A note on regulatory responses to COVID-19 pandemic: Balancing banks' solvency and contribution to recovery

Mohammad Bitar[1†], Amine Tarazi[2, 3]

[1] Nottingham University Business School, University of Nottingham, Jubilee Campus, Nottingham NG8 1BB, United Kingdom.

[2] Université de Limoges, LAPE, 5 rue Félix Eboué, 87031 Limoges Cedex, France; [3] Institut Universitaire de France (IUF), 1 rue Descartes, 75231 Paris Cedex 05, France.

Abstract.

We discuss the implications on banks and the economy of prudential regulatory intervention to soften the treatment of non-performing exposures (NPEs) and ease bank capital buffers. We apply these easing measures on a sample of Globally Systemically Important Banks (G-SIBs) and show that these banks can play a constructive role in sustaining economic growth during the COVID-19 pandemic. In addition, an empirical analysis shows that prudential regulatory responses to COVID-19 along with high regulatory capital and low non-performing loans ratios are positively associated with economic growth. Thus, banks should maintain high capital ratios in the medium-term horizon to absorb future losses, as the effect of COVID-19 on the economy might take time to fully materialise.

1. Introduction

In December 2019, The Chinese Center for Disease Control and Prevention (CCDC) informed the World Health Organization (WHO) of unknown cases of pneumonia that took place in the city of Wuhan, Hubei province of China (WHO, 2020). The novel virus belongs to a large family of coronaviruses such as the Severe Acute Respiratory Syndrome (SARS) and the Middle East Respiratory Syndrome (MERS-CoV). Coronavirus is a respiratory virus; it is contagious and can spread through droplets generated when an infected person coughs or sneezes. The WHO characterized the disease as a pandemic on March 11, 2020 (WHO, 2020), and proposed an official name, COVID-19, an acronym that stands for coronavirus disease 2019. At the time of writing this paper, the pandemic is still ongoing and the number of COVID-19 cases have reached 292.88 million globally while the death toll has reached 5.45 million people.[1] Fig. 1 compares the number of COVID-19 confirmed cases and deaths between several developed countries and China. The number of confirmed cases and deaths continue to increase rapidly in the US (Fig. 1B), the EU countries along with the UK, Canada, and Japan (Fig. 1A). However, China seems to have managed to flatten its curve as early as the end of March 2020 (Fig. 1C).

INSERT FIGURE [1] AROUND HERE

Although the rapid spread of COVID-19 has taken both governments and health officials by surprise, governments have mainly responded by trying to contain, delay, and mitigate the effect of the disease on their national health system. In general, the "golden rule", implemented by government officials, requires shutting down schools and workplaces, imposing travel restrictions, staying home orders and employing social distancing measures, along with various economic relief plans, aggressive monetary expansion, and bank prudential regulatory measures. The purpose of these actions is to reassure investors and the public, and alleviate the negative effects of COVID-19 on economic growth and the soundness of the financial system. These relief plans are similar to the ones implemented during the 2007/2009 financial crisis; yet, their scale is massive and covers all economic and financial sectors.

Against this background, this paper considers two questions. First, what are prudential regulators doing so far in responding to the pandemic? Second, what are the potential implications of prudential regulatory intervention on economic growth? To address these questions, we follow two steps. First, we compare prudential regulatory responses to lessen the

---

[1] Ourwroldindata.org, https://ourworldindata.org/grapher/total-deaths-and-cases-covid-19. Last accessed on Jan. 3, 2022.

growing pressure on the economy and the financial sector. We focus on two common aspects used in the relief packages undertaken in the United States, the EU, the UK, and Canada: i) the easing of bank capital buffers and ii) the economic relief plans. We consider a sample of Globally Systemically Important Banks (G-SIBs) to discuss the implications of softening the treatment of non-performing exposures (NPEs) and easing capital buffers on credit supply and bank solvency. Second, we examine the effect of COVID-19 spread and prudential regulatory responses on economic growth.

Recent economic and finance literature is oblivion about the influence of pandemics and epidemics on economic growth and financing decisions. While the WHO warned in a recent report[2] that the world is in an imminent danger of a global pandemic (WHO, 2019), little or no actions have been undertaken by researchers and policy makers to study the potential effect of diseases on economic growth. One notable study is Fan et al. (2018), who estimates that the expected annual losses from pandemic events is approximately $500 billion, or 0.6 percent of global income, a sum that now appears to be greatly underestimated. Berger and Demirgüç-Kunt (2021) emphasize that the COVID-19 pandemic as the "most unanticipated large and widespread exogenous economic shock of all time". Recent figures show a significant effect of COVID-19 on global economy growth. From job loss to the growing uncertainty and the volatility of the securities markets, the World Economic Outlook (WEO, 2021) report, recently published by IMF, shows that global economic growth is estimated at -3.5 percent in 2020. Advanced countries such as the US, the EU, the UK, and Canada's economic growth is estimated at -4.9% on average. The effect of the pandemic is estimated to be lower in emerging markets and developing economies. While the WEO is projecting a -2.4% economic growth for emerging and developing economies, China's economic growth remains positive and estimated at 2.3% for 2020.

This paper aims to complement the embryonic literature on COVID-19 by discussing the actions undertaken by governments and bank prudential regulators to lessen the economic fallout from the pandemic and maintain the supply of credit. Specifically, we discuss the implications on banks and the economy of softening the treatment of NPEs and easing capital buffers. In addition, we apply these easing measures on a sample of G-SIBs and show that these banks may play a constructive role in sustaining economic growth during the COVID-19 pandemic. An empirical investigation on the effect of prudential regulatory responses on economic growth

---

[2] Global Preparedness Monitoring Board report (2019).

reinforces this view. However, it might be counterproductive if – because of depleted buffers combined with higher credit risk – economic and financial distress thwarts the recovery from the COVID-19 shock that was originally non-financial.

The rest of the paper is organized as follows. Section 2 provides statistics on bank compliance with capital requirements using a sample of G-SIBs. Section 3 discusses the implications of prudential regulatory intervention adopted by four governments in response to the COVID-19 pandemic. Section 4 examines the effect of the spread of COVID-19 and prudential regulatory responses on economic growth. Section 5 concludes.

2. Bank compliance with capital requirements

Banks play a key role in financing economic growth and governments COVID-19 policies aim to facilitate banks' role to maintain lending (International Monetary Fund and World Bank, 2020). These policies include the introduction of repayment moratoria, flexibility in the treatment of non-performing loans, releasing capital buffers, and providing guidance on how to navigate prudential regulation during the COVID-19 period. While these policies aim to facilitate access to finance and stimulate economic growth, they have a short-term nature and are set to expire in summer 2021. Therefore, the post-pandemic economic growth depends on maintaining a delicate balance between two factors: i) the continuity of COVID-19 relief measures related to the release of bank capital buffers and the lenient treatment of NPEs, and ii) the materialisation of credit risk and its effect on bank solvency once prudential regulators decide to exit these exceptional measures. Yet, controlling for both factors is difficult with the continuous increase in COVID-19 cases and the emergence of new and highly contagious variants.

Overall, maintaining a status quo in the medium-term may lead to a large increase in borrowers' payment deferrals and thus an increase in bank credit risk. A simple calculation gives an idea of this. Table 1 shows the aggregated assets of the 33 G-SIBs operating in 12 countries at the end of 2017. We refer to the Financial Stability Board (FSB) list of G-SIBs and collect the data on bank regulatory capital from the Orbis BankFocus database. We focus on G-SIBs because of their scale and the degree of their importance and interconnectedness within the global and the domestic financial markets. They are important since their failure may affect the stability of the financial system as a whole and the development of the global economy. Total assets amount to $55.2 trillion, of which $24.1 trillion are loans[3] to the economy and $12.5

---

[3] 30% of G-SIBs loans are residential mortgages, and loans and leases to corporate enterprises.

trillion are securities. Since G-SIBs capital[4] amounts to $4 trillion, it would only take 16.6% (24.1*16.6% = 4) of the G-SIBs loans not being reimbursed to wipe out their entire capital.

<center>INSERT TABLE [1] AROUND HERE</center>

To examine whether the rate of 16.6% credit default is possible in the recovery period, we retrieve data on bank credit risk using the same sample reported above. We use two bank-level measures of credit risk, i.e. the impaired loans to gross loans ratio and the bank type of risk-weighted assets (i.e. credit risk, market risk, and operational risk) divided by total risk-weighted assets ratio, and one country-level aggregated measure of credit risk, i.e. the non-performing loans to gross loans ratio. Data on bank-level credit risk is collected from Orbis BankFocus while data on country-level credit risk is collected from the International Monetary Fund's website. Bank-level data covers 33 G-SIBs located in 12 countries and covering the preCOVID-19 period, spanning from 2011 to 2019. Fig. 2A shows that the ratio of impaired loans to gross loans had fallen significantly between 2013 and 2019, from an average of 3.38% to 1.85%. The ratio of non-performing loans to gross loans ratio is showing a very similar pattern but with large disparities between countries. Fig. 2B shows that Italy had a non-performing loans ratio of 18.1% in 2015, higher than the 16.6% figure presented above, and was still significantly above the G-SIBs countries' average in the preCOVID-19 period estimated at 3.44%. In addition, Fig. 4C indicates that in the preCOVID-19 period, bank exposure to credit risk dominated exposures to market risk and operational risk, and accounts for 78.42% of G-SIBs risk-weighted assets, on average. Consequently, it is possible that the capital of some banks will be exhausted if credit risk screening measures are relaxed in the short-term and bank capital buffers are depleted, which may lead to an insolvency problem in the recovery period.

<center>INSERT FIGURE [2] AROUND HERE</center>

Next, we explore how banking institutions may be in a better position in helping the economy to absorb the impact of the COVID-19 pandemic compared to their position during the 2007/2009 financial crisis by focusing on G-SIBs compliance with Basel III capital reforms. The number of available observations on the components of capital adequacy ratio (CAR) varies between years with 2017 reporting the highest number of available observations across the sample period. Thus, we use 2017 as a base year to compute the capital conservation buffer (CCB), the counter-cyclical buffer (CyB), and the G-SIBs capital surcharge.

---

[4] The ratio of total capital to total assets (or the unweighted capital ratio) represents 7.23% of bank total assets. [5] Out of the eight G-SIBs reported in Table 1, data on net income and retained earnings is only reported for five banks.

Table 2 Panel A and Fig. 4D show that while the minimum CAR is 8%, G-SIBs prefer to hold CARs well above the minimum standardized level. However, due to the gradual implementation of the capital reforms across countries, the average CAR for G-SIBs varies significantly. CAR increased from 14.23% in 2011 to 17.41% in 2019 (Fig. 4D), with the lowest value around 13.91% in Spain and the highest value around 19.61% in Sweden (Table 2, Panel A). The statistics suggest that G-SIBs in Northern European countries along with UK, and American banks are highly capitalized compared to their Southern European and Chinese counterparts. Fig. 4D also shows that more than 66% of CAR is core capital in the form of CET1. Furthermore, Panel A shows that national regulatory authorities require banks to maintain their CCB at 2.5% of risk-weighted assets. The level of banks' CyBs, however, varies substantially across jurisdictions. While most G-SIBs located in the EU have maintained their CyB near or at 0%, other countries such as Canada, Sweden, and China have chosen to maintain their CyB at 2.5% of risk-weighted assets.

Table 2 Panel B shows that G-SIBs are well capitalized; they maintain around $3.508 trillion of total capital out of which $2.727 trillion is categorized under CET1 or capital of good quality. Panel B also shows that G-SIBs have almost accumulated $534 billion under CCB in 2017. Countries such China and the United States have accumulated $206 billion and $158 billion, respectively, thus representing 68.2 percent of the total value of CCB for G-SIBs. As for the CyB, G-SIBs have approximately accumulated $248 billion, largely dominated by Chinese banks with $206 billion. Finally, Panel B shows that the accumulated capital surcharge has reached $300.7 billion in 2017 and expected to be much higher in 2018 and 2019. Once again, American and Chinese banks hold $112 billion and $104 billion, respectively, representing 87.1% of the total value of capital surcharge for G-SIBs.

INSERT TABLE [2] AROUND HERE

On the whole, the numbers indicate a large cross-country variation in G-SIBs capital buffers, where G-SIBs in the United States and China dominate their counterparts in other countries. Capital buffers are important tools available to banks in times of economic downturns such as the COVID-19 period; they can be used in the short-term horizon to support the continuous provision of credit to households and businesses instead of using taxpayers' resources. Nevertheless, the use of these buffers along with a more lenient treatment of NPEs should not undermine banks' solvency in the recovery period. In the next section, we review and discuss the implications on the economy of four measures undertaken by prudential regulators

and governments to release bank capital buffers and ease the treatment of NPEs during the COVID-19 pandemic.

3. Governments' responses to COVID-19 pandemic: Easing capital buffers and lenient treatment of NPEs

We discuss the implications on the economy for four cases of prudential regulatory intervention to ease capital buffers in the US, the EU, the UK, and Canada. We also review the measures undertaken by regulators allowing for a more lenient treatment of NPEs. Prudential regulators can ease capital buffers in three ways. First, they can partially or totally remove the requirements on capital buffers such as in the UK and Canada. Second, they can publicly or privately encourage temporary ease of capital requirements such as in the EU. Finally, they can de-link the use of capital buffers from dividend payments such as in the US. We discuss each of these four cases below.

Case 1: *The US response to COVID-19 pandemic – delinking CCB from dividend payments*

Under the Fed rule, if the largest American banks' CCB falls below 2.5% of risk-weighted assets plus the required CyB and the G-SIBs capital surcharge, the bank becomes subject to stringent limitations on capital distributions and discretionary bonus payments. These distributions are calculated as a percentage of eligible retained income. Eligible retained income is defined as the average net income for the four calendar quarters preceding the current calendar quarter, net of any distributions. On March 20, 2020, the Fed approved a new revised (interim) rule allowing banks to more gradually limit distributions in the COVID-19 period. The new rule defines eligible retained income as the average of net income for the four quarters preceding the current calendar quarter. This revision will allow banks to build-up their CCB more easily since they no longer need to deduct distributions of previous years from their net income. The revision will also reduce stringent limitations on bank capital distributions and discretionary bonus payments by allowing it to be more gradual.

To examine how the distribution limitations under the new interim rule can be more gradual, we collect quarterly data on net income and retained earnings for five G-SIBs in the United States from the CRSP/Compustat merged database.[5] The data shows that these banks had $22.86 billion, on average of net income for quarter 3, 2018 to quarter 3, 2019 period. For quarter 4, 2019, these banks had $583.31 billion available for distribution ($562.92 billion prior

---

[5] Out of the eight G-SIBs reported in Table 1, data on net income and retained earnings is only reported for five banks.

quarter retained earnings and 20.39 billion current quarter net income). [6] We assume that the G-SIBs maintain adequate levels of CyBs and capital surcharges. We also assume that banks distribute 75% of their net income at each quarter. Fig. 5 compares the maximum payout amounts under the new interim rule and the Basel III rule. The graph clearly shows that under the new interim rule, the maximum distribution allowable in quarter 4, 2019 declines more gradually, whereas the previous Basel III rule has a more significant cliff at 2.5%. This revision provides banks with stronger incentives to continue their supply of credit and support economic growth in the short-term horizon.

<div align="center">INSERT FIGURE [5] AROUND HERE</div>

Case 2: *The EU response to COVID-19 pandemic – temporary capital relief*

The European Central Bank (ECB) requires banks in member states to follow a more stringent definition of capital compared to banks in the United States and Canada. ECB defines minimum capital requirements' ratio as the sum of Pillar 1 capital and Pillar 2 capital (excluding Pillar 2 Guidance, explained below). In addition, banks are required to add up several capital buffers, including the CCB, the CyB, and the G-SIBs capital surcharge. Pillar 1 capital is the sum of Tier 1 capital and Tier 2 capital. Pillar 2 capital consists of two parts. Pillar 2 Requirements (P2R), which includes risks that are not underestimated or not sufficiently covered by Pillar 1. Pillar 2 Guidance (P2G), which specifies to each bank the adequate level of capital to be maintained in stress situations. The level of adequate capital is calculated based on factors related to adverse scenarios in the ECB's supervisory stress tests. If a bank fails to meet the ECB minimum capital requirements, restrictions may be imposed on the distributions of dividends and bonuses. On March 12, 2020, the ECB announced that banks could temporarily operate below their P2G, the CCB, the CyB, and the G-SIBs capital surcharge. In addition, the ECB will allow banks to partially use additional Tier 1 or Tier 2 instruments that do not qualify as CET1 to meet P2R.

Recall that Table 2 Panel A shows large differences between EU countries capital buffers' requirements. While banks maintain CCBs at 2.5% of risk-weighted assets in all countries, the level of CyB varies between 0%, in Germany, Italy, Netherlands and Spain, 0.5% in France, and 2.5% in Sweden. For example, Panel B shows that in 2017 the four G-SIBs in France hold more than $95 billion in their CCB, CyB, and G-SIBs capital buffers compared to $9 billion build-up by the one Swedish G-SIB. These differences indicate that releasing buffers, in particular the

---

[6] We focus on quarter 3, 2018 to quarter 4, 2019 period because data is not available on quarter 1, 2020.

CyB, may have a very limited and nonhomogeneous effect on supporting banks and stimulating economic activity, given the prevailing low and sometimes non-existent CyBs in some EU countries compared to other countries in the preCOVID-19 period. The ECB estimates that the release of the P2G as well as the less stringent requirements regarding additional Tier 1 capital and Tier 2 capital instruments will allow banks to use around €120 billion of additional CET1 capital to maintain economic activities in the short-term horizon.

Case 3: *The UK response to COVID-19 pandemic – total release of CyB*

In early January 2020, the UK CyB was at 1% of risk-weighted assets and has been due to reach 2% by December 2020. However, on March 11, 2020, the Financial Policy Committee (FPC) reduced the CyB to 0% to provide additional support to banks in supplying the economy. The FPC decision will be maintained for at least 12 months and any subsequent increase would not take effect until March 2023 at the earliest.

Based on the available data and our calculations, Table 2 Panel B shows that the four G-SIBs in the UK have more than $18.45 billion in their CyB in 2017. With the total release of the CyB, businesses and households should be able to rely on banks to meet their needs for financing to maintain their activities during the COVID-19 distress period. According to the FPC, the release of the CyB will enable all UK banks to provide £190 billion in additional lending to the economy.

Case 4: *The Canadian response to COVID-19 pandemic – partial relief of CyB*

In Canada,[7] the CyB was at 2.25% of risk-weighted assets to be effective as at April 30, 2020. However, on March 13, 2020, the Office of the Superintendent of Financial Institutions (OSFI) reduced the CyB to 1% in response to the current challenges imposed by COVID19. According to the OSFI, releasing the CyB aims to improve the resiliency of the Canadian financial systems and boost lending and economic growth. OSFI committed that any further increase in the buffer will not be made for at least 18 months from the above date.

Based on the available data and our calculations, Table 2 Panel B shows that the largest Canadian bank in 2016, i.e. the Royal Bank of Canada (RBC), had more than $7.55 billion in its

---

[7] We include Canada as the fourth case study for two reasons: Canada allowed banks to partially release their countercyclical buffers (CyBs) from 2.25% to 1% while other countries either allowed banks to totally release their CyBs such as in the UK or they have not accumulated CyBs prior to the pandemic such as most of the EU countries. Second, the Canadian Office of Superintendent of Financial Institutions (OFSI) along with other national prudential regulators provide clear and thorough information on the various tools enacted by the Canadian government to ease the treatment of NPEs and capital buffers.

CyB. With the COVID19 CyB adjustment, RBC can have a $4.19 billion of additional lending capacity to the Canadian economy. However, 2016 is the latest year of available data for RBC; we expect that the actual CyB value to be higher in 2019. According to the OSFI, the release of the CyB will enable Canadian banks to provide $300CAD billion in additional lending to the economy in the short-term horizon.

Finally, prudential regulators have taken complementary actions to further increase bank capacity to supply credit. In addition to easing capital buffers, regulators have allowed for a more lenient treatment of NPEs such as NPLs, which could help in reducing the erosion in bank regulatory capital that results from increased provisioning for expected credit losses (Ehrentraud and Zamil, 2020). Specifically, when counting the 90 days past due, banks can exclude payment moratorium periods granted to borrowers in difficulties due to the COVID-19 pandemic. These borrowers become past due and categorised as NPEs only when the COVID-19 payment deferral period ends and they remain unable to make the rescheduled payments in a timely manner. In addition, when a loan is designated as forborne, the BCBS clarified that borrowers benefitting from COVID-19 deferral or public guaranteed should not be automatically classified as NPEs. However, if distressed loans were to be reverted to NPEs, bank earnings may be reduced, which could negatively affect CET1, the numerator of bank regulatory capital ratio. Moreover, including loans as NPEs increase bank risk weighted assets, the denominator or of bank regulatory capital. In view of the above, the exclusion of COVID-19 payment moratorium from NPEs may increase bank reported regulatory capital ratios in the short-term, while allowing banks to continue making loans. Table 3 provides a brief review of prudential regulatory measures taken by governments in the US, the EU, the UK, and Canada along with the general economic relief plans enacted to alleviate tensions for all economic sectors.

INSERT TABLE [3] AROUND HERE

Overall, the easing of capital buffers along with the lenient treatment of NPEs can be effective if included with a general strategic plan that evolves depending on the economic impact of COVID-19 pandemic. This plan should have a short-term horizon and combine transparency and effective market discipline. Stimulating credit supply by allowing banks to use their capital buffers may be short-lived if banks take on more risk with no buffers. In addition, more lenient treatments of NPEs along with the government guarantees to reduce risk-weighted assets should not compromise the "more skin in the game" policy. Such a policy is important to protect bank solvency and increase lenders' ability to discriminate between good and bad credit. Sustaining

economic activities during the COVID-19 is important; however, the use of capital buffers along with the complementary actions should not undermine banks' solvency over the medium-term. Otherwise, the COVID-19 economic shock may be replaced with a long recession and severe financial crisis in the recovery period.

4. The effect of COVID-19 and prudential regulatory responses on economic growth

The COVID-19 pandemic represents the first major challenge for the Basel III regulatory reforms since the 2007 – 2009 financial crisis. In section 2, we show that as a result of these reforms, banks entered the pandemic with strong capital ratios (Borio, 2020) and they were able to mitigate economic shocks (Financial Stability Board, 2020) by supplying credit to the corporate sector and households (Demirgüç-Kunt et al., 2020; Didier et al. 2021). While numerous studies have shown interest in studying the association between finance and economic growth (Levine et al., 2000; Beck et al. 2000; Law and Singh, 2014; Beck et al. 2014), little work has been done on the role of banks in supporting economic growth during pandemics. Iwanicz-Drozdowska et al. (2021) find that events such as COVID-19 generate the most widely and rapidly spreading market contagion compared to other non-economic shocks such as geopolitical and terrorism events. Exploring how the COVID-19 pandemic affects bank performance, Demirgüç-Kunt et al. (2020) find that public, large, and well capitalized banks suffered from greater reduction in their stock returns, reflecting their greater role in supporting the economy during the COVID-19 crisis. In line with this, Acharya and Steffen (2020) investigate how COVID-19 relief measures affect bank stability. They argue that COVID-19 credit losses might bring banks closer to the regulatory minimum capital requirement, endangering their financial stability and their role in financing the real economy in the recovery period. In addition, Feyen et al. (2021) argue that resorting to relaxed policy measures that are not consistent with the prudential regulatory standards may provide a relief in the short-term but may accumulate risks in the future. These risks may affect bank solvency, reduce balance sheet transparency, and increase moral hazard, hence, undermine the stability of the financial system and compound the economic impact of COVI-19 pandemic. An empirical investigation, however, shows that emerging markets and developing economies with better economic conditions and larger populations have implemented more COVID-19 policy measures. Finally, Ellis et al. (2021) and Didier et al. (2021) argue that while post-financial crisis regulatory responses have been successful in avoiding crises, these regulations were not defined to deal with a large exogenous shock, such as the COVID-19 pandemic because of the challenges to coordinate different

jurisdictions. We add to this emerging literature and explore the effect of COVID-19 spread and COVID-19 prudential regulatory measures on economic growth in developed countries.[8]

We construct an initial sample of 41 OECD and partner countries, for which we collect data from multiple sources. Financial and macroeconomic control variables are from the World Bank and the International Monetary Fund at the end of 2019. COVID-19 prudential regulatory measures are collected from the World Bank's database of policy responses related to the financial sector as a response to the spread of COVID-19. Data on COVID-19 spread is from "our world in data" website and the European Centre for Disease Prevention and Control, covering the February 2020 – April 2021 period. Finally, data on national health systems is from the World Bank at the end of 2017 (the latest available year).

We begin by illustrating the unconditional association between GDP per capita and two COVID-19 prudential regulatory measures, i.e. the banking sector policy response index and the financial sector policy response index. Figs. 6 and 7 plot the mean banking sector policy response index and the mean financial sector policy response index, as reported in Table 4. The graph shows that GDP per capita exhibits an increasing pattern as a function of increasing policy responses related to the financial sector as a response to the spread of COVID-19. In addition, the difference-in-median tests in Table 4 using both policy response indexes are significant at the 1% level. Hence, countries that have responded with more COVID-19 policy measures have a significantly higher GDP per capita.

INSERT TABLE [4] AROUND HERE

Table 5 reports descriptive statistics for the 41 OECD countries for the GDP per capita, regulatory capital ratios, credit risk measures, COVID-19 prudential regulatory measures, and additional country-level variables on financial ratios, macroeconomic control variables, and national health control variables. The numbers indicate a large cross-country variation in financial ratios and COVID-19 prudential regulatory measures. For instance, the capital adequacy ratio ranges from a minimum of 14.283% in Chile to 25.818% in Estonia. The banking sector policy response index also varies across countries. While Italy implemented 74 banking related temporary relief measures, Japan only implemented 6. Finally, GDP per capita varies

---

[8] We solely rely on developed countries for three reasons: 1) to be consistent with our sample of countries with G-SIBs; these banks are mainly headquartered and operating in OECD and partners countries; 2) to avoid having mix regulatory standards in terms of the adoption of Basel III guidelines versus Basel II guidelines; 3) some developing and emerging countries lack of recent observations on key financial ratios, macroeconomic, and national health control variables.

substantially across countries. We find that Switzerland, Ireland, and Luxembourg rank at the top of the GDP per capita measure whereas India, Indonesia, and South Africa rank at the bottom.

INSERT TABLE [5] AROUND HERE

Next, we empirically examine the effect of COVID-19 spread on economic growth using the following baseline regression model:

$$\text{Economic\_growth}_j = \alpha + \beta_1 \times \text{COVID19S}_{jt} + \beta_2 \times \text{HEALTH}_j + \varepsilon \quad (1)$$

where $\text{Economic\_growth}_{jt}$ is country's *GDP per capita* collected from the World Bank's World Development Indicators. COVID19S_{jt} captures human casualties caused by the pandemic by using three alternative measures: 1) the daily number of new confirmed cases of COVID-19 (log), *Number of COVID-19 cases*, 2) the daily number of new death cases attributed to COVID-19 (log), *Number of COVID-19 deaths*, and 3) the share of COVID-19 positivity rate, *COVID-19 positive rate*.[9] HEALTH_j controls for national health systems and includes: *Male smokers*, *Diabetes prevalence*, *Hospital beds per thousand*, *Life expectancy,* and *Extreme poverty*. Table 1 in the appendix provides definitions and sources of all variables included in our empirical models.

Our regression model is applied to 41 OECD and partners countries; these countries have responded to the spread of COVID-19 pandemic with various economic and prudential relief packages. Table 6, Panel A, models 1-2 show that COVID-19 spread is negatively and significantly associated with economic growth at the 1% level. Increased number of COVID-19 cases may push governments to impose strict rules such as lockdowns and social distancing measures, thus slowing economic activities and employment. As for health measures, model 2 shows that pre-medical conditions such as diabetes, smoking prevalence along with extreme poverty are negatively associated with economic growth. In contrast, life expectancy – which reflects healthy life style, access to health care systems, and economic status – and the number of available beds in hospitals – which represents the capacity of hospitals to adapt and endure more daily cases of infection – are positively associated with economic growth. Finally, models 3 to 6 continue to indicate that the spread of COVID-19 pandemic has a negative effect on economic growth even after using alternative measures of COVID-19 spread.

---

[9] We collect the data on COVID-19 spread from "Our world in data" website, covering the Jan 31, 2020-Apr 15, 2021 period.

In a second step, we examine the effect of COVID-19 temporary relief measures on economic growth. We exclude 14 countries because they lack data on COVID-19 prudential regulatory measures, thus reducing the sample size substantially to 27 countries and the results should be interpreted with caution. We use the following regression model:

$$\text{Economic\_growth}_j = \alpha + \beta_1 \times \text{COVID19S}_{jt} + \beta_2 \times \text{PRUDENTIAL}_j + \beta_3 \times \text{BANK}_j$$

$$+ \beta_4 \times \text{MACRO}_j + \varepsilon \quad (2)$$

PRUDENTIAL_j represents two prudential regulatory relief measures. The *Banking policy response index* is the sum of all the banking sector prudential policy measures taken by a government up to April 13, 2021 to mitigate the effect of the COVID-19 spread. This measure encourages flexibility in the application of Basel III requirements such as the release of capital and liquidity buffers, the ease on the treatment of nonperforming loans, and providing guidance on the use of such flexibility (Feyen et al., 2020).[10] The *banking sector regulation* measures the number of days elapsed since the World Health Organization declaration on January 30, 2020, until the first banking sector measure taken by a government to support banking institutions following the spread of the COVID-19 pandemic. $BANK_j$ represents bank regulatory characteristics including capital adequacy ratio, tier 1 capital ratio, nonperforming loans ratio. We also control for profitability and liquidity using return on assets and liquid assets to assets ratio. Finally, $MACRO_j$ controls for macroeconomic factors such as domestic credit to private sector as a percentage of GDP and current account as a percentage of GDP.

Table 6, Panel B, Models 1-2 show that the banking sector policy response index have a significantly positive effect on economic growth at the 1% level. The finding possibly indicate that the implementation of prudential relief packages in terms of releasing capital buffers and the lenient treatment of nonperforming loans moderate the adverse effect of COVID-19 spread on economic growth. We also find that tier 1 capital ratio, capital adequacy ratio are significantly positively associated with economic growth at 1% level, suggesting that banks with stronger compliance with regulatory capital positions prior to the COVID-19 pandemic are more effective in maintaining the supply of credit and thus sustaining economic growth. Furthermore, models 3-4 show that the government regulatory relief measures dedicated to the banking sector, tier 1 capital ratio, and capital adequacy ratio are significantly positively associated with economic

---

[10]The banking policy response index also categorizes these measures into five categories of governmental responses: i) crisis management, ii) integrity, iii) operational continuity, iv) prudential policies, and v) policies related to supporting borrowers.

growth. The findings suggest that faster implementation of COVID-19 banking policies and banks with capital components of good quality, i.e. tier 1 capital, play a significant role in maintaining economic growth. Finally, Models 5-6 show that while both the banking sector policy response index and the banking sector regulation measure continue to show a positive effect on economic growth, the nonperforming loan ratio is negatively associated with GDP per capita. Nonperforming loans combined with relaxing the classification and the treatment of NPEs may generate more risks in the medium-term, undermining bank solvency and possibly worsening the economic impact of COVID-19 in the recovery period.

<center>INSERT TABLE [6] AROUND HERE</center>

Now, we address concerns about the choice of the main independent variables and potential omitted control variables. We use three alternative proxies for :1) COVID-19 prudential relief measures, i.e. *Financial sector policy response index*, 2) capital, i.e. *Capital to assets ratio*, and 3) credit risk, i.e. *Non-performing loans to provision ratio*. We also include several additional country-level control variables, i.e. Global systemically important banks dummy (*G-SIBs*), *Unemployment rate*, and *Urban population to total population*. The findings reported in Table 7 and continue to show that while prudential COVID-19 measures and capital ratio are positively associated with economic growth, the nonperforming loans measures have a negative effect on economic growth (Panel A). These findings are also robust and continue to show their expected signs even after the inclusion of additional control variables (Panel B).

<center>INSERT TABLE [7] AROUND HERE</center>

Finally, we use data on COVID-19 spread and GDP per capita with various frequencies to further investigate whether the coefficients for the effect of COVID-19 temporary relief measures on economic growth remain unchanged. In Table 8, we use the log of the cumulative weekly number of confirmed COVID-19 cases, *Weekly number of COVID-19 cases* (Panel A) and the log of the cumulative weekly number of confirmed COVID-19 deaths, *Weekly number of COVID-19 deaths* (Panel B). In Table 9, Panel A, we collect quarterly data on GDP per capita and compute quarterly data on the cumulative quarterly number of COVID-19 cases (and death). In Panel B, we use quarterly data on GDP per capita, the quarterly number of confirmed COVID-19 deaths, and a measure of COVID-19 contagion. COVID-19 contagion is calculated following Çolak and Öztekin (2021) as the log of (1 + total number of confirmed deaths per million) in the country.

<center>INSERT TABLE [8] AROUND HERE</center>

<center>15</center>

Weekly COVID-19 data is collected from the European Centre for Disease Prevention and Control website and covers week1, 2020-week 52, 2021 period.[11] Quarterly data on GDP per capita is collected from the OECD data website and covers quarter 1, 2020-quarter 3, 2021.[12] The findings in both tables continue to indicate that both the banking sector regulation and the financial sector policy response index have significantly positive effects on economic growth. In addition, while the Tier 1 capital ratio and the capital adequacy ratio exhibit a positive effect on economic growth, the non-performing loan ratio is negatively associated with economic growth.

INSERT TABLE [9] AROUND HERE

5. Conclusion

What are governments and prudential regulators doing so far in responding to the pandemic? What are the potential implications of prudential regulatory intervention on economic growth? We show that countries have been reacting by implementing various government-led economic relief plans. These plans have a massive scale and cover all economic sectors; however, they are characterized as short-term and only structured to sustain economic activities for few months.

Focusing on the prudential regulatory actions taken by governments to ease bank capital requirements, we document that banks should be able to play a constructive role in maintaining economic activities during the COVID-19 pandemic. Using a sample of Globally Systemically Important Banks (G-SIBs), we document that these banks are well capitalized in the preCOVID-19 period and that various measures, although very different across countries, have been taken to ease capital requirements. While EU countries deferred the application of more stringent capital rules, countries such as the US, the UK, and Canada are temporary relaxing their countercyclical buffers. We hence argue that such measures may not have the same intended effect of stimulating economic growth everywhere. Nevertheless, depending on the level of additional capital buffers maintained in the preCOVID-19 pandemic, releasing these buffers may provide G-SIBs with flexibility in their lending decisions. However, the use of capital buffers along with the complementary actions, such as softening the treatment of non-performing loans, could undermine banks' solvency over the medium-term. Therefore, the COVID-19 economic shock could still possibly lead to a long recession and a severe financial crisis if regulators do not

---

[11] https://www.ecdc.europa.eu/en/publications-data/data-national-14-day-notification-rate-covid-19. Last accessed on Jan. 3, 2022.
[12] https://stats.oecd.org/index.aspx?queryid=66948. Last accessed on Jan. 3, 2022.

carefully adjust their action depending on short-run developments. An empirical investigation on the effect of prudential regulatory responses, bank capital, and non-performing loans on economic growth supports this view.

At the time of writing this paper, governments and regulators are at the limits of what they can do in terms of recovery. Enacting economic relief plans are welcomed in the short-term but cannot continue indefinitely with no real changes in community behaviour. As we move ahead, we need to fundamentally rethink our societal behaviour and try to understand the "new normal" in our economic activities and financial decisions. It would be hard to believe that we can just "switch on" the economy again and go back to the preCOVID-19 economic conditions; rather, combating the virus requires more strategic actions from governments than just enacting short-term relief packages. These actions should have a medium-term horizon and combine transparency and effective market discipline without compromising prudential regulation.

References

Acharya, V., Steffen, S. 2020. The risk of being a fallen angel and the corporate dash for cash in the midst of COVID. *The Review of Corporate Finance Studies* 9, 430–471.

Bank of England (BoE). 2020. BoE measures to respond to the economic shock from Covid-19.

Bank of England (BoE). 2020. Financial policy summary and record.

Beck, T., Levine, R. Loayza, M. 2000. Finance and the sources of growth. *Journal of Financial Economics* 58, 261–300.

Beck, T., Degryse, H., Kneer, C. 2014. Is more finance better? Disentangling intermediation and size effects of financial systems. *Journal of Financial Stability* 10, 50–64.

Berger, A.N., Demirgüç-Kunt, A. 2021. Banking research in the time of COVID-19. *Journal of Financial Stability* 10, https://doi.org/10.1016/j.jfs.2021.100939

Borio, C. 2020. The prudential response to the Covid-19 crisis. Bank of International Settlements.

Demirgüç-Kunt, A., Pedraza, A., Ruiz-Ortega, C. 2020. Banking sector performance during the COVID-19 crisis. World Bank Policy Research Working Papers 9363, The World Bank.

Didier, T., Huneeus, F., Larrain, M., Schmukler, S.L. 2021. Financing firms in hibernation during the COVID-19 pandemic. *Journal of Financial Stability* 53, forthcoming. https://doi.org/10.1016/j.jfs.2020.100837.

Ehrentraud, J., Zamil, R. 2020. Prudential response to debt under COVID-19: the supervisory challenges. FSI Briefs No 10. The Financial Stability Board, Basel, Switzerland.

Ellis, S., Sharma, S., Brzeszczyński, J. 2021. Systemic risk measures and regulatory challenges. *Journal of Financial Stability*, In press, https://doi.org/10.1016/j.jfs.2021.100960.

European Central Bank (ECB). 2020. ECB Banking Supervision provides temporary capital and operational relief in reaction to coronavirus.

European Central Bank (ECB). 2020. FAQs on ECB supervisory measures in reaction to the coronavirus.

Fan, V.F., Jamison, D.T., Summers, L.H. 2018. Pandemic risk: How large are the expected losses. Bull World Health Organ 96.129–134.

Federal Deposit Insurance Corporation (FDIC). 2020. FAQs for financial institutions affected by the coronavirus disease 2019.

Feyen, E., Gispert, T., Kliatskova, T., Mare, D.S. 2020. Taking stock of the financial sector policy response to COVID-19 around the world. World Bank Policy Research Working Papers 9497, The World Bank.

Financial Stability Board (FSB). 2020. COVID-19 Pandemic: financial stability implications and policy measures taken. The Financial Stability Board, Basel, Switzerland.

International Monetary Fund and World Bank. 2020. COVID-19: The regulatory and supervisory implications for the banking sector. A Joint IMF-World Bank Staff Position, Note1. Washington D.C., USA.

Iwanicz-Drozdowsk, M., Rogowicz, K., Kurowski, L., Smaga, P. 2021. Two decades of contagion effect on stock markets: Which events are more contagious? *Journal of Financial Stability* 55, https://doi.org/10.1016/j.jfs.2021.100907.

Law, S., Singh, N. 2014. Does too much finance harm economic growth? *Journal of Banking & Finance* 41, 36–44.

Levine, R., Loayza, N., Beck, T. 2000. Financial intermediation and growth: Causality and causes. *Journal of Monetary Economics* 46, 31–77.

Office of the Comptroller of the Currency (OCC). 2020. Regulatory capital rule: Eligible retained income rules and regulations, Federal Register Vol. 85, No. 55.

Office of the Superintendent of Financial Institutions (OFSI). 2020. OSFI actions to address operational issues stemming from COVID-19.

World Economic Outlook (WEO). 2021. The great lockdown Policy support and vaccines expected to lift activity. World Economic Outlook reports. International Monetary Fund. Available at https://www.imf.org/en/Publications/WEO/Issues/2021/01/26/2021-world-economic-outlook-update.

World Health Organization (WHO). 2019. A world at risk: Annual report on global preparedness for health emergencies. Available at https://apps.who.int/gpmb/assets/annual_report/GPMB_annualreport_2019.pdf.

World Health Organization (WHO). 2020. WHO Timeline - COVID-19. Available at https://www.who.int/news-room/detail/27-04-2020-who-timeline---covid-19.

Figures
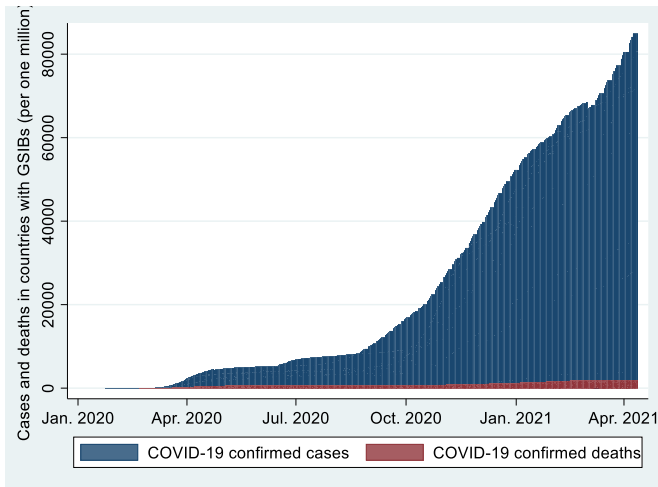
Fig 1A. The number of COVID-19 confirmed cases and deaths per one million in countries with Globally Systemically Important Banks (G-SIBs). These countries include Canada, France, Germany, Italy, Japan, Netherlands, Spain, Sweden, Switzerland, and the UK. Source: Our World in Data website.

Fig 1B. The number of COVID-19 confirmed cases and death per one million in the United States. Source: Our World in Data website.

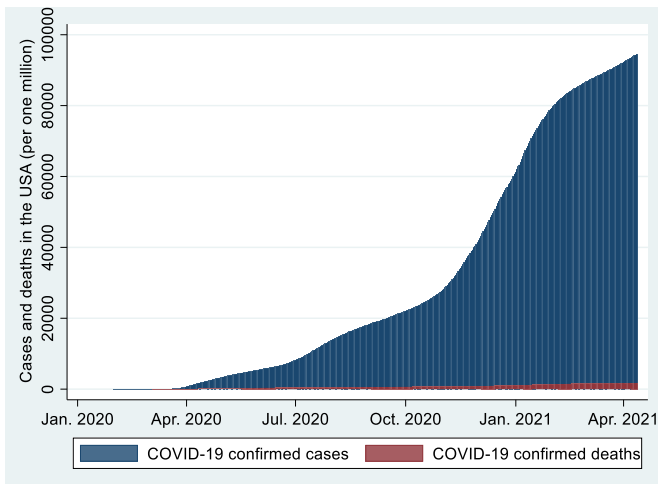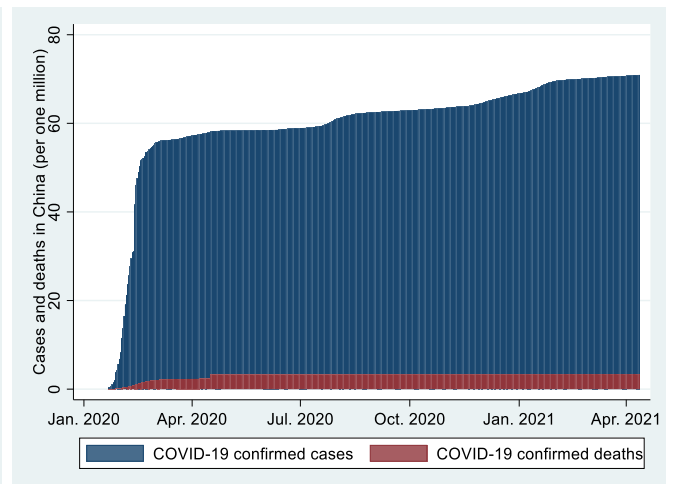**Fig 1C.** The number of COVID-19 confirmed cases and death per one million in China. Source: Our World in Data website.
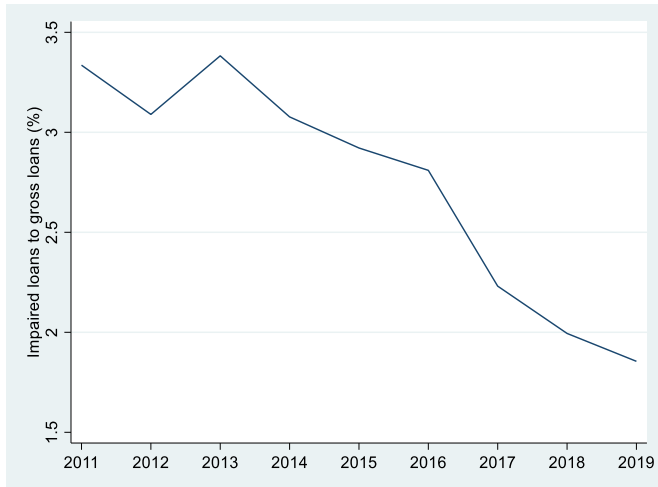
Fig 2A. This figure plots the ratio of impaired loans to gross loans. The data is obtained at yearly frequency for 2011 – 2019. Source: Orbis BankFocus.
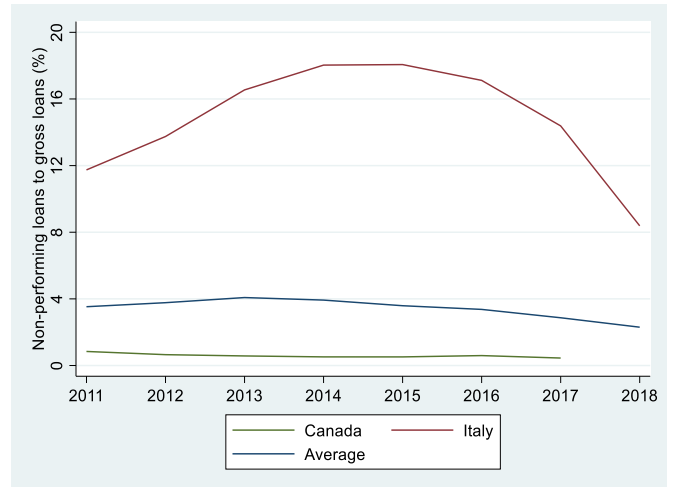
Fig 2B. This figure plots the ratio of non-performing loans to gross loans. The data is obtained at yearly frequency for 2011 – 2019. Source: WDI, World Bank
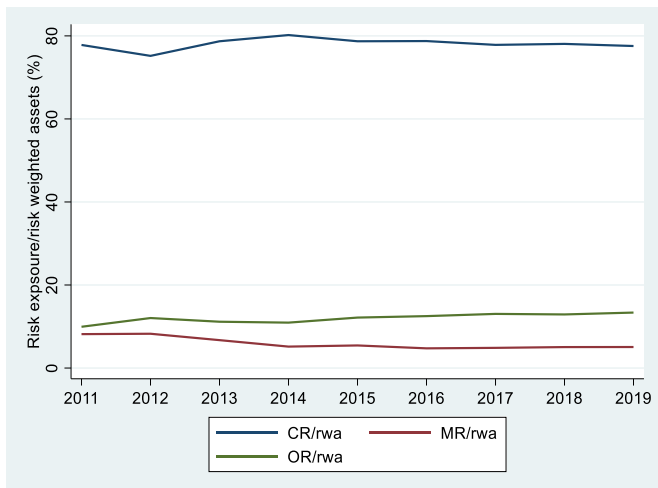
Fig 2C. This figure plots the ratio of bank risk exposure to risk-weighted assets. CR/rwa is the risk-weighted assets dedicated to credit risk divided by total risk-weighted assets. MR/rwa is the risk-weighted assets dedicated to market risk divided by total risk-weighted assets. OR/rwa is the risk-weighted assets dedicated to operational risk divided by total risk-weighted assets. The data is obtained at yearly frequency for 2011 – 2019. Source: Orbis BankFocus.
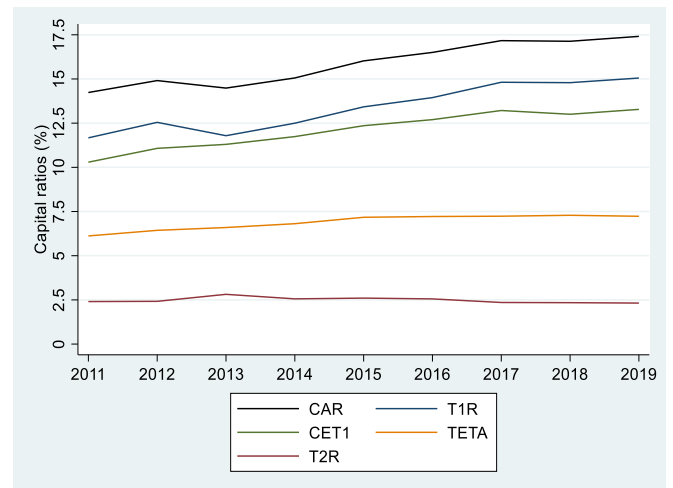
Fig 2D. This graph plots G-SIBs compliance with Basel III capital ratios. CAR is the bank capital adequacy ratio defined as Tier 1 capital plus Tier 2 capital divided by risk-weighted assets. T1R is the Tier 1 capital divided by risk-weighted assets. T2R is Tier 2 capital divided by risk-weighted assets. CET1 is core capital divided by risk-weighted assets. TETA is the total equity to total assets (unweighted) ratio. The data is obtained at yearly frequency for 2011 – 2019. Source: Orbis BankFocus.
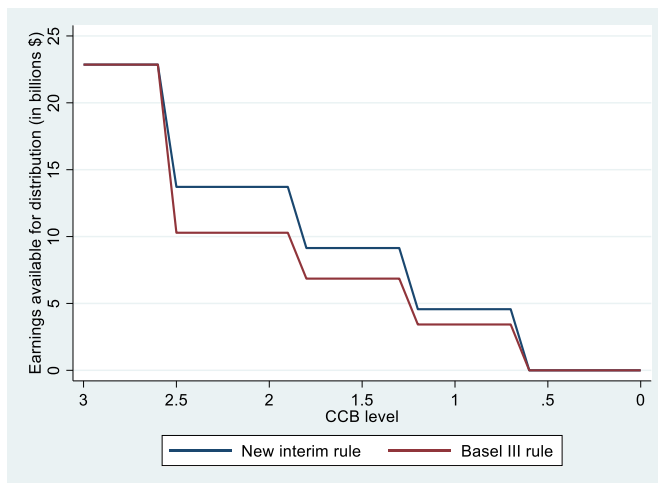
Fig 5. This figure compares the maximum payout amounts under the new COVID-19 interim rule and the Basel III rule in the US. The data required on earnings to compute the maximum payout amounts for quarter 4, 2019 is obtained at quarterly frequency for quarter 3, 2018 to quarter 3, 2019. The sample used includes five G-SIBs. Source: CRSP/Compustat merged database.

21
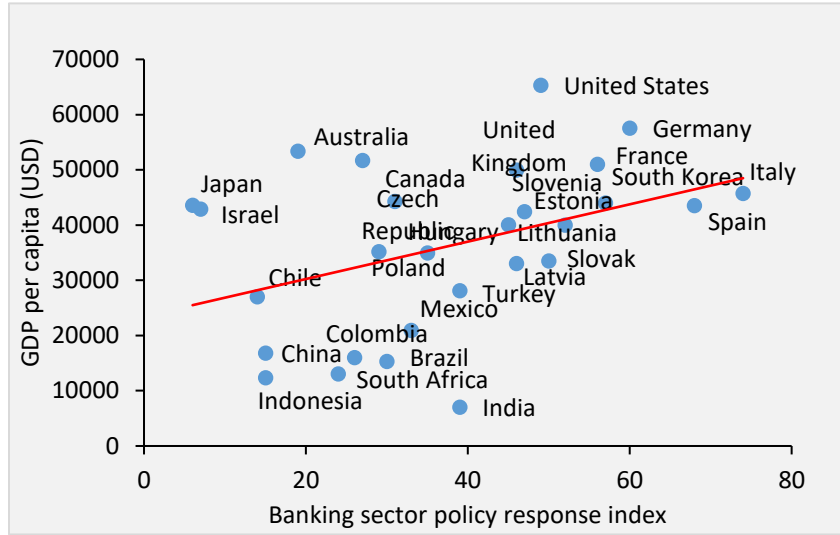
Fig 6. This figure plots the association between the banking sector policy response index and countries' GDP per capita. The banking sector policy response index is the sum of all the banking sector prudential policy measures taken by a government up to April 13, 2021 to mitigate the effect of the COVID-19 spread.
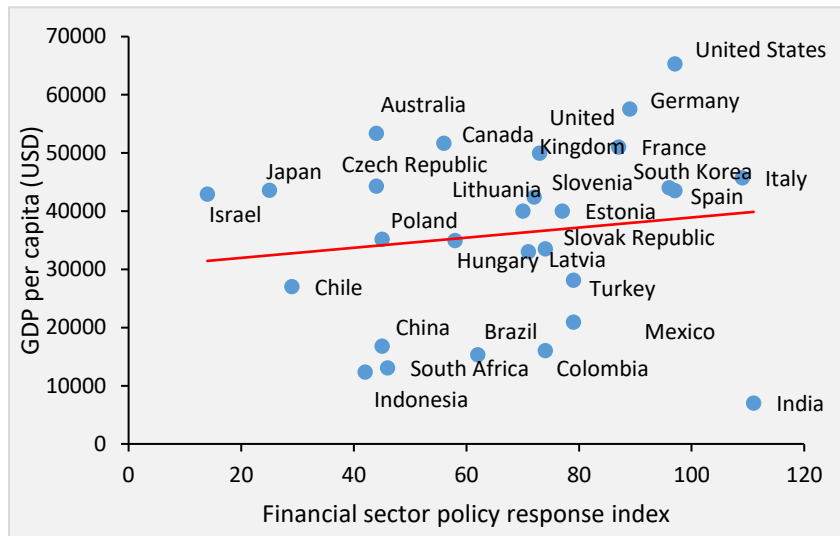
Fig 7. This figure plots the association between the financial sector policy response index and countries' GDP per capita. The financial sector policy response index is the sum of all the policy measures dedicated to the financial system taken by a government up to April 13, 2021 to mitigate the effect of the COVID-19 spread.

Tables

Table 1

G-SIBs aggregated balance sheet's components (in thousands $), end of 2017

	Cash and reserves	Loans (non-financial sector)	Loan loss reserves	Impaired loans	Securities (non-financial sector)	Fixed assets	Total equity capital	Total assets
Amounts	5,743,819,266	24,107,966,472	444,717,994	479,741,292	12,549,452,295	397,037,472	4,050,656,260	55,187,877,792
%, TA	9.11	40.7	0.75	1.1	23.2	0.7	7.23	100

The sample includes 33 G-SIBs in the following 12 countries: Canada, China, France, Germany, Italy, Japan, Netherlands, Spain, Sweden, Switzerland, the UK, and the USA.

Table 2

Basel III capital reforms in the PreCOVID-19 period using a sample of Globally Systemically Important Banks (G-SIBs)

Panel A. Capital guidelines across countries with G-SIBs

| Country	National and international regulatory capital ratios				Additional buffers		Treatment for G-SIBs		National authorities' capital requirements	Actual CAR (as reported by G-SIBs)
	# G-SIBs	Prudential regulators[†]	Yearly update	Minimum CAR (%)	CCB (%)	CyB (%)	G-SIBs bucket	G-SIBs capital surcharge (%)	CAR+CCB+CyB+G-SIBs capital surcharge	(Tier1+Tier2)/RWA
Canada	2	OSFI and BIS	2019	8	2.5	2.25	1 (2 bank)	1	13.25%	14.78%
China	4	CBRC and BIS	2019	8	2.5	2.5	1 (2 banks)	1	Between 13.5% and 14%	14.03%
							2 (2 banks)	1.5		
France	4	ESRB and BIS	2020	8	2.5	0.5	1 (3 banks)	1	Between 12% and 12.5%	15.64%
							2 (1 banks)	1.5		
Germany	1	ESRB and BIS	2016	8	2.5	0	2 (1 bank)	1.5	12%	16.3%
Italy	1	ESRB and BIS	2016	8	2.5	0	1 (1 bank)	1	11.5%	14.6%
Japan	3	FSA and BIS	2016	8	2.5	0	1 (2 banks)	1	Between 13.5% and 14%	16.26%
							2 (1 bank)	1.5		
Netherlands	1	ESRB and BIS	2016	8	2.5	0	1 (1 bank)	1	11.5%	16.72%
Spain	2[*]	ESRB and BIS	2016	8	2.5	0	1 (2 banks)	1	11.5%	13.91%
Sweden	1[*]	ESRB and BIS	2020	8	2.5	2.5	1 (1 bank)	1	14%	19.16%
Switzerland	2	BIS	2020	8	2.5	0	1 (2 banks)	1	11.5%	18.14%
UK	4[*]	FPC and BIS	2020	8	2.5	1 to 0	1 (2 banks)	1	Between 11.5% and 12.5%	17.88%
							2 (1 bank)	1.5		
							3 (1 bank)	2		
USA	8	Fed and BIS	2016	8	2.5	0	1 (3 banks)	1		16.99%
							2 (3 banks)	1.5	Between 11.5% and 13%	
							3 (1 bank)	2		
							4 (1 bank)	2.5		

Panel B. Components of bank regulatory capital (in thousands $)

	# G-SIBs	Year	CET1 capital	Additional Tier 1 capital	Tier 1 capital	Tier 2 capital	Capital adequacy	CCB	CyB	G-SIBs capital surcharge
Canada	1	2016	40,818,473	1,742,893	42,561,366	7,007,386	49,568,752	8,388,303	7,549,473	3,355,321
China	4	2017	985,545,922	52,928,311	1,038,474,233	169,718,498	1,208,192,731	205,733,584	205,733,584	103,840,150
France	4	2017	303,945,687	29,115,396	333,061,083	58,499,435	391,560,518	57,062,981	11,412,596	26,675,349
Germany	1	2017	60,934,013	8,182,821	69,116,834	7,656,328	76,773,162	10,320,489	0	6,192,294
Netherlands	1	2017	48,693,961	5,534,768	54,228,729	13,242,666	67,471,395	9,273,191	0	3,709,277
Spain	2	2017	139,735,191	9,293,372	149,028,563	26,649,636	175,678,199	28,985,578	0	11,594,232
Sweden	1	2017	29,400,829	4,189,153	33,589,982	4,484,181	38,074,163	3,771,180	3,771,180	1,508,472
Switzerland	1	2017	36,974,000	2,432,000	39,406,000	8,077,000	47,483,000	6,089,920	0	2,435,968
UK	4	2017	263,645,288	58,459,048	322,104,336	74,562,195	396,666,531	46,137,441	18,454,976	29,283,252
USA	8	2017	817,550,200	109,768,750	927,318,950	129,374,284	1,056,693,234	158,217,953	0	112,116,734
All	27	2017	2,727,243,564	281,646,512	3,008,890,076	499,271,609	3,508,161,685	533,980,620	247,760,639	300,711,049

Notes: [†]OSFI is the Canadian Office of the Superintendent of Financial institutions. CBRC is the Chinese Banking Regulation Commission. ESRB is the European Systemic Risk Board. FSA is the Japanese Financial Services Agency. FPC is the UK's Financial Policy Committee. Fed is the Federal Reserve. BIS is the Bank for International Settlements. G-SIBs is Globally Systemically Important Banks. CET1 is Common Equity Tier 1. CCB is Capital Conservation Buffer. CyB is the Countercyclical Buffer.

[*]Only one of the two largest Spanish banks, Santander Bank, is still considered as a G-SIB in the BIS 2019 list. Nordea bank in Sweden and Royal Bank of Scotland in the UK were considered as G-SIBs until 2017. In Panel B, We exclude Italy and Japan because of missing data on some regulatory capital components.

Table 3
Governments' responses to COVID-19 pandemic

	Prudential regulator	G-SIBs – Capital measures			Economic actions	Potential implications
		Capital adequacy	Capital buffers (i.e. CCB, CyB, and G-SIBs capital surcharge)	Non-performing exposures (NPE)	Stimulus packages and changes in the monetary policy	
USA	FDIC (May, 27, 2021) and OCC (March 20, 2020)	The Fed, the FDIC, and the OCC support banks that choose to use their capital buffers to lend and undertake other supportive actions during the COVID-19 period.	• If G-SIBs' CCB falls below 2.5% of risk-weighted assets plus the required CyB and the G-SIBs capital surcharge, they become subject to limitations on capital distributions. • Distribution limitations under the CCB are calculated as a percentage of eligible retained income. Eligible retained income is defined as the average net income for the four calendar quarters preceding the current calendar quarter, net of any distributions. • The new revised rule of eligible retained income is the average net income for the 4 calendar quarters preceding the current calendar quarter without deducting distributions. • The revised rule allows G-SIBs to follow a more gradually limit distributions on capital in the COVID-19 period.	Short-term loan modification made to borrowers affected by COVID-19 who were paying as agreed before the debt modification should not be considered as "troubled debt" restructuring. Hence, COVID-19 payment deferrals can be excluded from NPEs for regulatory purposes.	Introduce a $2,142 billion emergency stimulus bill. The bill includes direct and indirect financial aid to households, businesses, banks, and personal finance and taxes. The stimulus bill is distributed on the following key sectors: • $300 billion in direct payment to households, providing $1,200 to adults and $500 per child. • $250 billion to make unemployment insurance available to a larger category of workers and extends the duration of the benefits from 26 weeks to 39 weeks. • $349 billion in loans to small businesses, covering payroll, rent, and utilities. • $500 billion to expand the Fed lending facilities and guarantee loans. • $32 billion in grants to cover airlines companies and contractors. • $150 billion in direct aid to states, distributed according to population size. • $221 billion in tax benefits for businesses allowing them to defer payroll taxes for the rest of the year. • $340 billion in additional spending to hospitals and public transit. The Fed cuts the federal fund rate to 0.25%.	The key outcome of the stimulus package as well as Fed interest cuts is to secure funds to unemployed workers, households and affected businesses. Along with easing capital measures, these urgent governmental intervention policies allow various stakeholders to continue their lending and borrowing activities without significantly affecting economic growth.
EU	ECB (March 12, 2020; April 3, 2020) BIS (2020)	The ECB will allow banks to operate temporarily below the level of Pillar 2 Guidance (P2G), the CCB, the CyB, and the G-SIBs capital surcharge. Banks are allowed to temporarily use instruments that do not qualify as CET1 in meeting their minimum capital requirements. Banks with capital buffers that fall below the minimum capital requirements can still distribute profits.	The ECB is allowing banks to release their CCBs as well as their CyBs. However, EU countries have different requirements in term of their CyBs. Banks in countries such as Germany, Italy, Netherlands, and Spain have no CyBs requirements while banks in France and Sweden are required to maintain 0.5% and 2.5% of risk-weighted assets, respectively. Thus, releasing CyBs may not have the same effect on stimulating economic growth, as some countries did not accumulate additional capital to build up their CyBs.	Banks can exclude the COVID-19 payment deferral period in counting the number of days past due, but they need to continue applying the UTP criterion in determining NPEs. However, in applying the UTP criterion, assessment should be based on the revised schedule of payments (after the 90 days past due) and that COVID-19 related payment moratorium should not be considered "distressed debt restructuring". As for forborne designation, payment moratorium should not be considered as forborne because they are aim to address systemic risks across the EU and not borrower-specific individual risk.	EU member states are committed to provide liquidity support for various sectors in distress. This support is estimated at 16% of EU GDP. It consists of public guarantee schemes and deferred tax payments. • Introduce a Coronavirus Investment Initiative allowing EU countries to use €37 billion to address the consequences related to the COVID-19 crisis. • Introduce a €750 billion Pandemic Emergency Purchase Programme (PEPP) that aims to purchase private and public securities with maturity date ranging between 70 days and 30 years. The ECB refinancing rate remains 0%.	Provide more flexibility to EU banks in addressing current economic conditions while ensuring the resiliency of the financial system.

Table 3
Governments' responses to COVID-19 pandemic – *(continued)*

	Prudential regulator	G-SIBS – Capital measures			Macroeconomic actions	Potential implications
		Capital adequacy	Capital buffers (i.e. CCB, CyB, and G-SIBs capital surcharge)	Loan Loss Reserves	Stimulus packages and changes in the monetary policy	
UK	FPC, MPC, and PRC (March 24, 2020) and Bank of England (March 11, 2020)	Bank capital buffers can be drawn down as much as necessary to support the economy through the COVID-19 temporary shock.	Reduce the CyB from 1% to 0%. This measure will stand for 12 months. This reduction will provide £190 in support to businesses and individuals. PRA estimates that the release of the CyB is equivalent to 13 times bank net lending to businesses in 2019. Banks should not use CyB and other facilities in terms of easing capital requirements to increase dividends and bonuses.	The PRA will exercise more flexibility regarding the use of forward-looking measures as the one required in the IFRS9. PRA reminds banks to be both reasonable and supportable in incorporating the impact of Covid-19 on borrowers into the expected credit loss (ECL) model. PRA noted that COVID-19 initial payment deferral and subsequent payment deferral extensions should not be counted as past due and should not be automatically categorised as UTP. Under UTP category, if a borrower does not resume full payments due to COVID-19, banks need to distinguish between borrowers facing short-term liquidity problems and borrowers facing longer-term solvency problems.	Introduce a new Term Funding Scheme for Small and Medium-sized Enterprises (TSFME) to provide support up to £100 billion to bridge credit supply issues. TSFME will be available for 12 months and offers 4 years funding with interest rates very close to the bank rate. Banks can borrow around £300 billion in from the Bank of England in all major currencies and on weekly basis. Bank of England cuts base rate to 0.1%.	These actions should allow banks with the capacity to supplying credit to the UK economy. Particularly, they provide insurance against adverse conditions in bank funding markets while at the same time incentivize banks to secure credit to businesses and households.
Canada	OSFI (March 27, 2020)	OSFI delayed the implantation of the Basel III guidelines on standardized approach and internal rating based approach to credit risk and operational risk to 2023. OSFI delayed the implantation of the Basel III guidelines on leverage ratio to 2023.	OSFI lowered the CyB from 2.25% to 1%. This action will allow largest Canadian banks to increase their lending capacities by $300 billion.	Loans with payment deferrals continue to be considered as performing loans during the deferral period (up to 6 months) and thus will not be considered as past due.	Introduce a $107 billion economic response plan. The plan provides support to households, small businesses, and large corporations. The economic response plan is distributed on the following key sectors: • $52 billion to households and businesses. • $55 billion in tax benefits, allowing individuals and businesses to defer payroll taxes until June 1, 2020 for individuals and August 31, 2020 for corporations. • 75% wage subsidy is available to small and medium businesses for a period of three months starting on March 15, 2020. Introduce the Canada Emergency Response Benefit (CERB) providing a $2000 in direct support for 4 months starting on March 15, 2020. This support is available for people who lost their job because of Covid-19. Bank of Canada cuts target rate to 0.25%	Provide more flexibility to banks in addressing current economic conditions while ensuring financial stability. Reduce unemployment rate. Maintain the funding channels between banks and the real economic and avoid economic recession.

Notes: Fed is the Federal Reserve. FDIC is the Federal Deposit Insurance Corporation. OCC is the Office of the Comptroller of the Currency. OSFI is the Office of the Superintendent of Financial Institutions. ECB is the European Central Bank. FPC is the Financial Policy Committee. PRA is the Prudential Regulatory Authority. MPC is the Monetary Policy Committee. PRC is the Prudential Regulation Committee. G-SIBs is Globally Systemically Important Banks. CET1 is Common Equity Tier 1. CCB is Capital Conservation Buffer. CyB is the Countercyclical Buffer

Table 4

GDP per capita as a function of governments' regulatory responses to COVID-19 spread: Differences-in-median tests

GDP per capita (USD)	t-test (diff)	p-value
Banking sector policy response index		
Below the median	28,969.17	
Above the median	45,742.01	
Diff. between means[†]	16,772.84	<.001***
Financial sector policy response index		
Below the median	33,859.64	
Above the median	38,879.77	
Diff. between means[†]	5,020.134	<.001***

Notes: This table presents the level of economic growth, i.e. GDP per capita, as a function of governments' regulatory responses, i.e. the banking sector policy response index and the financial sector policy response index, to COVID-19 spread. [†]We reports the results of differences-in-median tests of GDP per capita conditioned on the below and above the median values of the banking sector policy response index and the financial sector policy response index.

Table 5

Summary statistics

	N	Mean	Median	SD	Min	Max
A. Dependent variable						
GDP per capita	41	45027	44011	21585	6997	124591
B. Independent variables						
B.1. COVID-19 measures						
Number of COVID-19 cases	41	839844	79932	2749200	1	31500000
Number of COVID-19 deaths	41	22642	2885	56569	1	565289
Positive rate	39	7.289	0.038	0.091	0	0.531
B.2. Regulatory capital measures						
Tier 1 capital ratio	41	17.421	16.708	3.566	10.618	25.312
Capital adequacy ratio	41	19.605	19.19	3.511	14.283	25.818
Equity to assets ratio	41	9.163	7.949	2.889	5.218	16.989
B.3. Credit risk measures						
NPL to gross loans ratio	41	3.038	1.962	4.565	0.236	29.797
NPL to provisions ratio	41	9.501	6.185	19.775	0.125	118.48
B.4. COVID-19 banking regulation intervention measures						
Banking sector policy response index	27	37.221	39	17.772	6	74
Financial sector policy response index	27	66.897	72	24.866	14	111
Banking sector regulation	27	38.638	41	14.425	2	83
C. Control-level variables						
Return on assets	41	0.619	0.503	0.534	-0.446	1.738
Liquid assets to assets	41	23.646	21.46	8.832	8.686	51.829
Private sector debt to GDP	41	146.01	149.71	77.717	30.258	406.562
Current account to GDP	41	0.907	0.492	3.984	-11.56	9.945
Male smokers	32	30.768	30	11.844	13.5	76.1
Diabetes prevalence	32	6.675	6.35	2.249	3.28	13.06
Hospital beds per thousands	32	4.27	3.32	2.624	0.53	13.05
Life expectancy	32	79.813	81.54	4.158	64.13	84.63
Extreme poverty	32	2.274	0.7	4.828	0.2	21.2
G-SIBs dummy	41	0.269	0	0.443	0	1
Unemployment rate	41	6.427	5.15	4.749	2.01	28.47
Urban population to total population	41	76.358	80.565	13.289	34.472	98.041

Notes: This table presents descriptive statistics for country-level control variables from 41 countries in 2019. Statistics fall into 3 panels. Panel A reports the dependent variable on economic growth, i.e. *GDP per capita*. Panel B reports the main independent variables. Panel B.1 represents measures of COVI-19 spread, i.e. *Number of COVID-19 cases*, *Number of COVID-19 deaths*, and *Positive rate*. Panel B.2 represents regulatory capital ratios, i.e. *Tier 1 capital ratio*, *Capital adequacy ratio*, and *Equity to assets ratio*. Panel B.3 represents credit risk measures, i.e. *NPL to gross loans ratio* and *NPL to provisions ratio*. B.4 represents the COVID-19 policy response indexes, i.e. the *Banking sector policy response index*, the *Financial sector policy response index*, and the *Banking sector regulation*. Panel C reports the country-level control variables, i.e. *Return on assets*, *Liquid assets to assets*, *Private sector debt to GDP*, *Current account to GDP*, *Male smokers*, *Diabetes prevalence*, *Hospital beds per thousands*, *Life expectancy*, *Extreme poverty*, *G-SIBs dummy*, *Unemployment rate*, and *Urban population to total population*.

Table 6

The effect of COVID-19 and prudential regulatory responses on economic growth

Dep. Var: GDP per capita						
Panel A. The effect of COVID-19 spread on economic growth						
Model #	(1)	(2)	(3)	(4)	(5)	(6)
Number of COVID-19 cases	-0.033***	-0.003***				
	(0.001)	(0.001)				
Number of COVID-19 deaths			-0.052***	-0.009***		
			(0.002)	(0.001)		
COVID-19 positive rates					-2.08***	-0.835***
					(0.039)	(0.032)
Male smokers		-0.012***		-0.012***		-0.015***
		(0.000)		(0.000)		(0.000)
Diabetes prevalence		-0.072***		-0.07***		-0.061***
		(0.001)		(0.001)		(0.001)
Hospital beds per thousand		0.026***		0.024***		0.014***
		(0.001)		(0.001)		(0.001)
Life expectancy		0.043***		0.044***		0.014***
		(0.001)		(0.001)		(0.001)
Extreme poverty		-0.049***		-0.048***		-0.07***
		(0.001)		(0.001)		(0.001)
Constant	10.94***	7.984***	10.98***	7.94***	10.76***	10.48***
	(0.016)	(0.085)	(0.012)	(0.087)	(0.005)	(0.063)
Observations (countries)	41	32	41	32	39	30
R2	0.035	0.758	0.063	0.758	0.118	0.812
Panel B. The effect of prudential regulatory intervention as a response to COVID-19 on economic growth						
Dep. Var: GDP per capita						
Model #	(1)	(2)	(3)	(4)	(5)	(6)
Number of COVID-19 cases	-0.003***	-0.006***	-0.002*	-0.003***	-0.007***	-0.0018**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tier 1 capital ratio	0.067***		0.038***			
	(0.001)		(0.001)			
Capital adequacy ratio		0.063***		0.04***		
		(0.001)		(0.001)		
Non-performing loans to gross loans ratio					-0.117***	-0.149***
					(0.002)	(0.001)
Return on assets	-0.374***	-0.413***	-0.405***	-0.421***	-0.477***	-0.424***
	(0.005)	(0.005)	(0.007)	(0.007)	(0.006)	(0.006)
Liquid assets to assets	0.012***	0.01***	0.013***	0.012***		
	(0.000)	(0.000)	(0.000)	(0.000)		
Banking sector policy response index	0.004***	0.004***			0.009***	
	(0.000)	(0.000)			(0.000)	
Banking sector regulation			0.016***	0.014***		0.008***
			(0.000)	(0.000)		(0.000)
Private sector debt to GDP	0.007***	0.006***	0.004***	0.004***	0.001***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Current account to GDP	0.074***	0.079***	0.046***	0.05***	0.056***	0.028***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	7.855***	8.059***	9.136***	9.082***	10.63***	10.72***
	(0.026)	(0.025)	(0.026)	(0.025)	(0.019)	(0.015)
Observations (countries)	27	27	27	27	27	27
Observations (daily)	11,469	11,469	11,469	11,469	11,469	11,469
R2	0.788	0.771	0.681	0.685	0.721	0.762

Notes: In Panel A, the sample size varies between 30 and 41 OECD and key partners' countries, depending on the available number of observations for the control variables. In panel B, we drop 14 countries because of missing data on the banking sector regulation and the banking sector's policy response index. The final sample consists of 27 OECD and key partners countries. The dependent variable is the natural logarithm of GDP per capita. Variables are defined in Table 1 in the Appendix. *, **, *** denotes statistical significance at the 10% level, 5% level, and 1% level, respectively.

Table 7

The effect of COVID-19 and prudential regulatory responses on economic growth: Robustness checks

Dep. Var: GDP per capita

Panel A. Alternative capital, nonperforming loans, and prudential response measures

Model #	(1)	(2)	(3)	(4)	(5)
Number of COVID-19 cases	-0.001	-0.002**	-0.012***	-0.004***	-0.012***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tier 1 capital ratio	0.045***				
	(0.001)				
Capital adequacy ratio		0.047***			
		(0.001)			
Capital to assets			0.028***		
			(0.002)		
Non-performing loans to gross loans ratio				-0.145***	
				(0.002)	
Non-performing loans to provisions ratio					-0.007***
					(0.000)
Return on assets	-0.441***	-0.463***	-0.508***	-0.524***	-0.55***
	(0.007)	(0.007)	(0.009)	(0.007)	(0.010)
Liquid assets to assets	0.012***	0.011***	0.017***	0.006***	0.012***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Financial sector policy response index	0.001***	0.001***	0.001***	0.005***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Private sector debt to GDP	0.004***	0.004***	0.004***	0.000	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Current account to GDP	0.051***	0.057***	0.065***	0.033***	0.05***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Constant	9.134***	9.091***	9.67***	10.71***	10.25***
	(0.024)	(0.024)	(0.030)	(0.017)	(0.018)
Observations (countries)	27	27	24	27	27
Observations (daily)	11,469	11,469	9,720	11,469	11,469
R2	0.67	0.672	0.642	0.741	0.624

Panel B. More country-level control variables

Dep. Var: GDP per capita

Model #	(1)	(2)	(3)	(4)	(5)	(6)
Number of COVID-19 cases	-0.004***	-0.007***	-0.006***	-0.008***	-0.011***	-0.008***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tier 1 capital ratio	0.06***		0.03***			
	(0.001)		(0.001)			
Capital adequacy ratio		0.055***		0.025***		
		(0.001)		(0.001)		
Non-performing loans ratio					-0.112***	-0.094***
					(0.002)	(0.001)
Return on assets	-0.362***	-0.413***	-0.321***	-0.344***	-0.385***	-0.335***
	(0.006)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)
Liquid assets to assets	0.008***	0.008***	0.004***	0.004***		
	(0.000)	(0.000)	(0.000)	(0.000)		
Banking sector policy response index	0.008***	0.008***			0.01***	
	(0.000)	(0.000)			(0.000)	
Banking sector regulation			0.012***	0.011***		0.006***
			(0.000)	(0.000)		(0.000)
Private sector debt to GDP	0.005***	0.005***	0.002***	0.002***	0.001**	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Current account to GDP	0.064***	0.068***	0.033***	0.034***	0.046***	0.023***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
G-SIBs	0.058***	0.053***	0.013*	0.006	0.282***	0.114***
	(0.007)	(0.008)	(0.008)	(0.008)	(0.007)	(0.008)
Unemployment rate	-0.013***	-0.015***	-0.027***	-0.028***	-0.011***	-0.02***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Urban population to total population	0.005***	0.003***	0.015***	0.014***	0.001	0.009***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Constant	8.097***	8.394***	8.6***	8.768***	10.75***	10.05***
	(0.031)	(0.032)	(0.09)	(0.029)	(0.027)	(0.025)
Observations (countries)	27	27	27	27	27	27
Observations (daily)	11,469	11,469	11469	11,469	11,469	11,469
R2	0.804	0.787	0.799	0.792	0.756	0.811

Notes: In Panel A the sample size varies between 30 and 41 OECD and key partners' countries, depending on the available number of observations for the control variables. In panel B, we drop 14 countries because of missing data on the banking sector regulation and the banking sector's policy response index. The final sample consists of 27 OECD and key partners countries. The dependent variable is the natural logarithm of GDP per capita. In panel A, we include the ratio of total capital to assets, the ratio of non-performing loans to provision, and the financial policy response index as alternative measures of capital, credit risk, and prudential regulatory responses to COVID-19. In Panel B, we include three additional control variables: a dummy variable to control for GSIBs, the unemployment rate, and the share of urban population to total population. Variables are defined in Table 1 in the Appendix. *, **, *** denotes statistical significance at the 10% level, 5% level, and 1% level, respectively.

Table 8

The effect of COVID-19 and prudential regulatory responses on economic growth: COVID-19 weekly frequencies

Panel A. Using the weekly number of COVID-19 cases to proxy for COVID-19 spread						
Dep. Var: GDP per capita						
Model #	(1)	(2)	(3)	(4)	(5)	(6)
Weekly number of COVID-19 cases	-0.001	-0.003*	0.003	0.001	-0.001	-0.003*
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Tier 1 capital ratio	0.067***		0.039***			
	(0.001)		(0.002)			
Capital adequacy ratio		0.063***		0.041***		
		(0.001)		(0.002)		
Non-performing loans to gross loans ratio					-0.118***	-0.149***
					(0.004)	(0.003)
Return on assets	-0.37***	-0.41***	-0.4***	-0.417***	-0.473***	-0.419***
	(0.011)	(0.011)	(0.015)	(0.014)	(0.013)	(0.013)
Liquid assets to assets	0.012***	0.011***	0.013***	0.012***		
	(0.000)	(0.000)	(0.000)	(0.000)		
Banking sector regulation	0.016***	0.014***			0.007***	
	(0.000)	(0.000)			(0.001)	
Banking sector policy response index			0.004***	0.004***		0.009***
			(0.000)	(0.000)		(0.000)
Private sector debt to GDP	0.007***	0.006***	0.004***	0.004***	0.001***	0.001
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Current account to GDP	0.074***	0.08***	0.047***	0.052***	0.057***	0.029***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	7.817***	8.018***	9.059***	9.01***	10.59***	10.66***
	(0.052)	(0.052)	(0.053)	(0.051)	(0.040)	(0.031)
Observations (countries)	2,734	2,734	2,734	2,734	2,734	2,734
Observations (daily)	27	27	27	27	27	27
R2	0.787	0.769	0.682	0.685	0.718	0.76

Panel B. Using the weekly number of COVID-19 deaths to proxy for COVID-19 spread						
Dep. Var: GDP per capita						
Model #	(1)	(2)	(3)	(4)	(5)	(6)
Weekly number of COVID-19 deaths	-0.001	-0.006***	-0.001	-0.003	-0.007***	-0.004**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Tier 1 capital ratio	0.067***		0.037***			
	(0.002)		(0.002)			
Capital adequacy ratio		0.062***		0.039***		
		(0.001)		(0.002)		
Non-performing loans to gross loans ratio					-0.115***	-0.147***
					(0.004)	(0.003)
Return on assets	-0.37***	-0.413***	-0.4***	-0.418***	-0.473***	-0.42***
	(0.011)	(0.011)	(0.015)	(0.015)	(0.014)	(0.014)
Liquid assets to assets	0.012***	0.011***	0.013***	0.012***		
	(0.000)	(0.000)	(0.000)	(0.000)		
Banking sector regulation	0.016***	0.014***			0.008***	
	(0.001)	(0.001)			(0.001)	
Financial sector policy response index			0.004***	0.004***		0.009***
			(0.000)	(0.000)		(0.000)
Private sector debt to GDP	0.007***	0.006***	0.004***	0.004***	0.001***	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Current account to GDP	0.075***	0.08***	0.046***	0.051***	0.057***	0.029***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	7.836***	8.060***	9.134***	9.09***	10.61***	10.72***
	(0.055)	(0.053)	(0.056)	(0.052)	(0.040)	(0.030)
Observations (countries)	27	27	27	27	27	27
Observations (biweekly)	2,643	2,643	2,643	2,643	2,643	2,643
R2	0.785	0.768	0.68	0.684	0.715	0.757

Notes: In both panels, the sample consists of 27 OECD and key partners countries. The dependent variable is the natural logarithm of GDP per capita. We control for bank regulatory capital using two ratios: Tier 1 capital ratio and capital adequacy ratio. We control for credit risk using the non-performing loans to gross loans ratio. Additional bank-level control variables include: return on assets and liquid assets to assets. We control for prudential regulatory responses to COVID-19 using the banking sector regulation and the financial sector policy response index. Additional country-level control variables include: the private sector debt to GDP, the current account to GDP, the weekly number of COVID-19 cases (Panel A), the weekly number of COVID-19 deaths (Panel B). Variables are defined in Table 1 in the Appendix. *, **, *** denotes statistical significance at the 10% level, 5% level, and 1% level, respectively.

Table 9

The effect of COVID-19 and prudential regulatory responses on economic growth: Quarterly frequencies

Panel A. Using quarterly frequencies for both GDP per capita and cumulative number of cases (deaths)						
Dep. Var: GDP per capita						
Model #	(1) Cumulative cases	(2) Cumulative cases	(3) Cumulative cases	(4) Cumulative deaths	(5) Cumulative deaths	(6) Cumulative deaths
Quarterly number of COVID-19	0.005 (0.008)	0.007 (0.008)	0.008 (0.006)	0.003 (0.007)	0.002 (0.008)	0.005 (0.006)
Capital adequacy ratio	0.027*** (0.006)	0.013* (0.007)		0.027*** (0.006)	0.012* (0.007)	
Non-performing loans to gross loans ratio			-0.112*** (0.013)			-0.111*** (0.013)
Banking sector regulation	0.006*** (0.001)			0.006*** (0.001)		
Financial sector policy response index		0.002** (0.001)	0.005*** (0.001)		0.002** (0.001)	0.005*** (0.001)
Bank control	Yes	Yes	Yes	Yes	Yes	Yes
Country control	Yes	Yes	Yes	Yes	Yes	Yes
Constant	8.948*** (0.254)	9.396*** (0.221)	10.32*** (0.098)	8.96*** (0.244)	9.472*** (0.213)	10.37*** (0.092)
Observations (countries)	27	27	27	27	27	27
Observations (quarterly)	151	151	151	149	149	149
R2	0.618	0.599	0.709	0.622	0.598	0.708
Panel B. Using quarterly frequencies for GDP per capita, the quarterly number of COVID-19 deaths, and COVID-19 contagion						
Dep. Var: GDP per capita						
Model #	(1) Deaths	(2) Deaths	(3) Deaths	(4) COVID-19 contagion	(5) COVID-19 contagion	(6) COVID-19 contagion
Quarterly number of COVID-19	-0.003 (0.011)	-0.002 (0.011)	-0.001 (0.010)	0.004 (0.011)	0.005 (0.011)	0.006 (0.010)
Capital adequacy ratio	0.029*** (0.007)	0.013* (0.008)		0.027*** (0.006)	0.012 (0.007)	
Non-performing loans to gross loans ratio			-0.113*** (0.014)			-0.112*** (0.013)
Banking sector regulation	0.007*** (0.002)			0.006*** (0.001)		
Financial sector policy response index		0.003** (0.001)	0.005*** (0.001)		0.003** (0.001)	0.005*** (0.001)
Bank control	Yes	Yes	Yes	Yes	Yes	Yes
Country control	Yes	Yes	Yes	Yes	Yes	Yes
Constant	8.95*** (0.251)	9.486*** (0.216)	10.41*** (0.097)	9.001*** (0.234)	9.481*** (0.203)	10.4*** (0.088)
Observations (countries)	27	27	27	27	27	27
Observations (quarterly)	141	141	141	152	152	152
R2	0.626	0.601	0.71	0.615	0.595	0.707

Notes: In both panels, the sample consists of 27 OECD and key partners countries. The dependent variable is the natural logarithm of quarterly GDP per capita. We control for bank regulatory capital using two ratios: Tier 1 capital ratio and capital adequacy ratio. We control for credit risk using the non-performing loans to gross loans ratio. Additional bank-level control variables include: return on assets and liquid assets to assets. We control for prudential regulatory responses to COVID-19 using the banking sector regulation and the financial sector policy response index. Additional country-level control variables include: the private sector debt to GDP, the current account to GDP, the quarterly cumulative number of COVID-19 cases and deaths (Panel A), the quarterly number of COVID-19 deaths and COVID-19 contagion (Panel B). Variables are defined in Table 1 in the Appendix. *, **, *** denotes statistical significance at the 10% level, 5% level, and 1% level, respectively.

Appendix

Table 1

Variable definitions and data sources

Variable	Definition	Data Sources
Dependent variables		
GDP per capita	The natural logarithm of the per capita values for the gross domestic product (GDP) expressed in current international dollars converted by purchasing power parity (PPP) conversion factor.	World Bank – World Development Indicators, sourced from World Bank Development Research Group, 2019 results.
Independent variables		
Measures of COVID-19 spread		
Number of COVID-19 cases	The natural logarithm of the daily number of new confirmed cases of COVID-19.	https://ourworldindata.org/coronavirus and European Centre for Disease Prevention and Control.
Number of COVID-19 deaths	The natural logarithm of the daily number of deaths attributed to COVID-19.	As above
COVID-19 positive rates	The share of COVID-19 tests that are positive, given as a rolling 7-day average.	As above
Weekly number of COVID-19 cases	The natural logarithm of the cumulative weekly number of new confirmed cases of COVID-19.	The European Centre for Disease Prevention and Control. Link: https://www.ecdc.europa.eu/en/publications-data/data-national-14-day-notification-rate-covid-19
Weekly number of COVID-19 deaths	The natural logarithm of the cumulative weekly number of new confirmed deaths cases of COVID-19.	As above
Quarterly of COVID-19 cases	The natural logarithm of the cumulative quarterly number of new confirmed cases of COVID-19.	As above
Quarterly of COVID-19 deaths	The natural logarithm of the cumulative quarterly number of new confirmed deaths of COVID-19.	As above
Quarterly number of COVID-19 deaths	The natural logarithm of the quarterly number of deaths attributed to COVID-19.	As above
COVID-19 contagion	The natural logarithm of (1 + total number of confirmed deaths per million).	As above
Measures of regulatory intervention as a response to the spread of COVID-19		
Banking sector regulation	The number of days elapsed since the WHO declaration on January 30, 2020, until the first banking sector response measure.	World Bank – Database of Policy Responses Related to the Financial Sector as a response to the spread of COVID-19.
Banking sector policy response index	The sum of all banking sector policy measures taken by a country up to time t to mitigate the impact of COVID-19	World Bank – Database of Policy Responses Related to the Financial Sector as a response to the spread of COVID-19.
Financial sector policy response index	The sum of all financial sector policy measures taken by a country up to time t to mitigate the impact of COVID-19	World Bank – Database of Policy Responses Related to the Financial Sector as a response to the spread of COVID-19.
Measures of bank characteristics		
Tier 1 capital ratio	The ratio of core capital. It is Tier 1 capital divided by risk-weighted assets computed under the Basel rules. Banks must maintain minimum Tier 1 capital of at least 6% under Basel III guidelines.	International Monetary Fund – Financial Policy indicators, 2019 results.
Capital adequacy ratio	The ratio of regulatory capital. It is the sum of bank Tier 1 plus Tier 2 capital as a percentage of risk-weighted assets. This ratio must be at least 8% under the Basel I, II and III guidelines.	International Monetary Fund – Financial Policy indicators, 2019 results.
Capital to assets ratio	The unweighted capital ratio. It is total equity capital divided by total assets.	International Monetary Fund – Financial Policy indicators, 2019 results.
Non-performing loans to gross loans ratio	The ratio of non-performing loans as a percentage of total gross loans	International Monetary Fund – Financial Policy indicators, 2019 results.
Non-performing loans to provisions ratio	The ratio of non-performing loans as a percentage of net of provisions to capital	International Monetary Fund – Financial Policy indicators, 2019 results.
Return on assets	The profitability ratio. It is net income as a percentage of total assets.	International Monetary Fund – Financial Policy indicators, 2019 results.
Liquid assets to assets ratio	The liquidity ratio. It is measured as liquid assets as a percentage of total assets.	International Monetary Fund – Financial Policy indicators, 2019 results.
Macroeconomic and other control variables		
Private debt to GDP	Amount of total private debt to GDP.	World Bank – World Development Indicators, sourced from World Bank Development Research Group, 2019 results.

Variable	Definition	Data Sources
Current account to GDP	Transactions in the balance of payments recording the import and export of goods and services, payments of income, and current transfers between residents of a country and non-residents as a percentage of a country GDP.	World Bank – World Development Indicators, sourced from World Bank Development Research Group, 2019 results.
Unemployment rate	Unemployment rate refers to the share of the labor force that is without work but available for and seeking employment.	World Bank – World Development Indicators, sourced from World Bank Development Research Group, 2019 results.
Urban population to total population	Urban population refers to the share of total population living in urban areas as defined by national statistical offices.	World Bank – World Development Indicators, sourced from World Bank Development Research Group, 2019 results.
G-SIBs	A dummy variable that equals 1 for countries with Globally Systemically Important Banks (G-SIBs) and 0 otherwise.	Author calculations and Financial Stability Board (FSB)

Measures of national health systems, poverty, and human development

Variable	Definition	Data Sources
Male smokers	The share of men who smoke, most recent year available.	World Bank – World Development Indicators, sourced from World Health Organization, Global Health Observatory Data Repository, 2017 results.
Diabetes prevalence	The diabetes prevalence as a percentage of population aged 20 to 79 in 2017.	World Bank – World Development Indicators, sourced from International Diabetes Federation, Diabetes Atlas, 2017 results.
Hospital beds per thousands	The number of beds in hospitals per 1,000 people, most recent year available.	https://ourworldindata.org/coronavirus and OECD, Eurostat, World Bank, national government records and other sources, 2017 results.
Life expectancy	The life expectancy at birth in 2019.	https://ourworldindata.org/coronavirus and James C. Riley, Clio Infra, United Nations Population Division, 2017 results.
Extreme poverty index	The share of the population living in extreme poverty, most recent year available.	World Bank – World Development Indicators, sourced from World Bank Development Research Group, 2017 results.