP}_{i,t}^{\{C;H\}} - \Delta NPL_{i,t}^{\{C;H\}}, 0\right) \times LLP_{i,t-1}^{\{C;H\}}}{NPL_{i,t-1}^{\{C;H\}}}\right), \quad \text{(A2.40)}$$

in which the pre-stress provisions for corporate and mortgage loans, $LLP_{i,t-1}^C$ and $LLP_{i,t-1}^H$, are derived from $LLP = \left(1.662 + 0.00092\,(RW \times 100)^2 - 0.06\,(RW \times 100)\right) \times LGD$ (Jobst and Weber 2016).

We can now plug the updated PDs above back in the IRB formula to derive the "shocked" RWs for both corporate loans and mortgages, respectively.

$$\begin{Bmatrix} \widehat{RW}_{i,t}^{\{C;H\}} \\ \widehat{RW}_{i,t}^{\{C;H\}} \end{Bmatrix} = \left(LGD_i^{\{C;H\}} \times \Phi \left(\frac{\Phi^{-1}\left(\begin{Bmatrix} \widehat{PD}_{i,t}^{\{C;H\}} \\ \widehat{PD}_{i,t-1}^{\{C;H\}} \end{Bmatrix} \right) + \sqrt{R}\,\Phi^{-1}(a)}{\sqrt{1-R}} \right) - \begin{Bmatrix} \widehat{PD}_{i,t}^{\{C;H\}} \\ \widehat{PD}_{i,t-1}^{\{C;H\}} \end{Bmatrix} LGD_i^{\{C;H\}} \right) 0.08 M^{\{C;H\}} \quad \text{(A2.41)}$$

[9]Note that the specification of credit risk weights using the advanced IRB formula in equation (A2.39) is concave on the PD value. Thus, using the average PD of the portfolio (instead of computing the weighted average of the credit risk weights calculated at loan level), may generate a conservative estimate.

[10]The EBA Risk Dashboard is part of the regular risk assessment conducted by the EBA and complements the Risk Assessment Report.

Impact of Corporate Shock

We account for the write-offs of each bank's corporate exposures in equation (A2.25) of the asset channel by revising equation (A2.40) above to

$$\widehat{PD}_{i,t}^{\{C;H\}} = PD_{i,t-1}^{\{C;H\}} \times \left(1 + \frac{max\left(\widehat{LLP}_{i,t}^{\{C;H\}} - \Delta\widehat{NPL}_{i,t}^{\{C;H\}} + L_{i,t-1}^{C}\rho_{illiquid,insolvent}^{C} LGD^{C}, 0\right) \times LLP_{i,t-1}^{\{C;H\}}}{NPL_{i,t-1}^{\{C;H\}}}\right), \quad \text{(A2.42)}$$

Impact of Policy Measures

Accounting for the impact of policy measures on the change in credit risk weights requires replacing the estimated loan loss provisions in equation (A2.42) with the specification in equation (A2.17) of the profitability channel after accounting for the corporate sector shock from equation (A2.29) of the asset channel so that

$$\widehat{PD}_{i,t}^{\{C;H\}} = PD_{i,t-1}^{\{C;H\}} \times \left(1 + \frac{max\left(\widehat{LLP}_{i,t}^{\{C;H\}} - \Delta\widehat{NPL}_{i,t}^{\{C;H\}} + L_{i,t-1}^{C}\rho_{illiquid,insolvent}^{C[with\ policy]} LGD^{C}(1-\omega_i)(1-\varphi\theta_t^{G})v_t, 0\right) \times LLP_{i,t-1}^{\{C;H\}}}{NPL_{i,t-1}^{\{C;H\}}}\right), \quad \text{(A2.43)}$$

in $t = 2020$, and

$$\widehat{PD}_{i,t+1}^{\{C;H\}} = PD_{i,t}^{\{C;H\}} \times \left(1 + \frac{max\left(\widehat{LLP}_{i,t+1}^{\{C;H\}} - \Delta\widehat{NPL}_{i,t+1}^{\{C;H\}} + L_{i,t}^{C}\rho_{illiquid,insolvent}^{C[with\ policy]} LGD^{C}(1-\omega_i)(1-\varphi\theta_t^{G})(1-v_t), 0\right) \times LLP_{i,t}^{\{C;H\}}}{NPL_{i,t}^{\{C;H\}}}\right), \quad \text{(A2.44)}$$

in $t + 1 = 2021$.

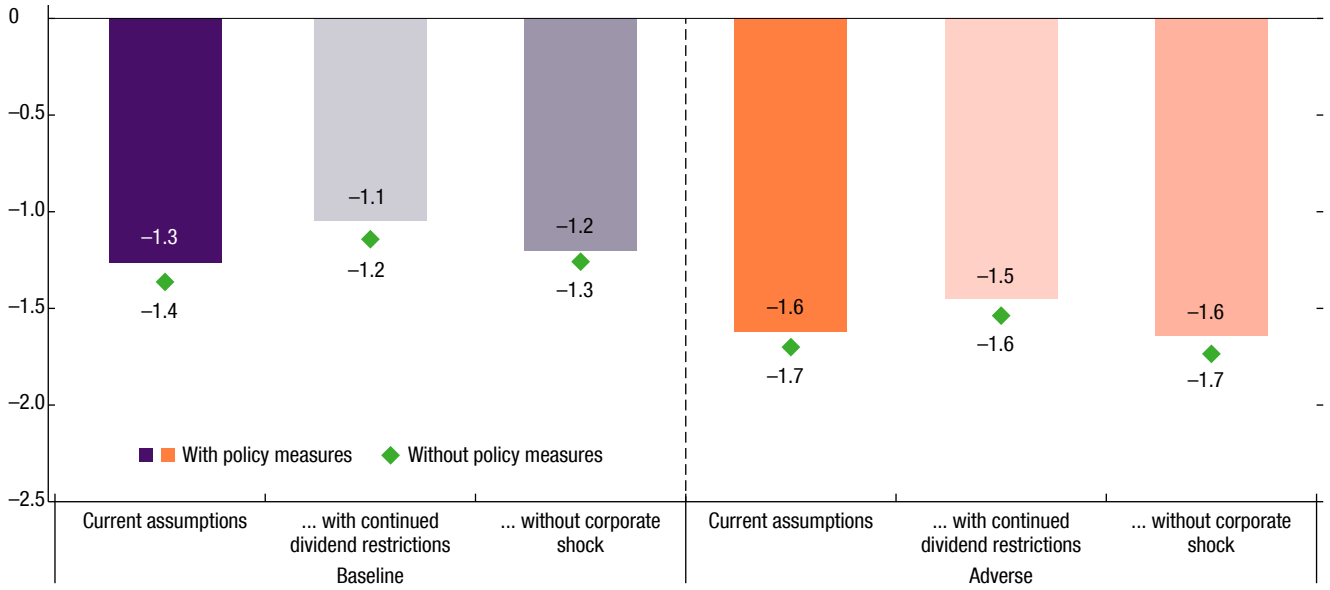
Note that we ignore the net impact of the write-offs of corporate loans on the credit risk weight of the loan portfolio. Empirical evidence presented in Jobst, Ong and Schmieder (2013) suggests that the risk weights of defaulted loans tends to be 2.5 times higher than that of the average loan, which would mean that $\tilde{PD}_{i,t}^{\{C;H\}}$ in equation (A2.43) above would be slightly lower all else equal.

Annex 3. Impact of COVID-19 on the Capital-to-Asset Ratio

In addition to the analysis of the CET1 ratio as a measure of bank solvency, we also consider the capital-to-asset ratio. This simpler measure of bank capital does not capture risk-weighted assets and is a proxy for the "leverage" ratio, and EU banks will need to maintain a minimum leverage ratio of 3 percent from June 2021. The leverage ratio is only a backstop to the regulatory risk-weighted capital ratios, such as CET1 ratio, and has been put in place to ensure that risk-weight modeling uncertainties and errors do not lead to excessively swollen balance sheets of banks. The leverage ratio leads to a simpler connection between banks' profitability and capital accumulation.

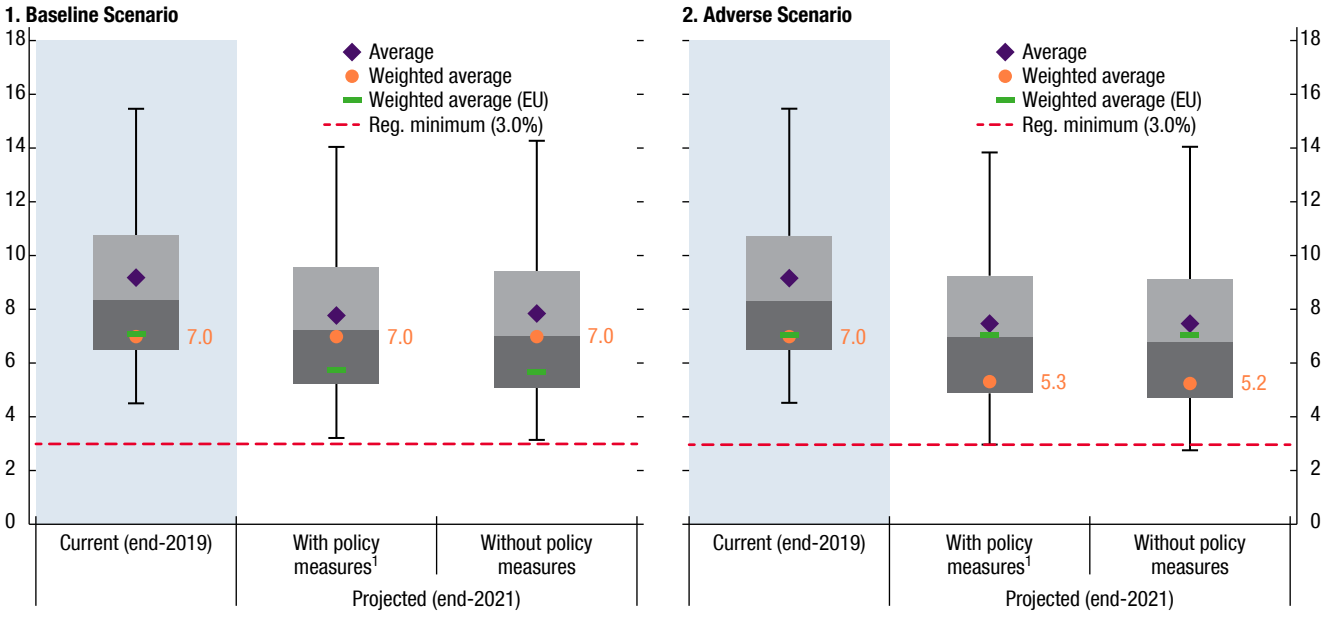
Similar to the results for the CET1 ratio, the capital-to-assets is projected to fall by about 2 percentage points through 2021 under the baseline scenario with policies. For this exercise, the methodology in Annex 2 is used for the profitability and the asset channels only. Starting from a relatively high level of 6.9 percent in 2019, European banks, on average, lose retained earnings with lower ROA through 2020, and are not able to replenish capital buffers through retained earnings even with the recovery in GDP growth envisaged for 2021 even with policies. This is because higher NPLs in 2020 weigh on ROA in 2021, and corporate bankruptcies require write-offs reducing capital against existing and projected provisions. While policies help, the capital-to-asset ratio does not benefit from reduced risk weights against a no-policy counterfactual. The sensitivity analysis of the capital-to-asset ratio suggests that continued dividend retention would provide mitigate the projected shock by 0.2 percentage points over the two-year time horizon. Excluding the single factor shock from a surge of corporate bankruptcies would not significantly change the results given the delayed insolvency procedures, resulting most of the rising provisioning expenses being absorbed by higher profitability during the recovery in 2021.

Annex Figure 3.1. Euro Area Banks: Change of Capital-to-Asset Ratio under Different Assumptions (Extended Coverage)
(Percentage points, end-2021 relative to end-2019)



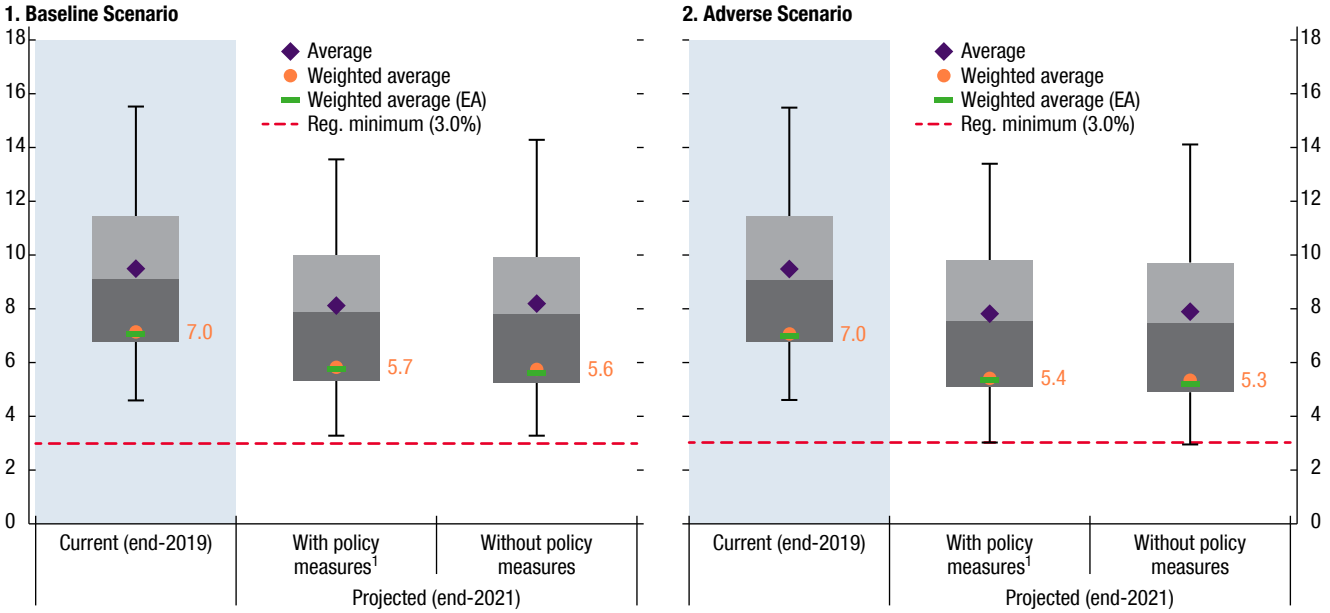
Sources: European Banking Authority; European Central Bank; FitchConnect; S&P Global Market Intelligence; and IMF staff calculations.

Annex Figure 3.2. Euro Area Banks (Extended Coverage): Solvency Stress Test
(Capital-to-asset ratio, percent)



Sources: European Banking Authority; European Central Bank; European Systemic Risk Board; FitchConnect; and IMF staff estimates.
Note: The grey shaded area of the boxplots shows the interquartile range (25th to 75th percentile), with whiskers at the 5th and 95th percentile of the distribution. The analysis covers the two main channels affecting both capital and assets under stress—changes in profitability (net interest income and provisions) and effective changes in total assets (net lending and write-offs after reserves). The crisis-specific risk drivers of these channels are (1) write-offs due to the projected insolvency of illiquid and insolvent firms (weighted by outstanding debt and mapped to the sector-by-sector corporate exposure of sample banks), (2) the profitability impact of policy measures (lower provisions for guaranteed loans to solvent firms, loss forbearance on eligible loans under moratoria, and decline in interest income due to duration of debt moratoria), In addition, there is a general change in net operating income after general provisions and losses on other noninterest income due to lower GDP growth and higher unemployment rate, including impairment charges for noncorporate exposures. The calculation does not consider changes in unexpected losses, which are reflected in the risk-weighting of asset exposures in the computation of capital adequacy.
[1]Debt repayment relief (moratoria) for businesses and households, corporate credit guarantees, delayed insolvency proceedings, and dividend restrictions (only in 2020).

Annex Figure 3.3. EU Banks (Extended Coverage): Solvency Stress Test
(Capital-to-asset ratio, percent)



Sources: European Banking Authority; European Central Bank; European Systemic Risk Board; FitchConnect; and IMF staff estimates.
Note: The grey shaded area of the boxplots shows the interquartile range (25th to 75th percentile), with whiskers at the 5th and 95th percentile of the distribution. The analysis covers the two main channels affecting both capital and assets under stress—changes in profitability (net interest income and provisions) and effective changes in total assets (net lending and write-offs after reserves). The crisis-specific risk drivers of these channels are (1) write-offs due to the projected insolvency of illiquid and insolvent firms (weighted by outstanding debt and mapped to the sector-by-sector corporate exposure of sample banks), (2) the profitability impact of policy measures (lower provisions for guaranteed loans to solvent firms, loss forbearance on eligible loans under moratoria, and decline in interest income due to duration of debt moratoria), In addition, there is a general change in net operating income after general provisions and losses on other noninterest income due to lower GDP growth and higher unemployment rate, including impairment charges for noncorporate exposures. The calculation does not consider changes in unexpected losses, which are reflected in the risk-weighting of asset exposures in the computation of capital adequacy.
[1]Debt repayment relief (moratoria) for businesses and households, corporate credit guarantees, deferred insolvency proceedings, and dividend restrictions (only in 2020).

Annex 4. Accounting and Prudential Treatment of Forborne Loans in Normal Times

Banks maintain (largely overlapping) sets of accounting and prudential provisions:

- **Accounting provisions focus on the proper measurement of asset values, and thus net worth, as attested by auditors**. They form a key input to standardized, comparable, published financial statements to inform investors and other market participants. Accounting provisions seek to reduce the net value of loans to something approximating their market (but not fire sale) value; they flow through the income statement and appear as negative entries on the asset side of the balance sheet. In the EU, the applicable accounting standard is transitioning from IAS 39 (incurred loss) to IFRS 9 (expected loss), with a phase-in through the end of 2022. Accounting provisions may neither fall short of required amounts (failing to capture risk) nor exceed them (potentially raising questions of tax avoidance or profit smoothing).
- **Prudential provisions add an extra layer of protection at the behest of regulators and supervisors**. These may supplement but not interfere with accounting provisions; the term "provision" is something of a misnomer here because, in practice, the process involves deductions from qualifying regulatory capital, which in turn require banks to add a microprudential overlay of additional capital and reserves. Some prudential provisioning requirements apply to all banks (Pillar 1), while others are set by supervisors on a bank-by-bank basis (Pillar 2). In the EU, prudential provisions are specified by the Capital Requirements Regulation (CRR) and Directive (as transposed), EBA technical standards, and EBA and ECB guidelines.

Under IFRS 9, banks must model expected losses based on historical, current, and forward-looking information, including macroeconomic forecasts. Although it is not necessary for a credit event to occur before an expected

credit loss is recognized, a missed payment is taken as an indication of increased risk, triggering a higher provision. At origination, the provision must cover expected loss resulting from possible default within 12 months (Stage 1). If thereafter the bank determines that a material increase in credit risk has occurred, the provision must also cover the lifetime expected loss on the loan (Stage 2). Finally, if credit risk is determined to have increased to the point where the loan is impaired (usually at more than 90 days past due), the provision must add coverage of future accrued interest at amortized cost (Stage 3).

CRR, in turn, specifies what measures constitute forbearance, which may trigger reclassification of the loan to nonperforming, resulting in higher prudential provisions. Loan classification criteria are further elaborated in EBA and ECB guidelines issued in 2016 and 2017, respectively, with the former stipulating more than 90 days past due as the default threshold. An ECB addendum on prudential provisioning issued in 2018 prompted accusations of Pillar 2 supervisory powers being misused to achieve Pillar 1 regulatory outcomes, necessitating clarifications and some adjustments by the ECB.

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