How Should U.S. Bank Regulators Respond to the COVID-19 Crisis?

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A B S T R A C T

Drawing on lessons from the 2007–2009 Global Financial Crisis (GFC) and a simple conceptual framework, we examine the response of U.S. bank regulators to the COVID-19 pandemic. We argue that the current regulatory strategy of "watchful waiting"—the same strategy that was used during the early stages of the GFC—poses unnecessary risks to the financial system and broader U.S. economy. Instead, promoting an early recapitalization of the banking system, by stopping dividends and by encouraging new equity issues, would be a more prudent way to manage the vulnerabilities the pandemic has created. We close by suggesting additional measures that we believe regulators should take in both the short and long run.

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Introduction

U.S. banks were robustly capitalized prior to the ongoing COVID-19 global pandemic and economic crisis. **Figure 1** shows that the risk-based capital ratios of publicly traded BHCs have risen significantly since the Global Financial Crisis (GFC), with most of the improvement coming in the form of high-quality, loss-absorbing common equity. Specifically, the aggregate CET1 ratio—the ratio of Common Equity Tier 1 to Risk-Weighted Assets—rose from 5.8% in 2009Q1 during the depths of the GFC to 11.7% in 2019Q4 on the eve of the COVID-19 pandemic.

However, the pandemic and the resulting sudden stop in global economic activity has increased the risk that banks will face large credit losses in the coming quarters. In this paper, we argue that policymakers should take more aggressive actions to ensure that banks remain well-capitalized so that they can continue to play their critical roles as providers of credit to the economy, both during the ongoing public health emergency, and once the health emergency ends and it is safe to resume normal economic activities. We first discuss some lessons for capital regulation from the GFC, emphasizing the importance of using the information in market prices and acting early. We then apply those lessons to the current COVID-19 crisis, arguing that both bank stock prices and simple stress testing exercises suggest that there is a risk that the pandemic results in large declines in bank capital in the coming quarters.

We next lay out a conceptual framework for bank capital regulation, drawing heavily on our earlier work (Greenwood et al [2017]), to provide guidance for how regulators should respond to this emerging risk. The framework emphasizes the importance of promoting what we call "dynamic resilience" following a large adverse shock to the banking system: in addition to seeking to reduce the probability of bank failure following such an adverse shock, capital regulation must also try to sustain bank lending and avoid a credit crunch that harms the broader economy. The key implication that comes out of this framework is that, in times of stress, regulators should simultaneously relax marginal bank capital ratio requirements and encourage banks to raise new dollars of equity. These actions augment the capacity of banks to provide credit to the economy, while simultaneously providing stronger incentives for new lending by reducing the marginal capital charges on new loans. We use this framework to evaluate regulatory actions since the COVID-19 pandemic began. The picture is decidedly mixed: regulators have been active in relaxing existing capital requirements on banks but have done little to encourage them to conserve or raise new equity capital.

We close by suggesting specific measures regulators can take in both the short and long run. First and foremost, at times like these, regulators should use their prudential authorities to encourage banks to increase their equity capital. This is effectively a way of buying low-cost insurance against the sorts of adverse scenarios that have become more likely due to the pandemic and the resulting economic stop. We also discuss longer-term changes to the regulatory regime that would make it easier to take these kinds of societal risk management actions in future crises.

I. Lessons from the 2007–2009 Global Financial Crisis

I.A Shifts in the Post-GFC Regulatory Consensus

Policymakers learned several lessons from the 2007–2009 Global Financial Crisis (GFC). At the highest level, the GFC led to a shift in the goals of bank regulation. Before the GFC the main goals were largely micro-prudential in nature—i.e., the aim was to promote the safety and soundness of individual financial

institutions. Since the GFC, policymakers have increasingly adopted a macro-prudential approach, recognizing that, in the presence of fire-sale and credit-crunch externalities, they must take steps to promote the soundness and stability of the financial system as a whole (Hanson, Kashyap and Stein [2011] and Bernanke [2011]).

This macro-prudential paradigm has two implications for capital regulation. First, policymakers have concluded that it is wise to require banks to have significantly more capital in normal times—and especially more high-quality, loss-absorbing common equity—than had been required before the GFC. While recognizing that bank equity is not without cost, policymakers have concluded that the benefits of heightened capital requirements (i.e., reducing the likelihood and expected severity of future financial crises) outweigh the costs of additional equity capital (i.e., a small increase in the cost of credit in normal times).

The second implication of the macro-prudential paradigm concerns the dynamics of regulation over time. A key example is the "lean versus clean" debate—should policymakers take active *ex ante* measures to lean against potential threats to financial stability as they build up, or should they do most of their work after the fact, focusing on *ex post* clean-up? Prior to the GFC, the consensus was that policy should primarily focus on clean-up (Greenspan [1999], Bernanke and Gertler [2000]). A central lesson of the GFC was that a "clean-up-only" approach may not be appropriate. As a result, many advanced countries have now adopted time-varying macro-prudential policies to lean against the wind of credit-market overheating and other financial imbalances (Borio and White [2014]).

A related dynamic lesson of the GFC—and one that has received far less attention from policymakers—is the importance of the "in-between" (Stein [2013], Greenwood et al [2017]). The lean-versus-clean framing calls to mind a simple model in which there are just two dates: (1) an *ex ante* date when there may or may not be a future financial shock—and when we may not know much about the form the shock will take—and (2) an *ex post* date after the shock has landed and policymakers are dealing with the aftermath. But this before-and-after dichotomy is misleading. Most banking crises unfold over quarters or even years, and the policy choices made during the "in-between" period—once cracks begin to appear in the banking system, but before the levee breaks—are among the most consequential in shaping subsequent economic outcomes.

I.B The In-Between Period during the GFC

Uncertainty is a hallmark of the in-between period. During these interim periods, it is typically clear that the banking system has suffered a major shock, but it is still unclear precisely how large that shock is. What information can policymakers draw on in such times?

As illustrated in **Figure 2**, a large drop in bank stock prices is an early warning indicator that signals an elevated risk of a future crisis.[1] During the GFC, bank stocks peaked in February 2007 and started declining as problems with subprime mortgages began to surface, as shown in **Panel A**. The first serious tremors of the GFC were felt in early August 2007, with BNP Paribas suspending redemptions on its money funds and investor runs on multiple asset-backed commercial paper programs. By March 2008

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1. The idea that large declines in bank stock prices indicate a heightened risk of a banking crisis is a general pattern that extends beyond the GFC. Using data for 46 countries over the period 1870-2016, Baron, Verner, and Xiong (2020) show that large declines in bank stocks precede the most acute phase of banking crises—i.e., runs by bank depositors and other disruptions to short-term bank funding—by more than 2 quarters. They show also that declining bank stock prices predict subsequent declines in bank credit and economic growth, controlling for the decline in nonfinancial stock prices.

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when the Federal Reserve made an emergency loan to facilitate Bear Stearns' acquisition by JP Morgan, bank stocks were down by more than 35% from their prior peak. At this point, it was clear that the U.S. financial system faced a significant threat—even if its precise magnitude was still to be determined.

Yet, in the six months between the failure of Bear Stearns and the failure of Lehman Brothers in mid-September of 2008, U.S. banks and their regulators adopted a strategy of watchful waiting (Gennaioli and Shleifer [2018]). Banks were slow to curtail payouts to common shareholders and took only limited steps to raise new equity capital during 2007 and early 2008. Between 2007Q1 and 2008Q2, publicly traded U.S. banks—which, collectively, would go on to charge off $216 billion of loans and incur $311 billion of provision expenses from 2008Q3 to 2009Q4—paid out almost $136 billion in cash to their common shareholders in the form of dividends and share repurchases. During this same 6-quarter period, banks raised only $68 billion of new equity, opting to primarily raise lower quality capital in the form of preferred stock. And, regulators were reluctant to aggressively pressure banks to suspend payouts and to recapitalize (Geithner [2014]).

Panel A of Figure 3 shows one reason regulators were slow to act, tracing the evolution of the CET1 ratio for U.S. publicly trade BHCs from 2006Q1 to 2009Q4. In contrast to the steep fall in stock prices, regulatory capital ratios, which are based on accounting values and hence by their nature are less forward-looking than stock prices, fell slowly. The aggregate CET1 ratio decreased from 7.7% in 2006Q1 to 6.1% in 2008Q2, a much smaller decline than that in stock market values.

The process of recapitalizing U.S. banks only began in earnest in mid-October 2008—after the crisis had reached its most acute stage in the weeks following Lehman's failure—when the U.S. Treasury began purchasing preferred stock in banks. Ultimately, however, U.S. banks only began issuing significant qualities of loss-absorbing common equity in 2009Q2 when the Supervisory Capital Assessment Program (SCAP)—the initial bank stress test—was used to compel equity issuance. By that point in May 2009, bank stocks had fallen by 70% from their pre-GFC peak.

With the benefit of hindsight, it seems clear that the GFC would have been less severe if regulators had acted earlier, by clamping down on payouts and compelling more common equity issuance. A key impediment to doing so was the conflict between bank shareholders' interests and those of the broader public due to debt overhang problems. Cutting back on shareholder payouts and issuing new common shares would have been beneficial for the economy and financial markets more broadly. However, those actions were clearly a negative for existing shareholders, as they would have entailed large transfers to underwater creditors.

These conflicts of interest—and the vocal protests they evoke from some bank executives—can deter regulators from taking full advantage of the legal and regulatory tools at their disposal. In particular, in the early stages of a banking crisis, some bank executives may point out that they are still well above their regulatory minimum capital requirements and will use this observation to argue that further capital-preservation measures are unnecessary. However, in periods of rapid change, regulatory ratios based on backward-looking accounting values can be particularly misleading, and there may be much to be learned from more forward-looking market prices.

I.C Market-based Signals during the GFC

While financial markets are far from perfectly efficient, movements in market prices can still be informative about future fundamentals. In the first column of **Table 1**, we make this point for the GFC episode by regressing each BHC's pre-Lehman stock price decline on its 2006Q4 balance sheet composition, which proxies for their pre-crisis exposure to different risk factors. The regression shows

there was a strong relationship between initial balance sheet exposures and the pre-Lehman decline in stock prices: the adjusted R^2 of the regression in column (1) is 35%.[2] Thus, stock price declines in the initial stages of the GFC reflected real bank-specific information. Importantly, they had also substantial predictive content for future bank losses.

Figure 4 shows that there was a strong cross-sectional relationship between the pre-Lehman decline in a BHC's share price and its post-Lehman loan loss provisions. Furthermore, this relationship was much stronger than that between a BHC's pre-Lehman change in the CET1 regulatory capital ratio and post-Lehman provisions. In particular, the R^2 of the forecasting regression using stock prices (24%) is almost five times greater than that from the comparable regression using CET1 ratios (5%). Simply put, bank stock price movements in the pre-Lehman stage of the GFC anticipated subsequent loan losses in a way that contemporaneous accounting-based capital ratios did not.

While stress testing was not available as a regulatory tool until the last stages of the GFC, it is available today, as the banking system confronts the risks posed by the COVID-19 pandemic. As we argue below, stress testing should be used in concert with market information to understand the risks banks face during periods of rapid change like the one we are currently undergoing.

II. The COVID-19 Crisis

What lessons does the GFC hold for banks in the current environment? In this section, we assess the extent to which current circumstances are a critical "in-between" period. We argue that both stock prices and simple stress-testing exercises suggest that there is a meaningful risk of large losses on bank assets due to the COVID-19 pandemic and economic crisis.

II.A Market-based Signals during the COVID-19 Crisis

Panel B of **Figure 2** shows that bank stocks dropped sharply in March 2020, falling roughly 50% from their January 2020 peak. Bank stocks have since recovered somewhat—they were down 40% from their peak as of May 25, 2020—but have recovered much less than the overall stock market, which is down just 13% from its peak. As **Table 2** further details, the decline to date in bank stocks has also been significantly larger than that of value stocks in general (down 22%), or even that of small-cap value stocks (down 29%), two indices which have been harder hit by recent events.

The second column of **Table 1** shows that the cross-section of bank stock prices again appears to be informative, as it was in the GFC. Relative to banks that hold more cash and securities, banks with larger portfolio shares of residential or commercial real estate loans, commercial and industrial (C&I) loans, and consumer loans have suffered larger stock price declines in recent months. The economic magnitudes are meaningful. For instance, the interquartile range of the C&I loan share is 9 percentage points, which corresponds to a 5 percent point difference in stock returns. The interquartile range of the commercial real estate (CRE) loan share is 20 percentage points, which corresponds to a 6 percentage point difference in stock returns. So once again, bank stock prices seem to be telling us something about the potential for significant loan losses and subsequent depletions of bank capital.

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2. In the regression, exposure to commercial real estate plays the largest role in explaining share price declines during the initial stages of the GFC. Of course, exposure to subprime mortgages also played a very important role. Unfortunately, it is not possible to isolate banks' exposures to subprime mortgages with the regulatory data available prior to 2009.

Table 2 further shows that traded credit market prices are also consistent with this concern. The S&P/LSTA leveraged loan index, which is composed of loans that are likely to have lower default probabilities than the average bank C&I loan, was down 22% at its trough and remains down 10%. Similarly, the Markit CMBX index, which is composed of loans that are likely of higher quality than the average bank CRE loan, was down 13% at its trough and remains down 9%. Like bank stock prices, these market prices suggest there is risk of meaningful losses on credit assets.

II.B Assessing the Potential Impact of COVID-19 on U.S. Bank Capital

Stress testing is a second way to explore the potential for large bank losses. In this section, we use the Capital and Loss Assessment under Stress Scenarios (CLASS) model developed in Hirtle, Kovner, Vickery, and Bhanot (2016) to quantify the implications of different macroeconomic scenarios for U.S. BHC capital ratios over a 9-quarter horizon that begins in 2020Q1 and ends in 2022Q1.

Two caveats apply to this analysis. First, our goal here is not to come up with precise point estimates for future bank capital ratios. Instead, we simply aim to explore what values can be generated under different macroeconomic scenarios, and to understand whether there are plausible scenarios that generate large losses. Given this goal, we feed a range of macroeconomic scenarios into the CLASS model, instead of focusing on a single adverse macroeconomic scenario as in the Fed's official Comprehensive Capital Analysis and Review (CCAR) and Dodd-Frank Act Stress Test (DFAST) exercises. Second, the CLASS model uses estimated historical relationships between bank outcomes and macroeconomic variables. Given the unprecedented nature of the COVID-19 shock, applying such historical relationships to current conditions necessarily involves meaningful out-of-sample extrapolation. In other words, there is more model uncertainty involved in stress testing now than there would be in a more typical recession.

II.B.1 The CLASS Model

We begin by briefly summarizing how the CLASS model works. See Hirtle et al (2016) for additional details. The CLASS model uses data from the FR Y-9C regulatory filings and simple time-series regressions to project the impact of future macroeconomic scenarios on the capital ratios of U.S. BHCs. To link the evolution of bank profitability and net charge-off ratios to macroeconomic variables, the CLASS model fits simple quarterly time-series models of the form:

$$ratio_t = \alpha + \rho \cdot ratio_{t-1} + \boldsymbol{\beta}'\mathbf{macro}_t + \varepsilon_t, \quad (1)$$

where $ratio_t$ is the bank ratio in question (e.g., the net interest margin or the net charge-off ratio on C&I loans) and $\mathbf{macro}_t$ is a set of one or more macroeconomic variables.[3] For example, in the regression specification for the C&I loan net charge-off ratio, there is just one macroeconomic variable in the CLASS model: the quarterly change in the unemployment rate. The model takes a user-specified path for the future evolution of a set of macroeconomic variables as input and uses these time-series regressions to

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3. The CLASS model includes 6 time-series regressions to estimate the components of pre-provision net revenue (e.g., net interest income, non-interest nontrading income) and 14 time-series regressions to estimate the individual components of total net-charge offs on loans (e.g., net charge offs on C&I loans, credit card loans, etc.). The macroeconomic variables in the CLASS model are (1) the unemployment rate, (2) the 4-quarter change in log home prices, (3) the 4-quarter change in log commercial real estate prices, (4) quarterly GDP growth, (5) the 3-month Treasury yield, (6) the 10-year Treasury yield, (7) the BBB-rated corporate yield, and (8) the 1-quarter log change in stock prices. The most important drivers of estimated capital shortfalls in the CLASS model are (1), (2), and (3), just as in the Fed's CCAR and DFAST exercises.

build up estimates for pre-provision net revenue and loan net charge-offs for each U.S. BHC. These estimates are then used to project a path for each BHC's equity capital.[4] The CLASS model assumes that BHCs suspend share repurchases and do not issue additional capital during the 9-quarter capital planning horizon.

We use a slightly modified version of the original Hirtle et al (2016) CLASS model as recently updated by researchers at the Federal Reserve Bank of Minneapolis (2020). The most important modifications introduced by the Federal Reserve Bank of Minneapolis (2020) are: (1) that, consistent with recent changes to CCAR and DFAST, BHC assets are assumed to remain constant at their 2019Q4 levels as opposed to growing over the future 9-quarter horizon; and (2) unlike the original CLASS model, the Federal Reserve Bank of Minneapolis (2020) includes estimated losses from operational risk, the global market shock to large bank trading portfolios, and the counterparty default losses assumed in the current CCAR and DFAST.[5,6]

We have made two additional modifications beyond those made by the Federal Reserve Bank of Minneapolis (2020). The first change is that, consistent with the Federal Reserve's recently adopted Stress Capital Buffer proposal, we assume that BHCs maintain their 2019Q4 dividends for just 4 quarters as opposed to the full 9-quarter planning horizon.[7] The second modification is related to problem of extrapolating from historical data out-of-sample. When we feed in adverse macroeconomic scenarios of the kind that seem plausible in light of the COVID-19 shock (e.g., with unemployment peaking above 20% and then taking several quarters to return to 10%), the CLASS model forecasts large *negative* loan loss provisions in 2021, which seems unlikely.[8] This result stems from the fact that the underlying econometric models are fit on a time-series sample that contains the GFC and one or two other typical recessions. Thus, the data do not directly speak to losses that might arise when if unemployment rises much higher than it has in previous recessions. To address this issue, we assume that net charge-offs are always positive, setting net charge-offs to zero in any future period where the CLASS model suggests that they would turn negative. This means that cumulative net charge-offs never decline in our implementation of the CLASS model.

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4. This involves additional assumptions on (i) the mapping between estimated loan net charge-offs and estimated loan-loss provision expenses, (ii) tax rates, and (iii) dividend payouts.

5. We are incredibly grateful to Ron Feldman and Jason Schmidt of the Federal Reserve Bank of Minneapolis for sharing their updated data and code. In addition to the most important changes noted above, the Federal Reserve Bank of Minneapolis (2020) made the following more minor changes: (1) they forecast net-charge offs for 12 loan categories as opposed to the 14 in the original CLASS model; (2) the historical time-series regressions in Equation (1) are now estimated using data from 1996Q1 to 2019Q4 as opposed to 1991Q1 to 2013Q3l; (3) the calculation of taxes and regulatory capital has been updated to reflect recent tax and regulatory changes—e.g., the tax rate is now set to 21% as opposed to 35%; (4) instead of the more complex dividend payout rule in the original CLASS model, they assume that dividends are held fixed at their 2019Q4 level over the 9-quarter planning horizon.

6. Federal Reserve Bank of Minneapolis (2020) included these additional losses from operational risk, the global market shock to large bank trading portfolios, and the counterparty default losses by assuming they would be the same as the Federal Reserve's 2019 DFAST.

7. See https://www.federalreserve.gov/newsevents/pressreleases/bcreg20200304a.htm.

8. While net charge-offs (charge-offs minus recoveries) and provisions *can* be negative, they have never gone highly negative in the aggregate.

II.B.2 Future Macroeconomic Scenarios

The most important drivers of loan loss provisions from our version of the CLASS model are the paths of the unemployment rate, home prices, and, to a lesser extent, commercial real estate prices.

We explore the implications for bank capital of two broad macroeconomic scenarios. Again, we do not mean for any of these scenarios to be interpreted as point estimates. The purpose of the exercise is simply to illustrate a range of outcomes. For the unemployment rate and real GDP growth, we take two macroeconomic scenarios constructed by the Minneapolis Fed as our less adverse and more adverse scenarios. The less adverse scenario corresponds to a "U-shaped" recession with unemployment peaking at 17.8% in 2020Q3. The more adverse scenario corresponds to a more severe, U-shaped recession in which unemployment peaks at 28.7%. The paths for unemployment under these two scenarios are shown in the upper-left hand corner of **Figure 5**, which also shows the path of unemployment during the GFC.

We consider two separate scenarios for real estate prices. The more adverse paths for residential and commercial real estate prices are the same as those used in the 2020 CCAR severely adverse scenario.[9] We also consider a less adverse decline in real estate prices. The paths of residential real estate prices in these two scenarios are shown in upper right-hand corner of **Figure 5** and the paths of commercial real estate prices are shown in the lower left-hand corner.

In all of our scenarios, we take the paths for interest rates and the stock market assumed in the 2020 CCAR severely adverse scenario.

II.B.3 Output from the CLASS Model

We implement our version of the CLASS model on the 21 domestic BHCs that are included in the 2020 CCAR, following the Federal Reserve Bank of Minneapolis (2020). The basic output is shown in **Figure 5** and **Table 3**. **Table 3** presents the CLASS-model implied decline in aggregate CET1 and the aggregate CET1 ratio across the resulting four scenarios—the combination of two different scenarios for unemployment and two different scenarios for real estate prices.

Panel A of Table 3 breaks down the change in aggregate CET1 if both unemployment and real estate prices follow the less adverse paths shown in Figure 5. As can be seen, the aggregate level of CET1 at the 21 U.S. BHCs was $1,050 trillion at the end of 2019 or 11.5% of risk-weighted assets. In this least adverse scenario, cumulative pre-provision net revenues total $243 billion and loan-loss provisions total $374 billion between 2019Q4 and 2022Q1. After accounting for the impact of trading losses ($80 billion), operational risk losses ($113 billion), and 4-quarters of dividends ($58 billion), CET1 declines by $389 billion, reaching $661 billion or 7.3% of current risk-weighted assets.

Figure 5 shows the path of the aggregate CET1 ratio for the U.S. BHCs as we vary the key drivers of losses—the unemployment ratio, home prices, and commercial real estate—one at a time (keeping the scenarios of the other two variables at their less adverse severities). Combining these, the lower-right hand figure reiterates that the aggregate CET1 ratio declines from 11.5% in 2019Q4 to 7.3% in 2022Q1 if all three macroeconomic variables follow their least adverse paths among the scenarios we explore. By contrast, if all three variables follow their more adverse paths among the scenarios we explore, the aggregate CET1 ratio is 5.5% in 2022Q1.

Table 4 illustrates the fraction of the 21 U.S. BHCs, both by number and by percent of assets, that would breach their minimum required CET1 ratios—equal to 4.5% plus any applicable Global Systemically

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9.   See https://www.federalreserve.gov/newsevents/pressreleases/files/bcreg20200206a1.pdf.

Important Banks (GSIB) surcharges—before 2022Q1 in each scenario. For instance, in the least adverse scenario in the upper left, the model suggests that 29% of BHCs accounting for 60% of BHC assets, including four of eight U.S. GSIBs, would breach their minimum required CET1 ratios over the next 9 quarters. By contrast, in our most adverse scenario in the lower right, 47% of BHCs accounting for 78% of assets, including five of eight GSIBs, would breach their CET1 minimums.

Figure 6 shows the CLASS-model implied path of cumulative net charge-offs for residential real estate loans, CRE loans, C&I loans, and consumer loans as a function of the macroeconomic scenario. It is worth noting that projected cumulative loan losses are either in line with or actually less severe than the market prices shown in **Table 3**. For instance, the projected cumulative loan loss rate for C&I loans is roughly 10%, which is in line with the current decline in the market price of leveraged corporate loans. By contrast, the cumulative rate of losses on CRE loans is roughly 3%, while CMBS prices suggest that CRE loan prices have fallen by 9%. Furthermore, the CLASS-model-implied loan loss rates in **Figure 6** are generally not as severe as those that were assumed in the 2009 SCAP.[10] In other words, the scenarios we consider here do not seem overly pessimistic given the scale of the COVID-19 shock and the tremendous uncertainty about the future path of the U.S. economy.[11]

Again, it is worth repeating that this simple stress-testing exercise is subject to a wide range of caveats, and we are not inclined to take any of the resulting point estimates literally. But we do believe that the broad qualitative message is worth taking seriously: given the magnitude of the shock associated with the COVID-19 pandemic and the heightened level of macroeconomic uncertainty today, there are plausible scenarios that involve large losses and significant capital depletion at U.S. banks.

III. A Conceptual Framework for Bank Capital Regulation

In this section, we sketch a conceptual framework for bank capital regulation, drawing heavily on Greenwood et al [2017], who argue that capital regulation should serve two logically distinct goals.[12] First, as traditionally recognized, risk-based capital ratio requirements should be used to reduce the probability of bank failures in normal times. Consistent with a macroprudential approach to regulation, the rationale is that banks do not fully internalize the costs of their failure to society—e.g., because of fire-sale and credit-crunch externalities—and therefore will choose to finance themselves with too little equity and will take too much risk in the absence of risk-based capital regulation.

The second aim of regulation, which has received somewhat less attention, and which we call "dynamic resilience," should be to ensure that banks recapitalize promptly following an adverse shock to the system. In the midst of the COVID-19 shock, we believe that a focus on dynamic resilience is critical. Policymakers should aim to get banks to raise new *dollars* of equity capital, not just maintain their usual risk-based capital ratios.

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10. See https://www.federalreserve.gov/newsevents/files/bcreg20090507a1.pdf. For instance, in the SCAP, regulators provided banks with indicative loss rates on prime residential mortgages between 7% and 8.5%, indicative loss rates between 9% to 12% on commercial mortgages, and indicative loss rates between 18% to 20% on credit cards and 10 to 12% on other consumer loans.

11. Naturally, if we feed in even more dire scenarios for the future path of unemployment and real estate prices into the CLASS model, the model returns larger declines in BHC CET1 ratios.

12. The Appendix to this paper sketches the model that Greenwood et al [2017] use to formalize these arguments.

Indeed, the desire to avoid a credit crunch generally implies that regulators should simultaneously require banks to raise new dollars of equity *and* relax capital ratio requirements following an adverse shock. To draw an analogy to efficient taxation, the optimal policy effectively pairs a base-broadening lump-sum tax increase (the new dollars of equity capital) with a reduction in marginal tax rates on new activity (the lower marginal capital charges on new loans). This combination is the most effective way to both stimulate new lending and to keep the risk of bank failure from rising too much.

Of these two methods of responding to an adverse shock, we see the former as the more relevant for two reasons. First, in the absence of a countercyclical capital buffer that can be drawn down in bad times—and note that this tool was not activated in the pre-COVID period in the U.S.—temporarily relaxing capital ratio regulations may not significantly change bank incentives to lend in practice. A bank whose required capital ratio is temporarily cut knows that the requirement will eventually revert back to its higher steady-state value. It may thus be reluctant to operate much below the long-run required capital ratio, preferring instead to cut lending so as to more rapidly get back into compliance with the steady-state capital requirement. Furthermore, following a large adverse shock, regulatory capital requirements may not be the binding constraint faced by banks. Instead, as capital adequacy declines, credit market investors may impose an even more stringent test, refusing to extend short-term wholesale funding to banks that are not strongly capitalized. Nevertheless, to the extent that some degree of capital ratio relief can be implemented, it is likely to be a useful part of the overall tool kit when the banking system is under stress.

The second reason to favor equity issues over temporary capital-ratio relief is that the social costs of equity issuance are likely low compared to the private costs. While the corporate finance literature has amply documented the reluctance of firms of all kinds to raise external equity, the best-understood mechanisms involve private costs, not social costs. Debt overhang and asymmetric information are the leading examples (Myers [1977] and Myers and Majluf [1984]). In both cases, the reluctance to issue equity arises from the fact that doing so transfers value from existing shareholders to either new shareholders or debtholders. But these transfers only affect the distribution of value, not total value, and hence are not relevant from a social-welfare perspective.

So, what might be the social costs of a policy of compelling banks to raise equity? One argument that is sometimes raised is that doing so may send a negative signal regarding bank regulators' private information about the health of bank balance sheets, and that this could in turn cause a panic and a damaging downward spiral in bank stock prices.

However, in the wake of the COVID-19 shock, it is not clear that regulatory decisions related to bank capital would reveal substantially different private information than the other historically aggressive policy interventions already taken by the Federal Reserve. Indeed, the Fed has been admirably forthright in its communications about the enormous macroeconomic risks and uncertainties created by the COVID pandemic. So, it seems a little odd to argue that they should take special care not to let on that the pandemic might also have negative consequences for bank capital adequacy.

IV. Evaluating Bank Regulatory Policy during the COVID-19 Crisis

In this section, we evaluate the bank regulatory response to the COVID-19 shock to date. We start by enumerating the set of policy actions regulators have taken since the onset of the COVID-19 crisis. We then compare those actions to the prescriptions suggested by our conceptual framework. The punchline is that regulators have done only half of what our framework prescribes for promoting dynamic resilience

following an adverse shock: they have been active in relaxing capital ratio requirements at the margin, but they have not succeeded in getting banks to curtail shareholder payouts or raise new equity capital.

IV.A Bank Regulatory Policy Actions to Date

The following is a partial list of actions taken by U.S. bank regulators since the onset of the COVID-19 pandemic, gathered from the Federal Reserve's website.

1. March 17, 2020. As a bank's level of equity capital falls, restrictions on capital distributions will now be phased in, rather than sharply imposed at a particular threshold.[13]

2. March 22, 2020. Supervisors will not direct institutions to automatically categorize loan modifications as troubled debt restructurings (TDRs).[14]

3. March 27, 2020. Banks that are required under U.S. accounting standards to adopt "current expected credit loss" accounting this year can mitigate the estimated cumulative regulatory capital effects for two years, beyond the three-year transition period already in place.[15]

4. March 27, 2020. Banks are permitted to adopt the "standardized approach for measuring counterparty credit risk rule" (SA-CCR) early for the reporting period ending March 31.[16]

5. April 1, 2020. The supplementary leverage ratio (SLR) requirement is temporarily relaxed, excluding U.S. Treasury securities and deposits at Federal Reserve Banks from the calculation of the rule for holding companies until March 31, 2021.[17]

6. April 6, 2020. Implementing Section 4012 of the CARES Act, the leverage ratio requirement for community banks is temporarily reduced to 8 percent.

7. Other changes in bank regulation, not directly related to capital

    a. April 14, 2020. Appraisals for residential and commercial real estate transactions can be deferred for up to 120 days.[18]

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13. See https://www.federalreserve.gov/newsevents/pressreleases/bcreg20200317a.htm. In a related announcement made on March 23, 2020, it was also announced that restrictions on capital distributions would be phased in, rather than sharply imposed at a particular threshold, as a bank's total loss absorbing capacity (TLAC) falls.

14. See https://www.federalreserve.gov/newsevents/pressreleases/bcreg20200322a.htm. This guidance was revised on April 7, 2020 to reflect Section 4013 of the CARES Act, which allows financial institutions to suspend the requirements to classify certain loan modifications as troubled debt restructurings (TDRs).

15. See https://www.federalreserve.gov/newsevents/pressreleases/bcreg20200327a.htm

16. See https://www.federalreserve.gov/newsevents/pressreleases/bcreg20200327a.htm

17. See https://www.federalreserve.gov/newsevents/pressreleases/bcreg20200401a.htm.

18. See https://www.federalreserve.gov/newsevents/pressreleases/bcreg20200414a.htm.

     b.   May 5, 2020. For banks participating in Money Market Mutual Fund Liquidity Facility and Paycheck Protection Program Liquidity Facility, liquidity coverage ratio requirements are relaxed.[19]

     c.   May 6, 2020. The submission date for targeted resolution plans (i.e., living wills) from some large foreign and domestic banks is extended.[20]

In addition to these official policy actions, it was announced on March 15, 2020 that the eight U.S. GSIBs—JPMorgan, Bank of America, Citigroup, Wells Fargo, Goldman Sachs, Morgan Stanley, Bank of New York Mellon and State Street—would suspend share repurchases, but not dividends, through June 30, 2020.[21] Based on the amount of share repurchases in 2020Q1, this one-quarter suspension should conserve equity capital equal to about 0.36% of risk-weighted assets for the GSIBs.

IV.B Evaluating Regulatory Policy

As noted above, our framework suggests that in response to an adverse shock, regulators should respond on two dimensions, by: (i) encouraging banks to raise new equity capital; while simultaneously (ii) loosening marginal capital requirements. All seven of the official regulatory actions listed above fall broadly into the second category. Only the announcement that the largest banks would temporarily suspend share repurchases falls into the first category. On balance, this simple enumeration, as well as the information in market prices and our stress testing exercise above, suggests that regulators have not emphasized the first type of action enough.

It is worth noting that, in contrast to the Federal Reserve, prudential regulators in other advanced countries have been more active in encouraging banks to conserve capital (Svoronos and Vrbaski [2020]). For example, on March 27, 2020, the European Central Bank formally asked banks to suspend common dividends and share repurchases through September 30, 2020.[22] The Bank of England followed suit on March 31, 2020, formally instructing large U.K. banks to suspend common dividends and repurchases through the end of 2020 and to temporarily halt cash bonus payments to senior bank staff.[23] Bank regulators in Australia, Brazil, Canada, India, Russia, Singapore, South Africa, Sweden, and Switzerland have also taken formal actions to temporarily curtail or suspend bank payouts to common shareholders.

One possible rationalization for the hesitancy of U.S. regulators to promote capital conservation might fall under the heading of "watchful waiting under uncertainty." While the public health emergency is certainly bad news for businesses and households and, by extension, their lenders, it is not yet clear just how bad the news is. It is possible that the public health emergency resolves in relatively short order, in which case banks will not need additional equity to survive and support additional lending. And so, according to this logic, it might be better to wait and see how things turn out before requiring banks to take the painful step of issuing equity at prices 40% below their recent peaks.

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19. See https://www.federalreserve.gov/newsevents/pressreleases/bcreg20200505a.htm.

20. See https://www.federalreserve.gov/newsevents/pressreleases/bcreg20200506a.htm.

21. See https://www.fsforum.com/types/press/releases/financial-services-forum-statement-on-share-buybacks/.

22. See https://www.bankingsupervision.europa.eu/press/pr/date/2020/html/ssm.pr200327~d4d8f81a53.en.html.

23. See https://www.bankofengland.co.uk/prudential-regulation/publication/2020/pra-statement-on-deposit-takers-approach-to-dividend-payments-share-buybacks-and-cash-bonuses.

In our view however, this sort of uncertainty, and the associated risk management considerations, cut in the opposite direction. Think about the costs of mistakes of either kind. If the economy does recover more quickly than expected, significant equity issues will not have been necessary, and banks will be over-capitalized and their shareholders will have been unnecessarily diluted. But the social cost of such dilution is small. By contrast, if the crisis drags on longer than expected, an under-capitalized banking sector could become a heavy drag on an already-weakened economy, at a large social cost. This sort of logic implies that uncertainty about the range of outcomes makes encouraging equity issuance by banks even more attractive from a social perspective than it would be if policymakers were managing solely with the median outcome in mind. In effect, issuing equity now is a relatively cheap way—for both banks and for the economy as a whole—to buy insurance against severely adverse scenarios.

Moreover, in the presence of uncertainty, policymakers need to consider the full range of probable future paths. Given the reference point of January 2020, issuing equity today, when bank stocks are down 40%, is likely to be perceived by banks as costly. But again, to draw the lesson from early 2008, one must bear in mind that there is a meaningful probability that the macroeconomy follows a path where banks stocks decline considerably further. Along this path, equity issuance becomes both more necessary and more costly, possibly requiring explicit government support as was the case in the GFC. From a social risk-management perspective, waiting until it is glaringly obvious that banks need to issue equity may prove to be considerably more costly than buying insurance against such a contingency today.

V. Policy Recommendations

In this final section, we present a concrete list of policy recommendations:

V.A Short-term Policy Recommendations

1. U.S. policymakers should require all U.S. BHCs to suspend both common dividends and share repurchases. Following other national regulators, U.S. regulators should also consider requesting that banks temporarily suspend part, or all, of their cash bonuses to senior executives and senior staff. Given the magnitude of these cash bonuses, such an action would conserve a meaningful amount of bank capital.[24]

2. Concurrently, policymakers should encourage banks to raise new common equity via secondary offerings. If done sooner rather than later, these equity offerings could be framed not as a response to imminent solvency concerns in the banking sector, but as banks doing their share to support the recovery by building the extra capacity needed to step in and re-intermediate other, more dysfunctional parts of the credit-supply system. At the same time, it should be made clear to bank executives that, given the potential economic damage associated with COVID-19, a strategy of "watchful waiting" runs a significant risk of forced equity issues later on at highly depressed prices, as well as the specter of government ownership.

. . .

24. Bank regulators in Australia, Brazil, Canada, Russia, South Africa, and the United Kingdom have recently taken steps to either limit or reduce cash bonuses (Svoronos and Vrbaski [2020]).

V.B Longer Term Recommendations

1. The Federal Reserve should consider ways to more explicitly incorporate the information contained in bank stock prices and other market indicators into the stress test process. In a crisis, forward-looking market prices can provide timelier information about the extent of damage that may be accumulating in the banking system as compared to backward-looking accounting metrics. This is not to argue that there should be a simple mechanical relationship between, say, bank stock prices and recapitalization requirements. But when the signals from markets are as strong as they are today, there should be a burden of proof on regulators to explain why they are not treating this information as worthy of an aggressive policy response.

2. The default presumption should be that in good times, the countercyclical capital buffer is always turned on, so that policymakers have room to cut this element of the overall capital requirement in a sharp downturn. As we have seen, the fact that this buffer was left off in the U.S. in recent years—unlike in many other major economies—has left bank regulators with less ability to encourage lending in the current crisis by cutting back the marginal capital charge on new loans. If the burden of proof is such that regulators have to be able to provide convincing evidence of credit-market excesses before ever turning the countercyclical buffer on, it seems unlikely, at least in the U.S. political environment, to ever be of much use.

3. Careful thought should be given to the question of whether the recent changes to the SLR—which have for the time being allowed both Treasury securities and reserves to be excluded from the denominator of the leverage ratio—will ultimately end up being temporary or permanent. Our view is that the exclusion for reserves should be, and is likely to be, semi-permanent. As long as the Fed continues to operate with a big balance sheet, it seems at cross-purposes to penalize banks for absorbing the reserves that this balance-sheet expansion creates. By contrast, we are more skeptical that the exclusion for Treasuries should last beyond the current period of market stress. First, as recent events have shown, longer-dated Treasuries are certainly not riskless in a mark-to-market sense. Second, and importantly, given that the SLR has been the binding capital requirement for many large BHCs, unless risk-based capital requirements are strengthened (which, while desirable in our view, seems unlikely for now) a permanent exclusion of Treasuries from the SLR denominator would allow for an overall reduction of capital in the banking system. This is an outcome that we believe would be counterproductive.

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Figure 1: U.S. bank capital ratios from 2006 to present. This figure shows the risk-based capital ratios of U.S. publicly traded BHCs from 2006Q1 to 2020Q1 using data from Form FR Y-9C. Specifically, we plot the Tier 1 capital ratio (the ratio of Tier 1 Capital to Risk-Weighted Assets) and the CET1 ratio (the ratio of Common Equity Tier 1 Capital to Risk-Weighted Assets). Prior to 2014Q1 (for Advanced Approaches BHCs) or 2015Q1 (for all other BHCs) when Common Equity Tier 1 Capital is first reported on the FR Y-9C, we constructed a proxy for Common Equity Tier 1 Capital (sometimes referred to as Tier 1 Common Equity) by taking the appropriate deductions from each BHC's reported Tier 1 Capital.
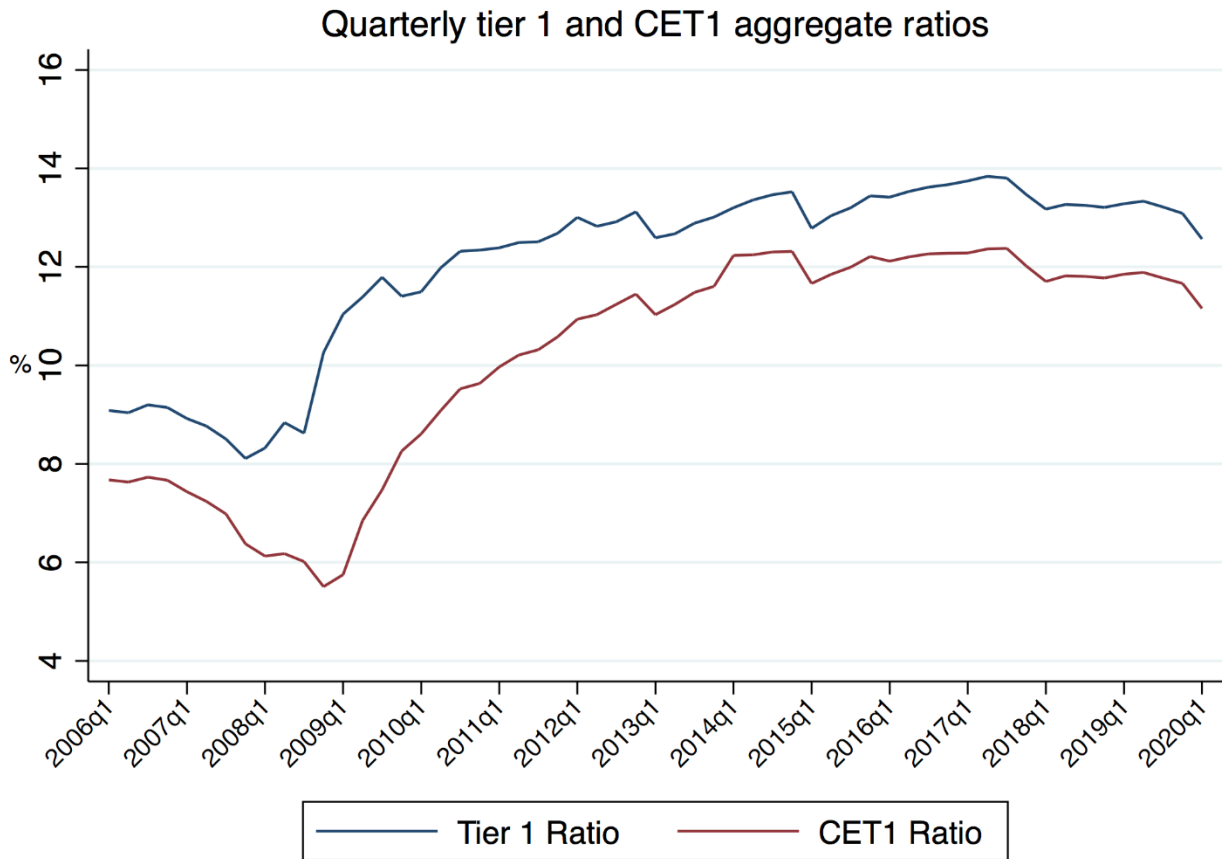

Quarterly tier 1 and CET1 aggregate ratios

Figure 2: Bank stock prices and capital actions during the Global Financial Crisis and the COVID-19 Crisis. This figure shows the path of U.S. BHC stock prices during the Global Financial Crisis (GFC) and the current COVID-19 crisis. Alongside the path of bank stock prices, we plot the path of quarterly capital actions by publicly traded U.S. BHCs. We proxy for bank stock prices using the KBW Bank Index, a capitalization-weighted index of 24 stocks that is designed to track the performance of U.S. money center and regional banking firms. (The index does not include traditional brokerage firms like Goldman Sachs and Morgan Stanley that are now organized as BHCs.) We normalize the level of bank stocks to their pre-crisis peak in both episodes. The pre-GFC peak occurred in late-February 2007 and the pre-COVID peak occurred in early January 2020. (Technically, the pre-COVID peak is a local peak since the KBW Bank Stock index has never overtaken its pre-GFC global peak). For the GFC, we show the path of bank stock prices from the beginning of 2006 through the end of 2009. For the current crisis, we show the path of stock prices from the beginning of 2019 through present. Using data from Form FR Y-9C, the figure also shows the path of quarterly capital actions by all publicly traded U.S. BHCs. Each quarter we show quarterly payouts to common shareholders (broken into dividends and share repurchases) as a fraction of quarter-end risk-weighted assets as well as capital stock issuance (broken into preferred and common stock), again as a fraction of risk-weighted assets. In the GFC plot, the aggregate payout and issuance numbers exclude Goldman Sachs and Morgan Stanley, which became BHCs in 2008Q3; this is to prevent the entry of these entities into the FR Y-9C data from inducing series breaks.
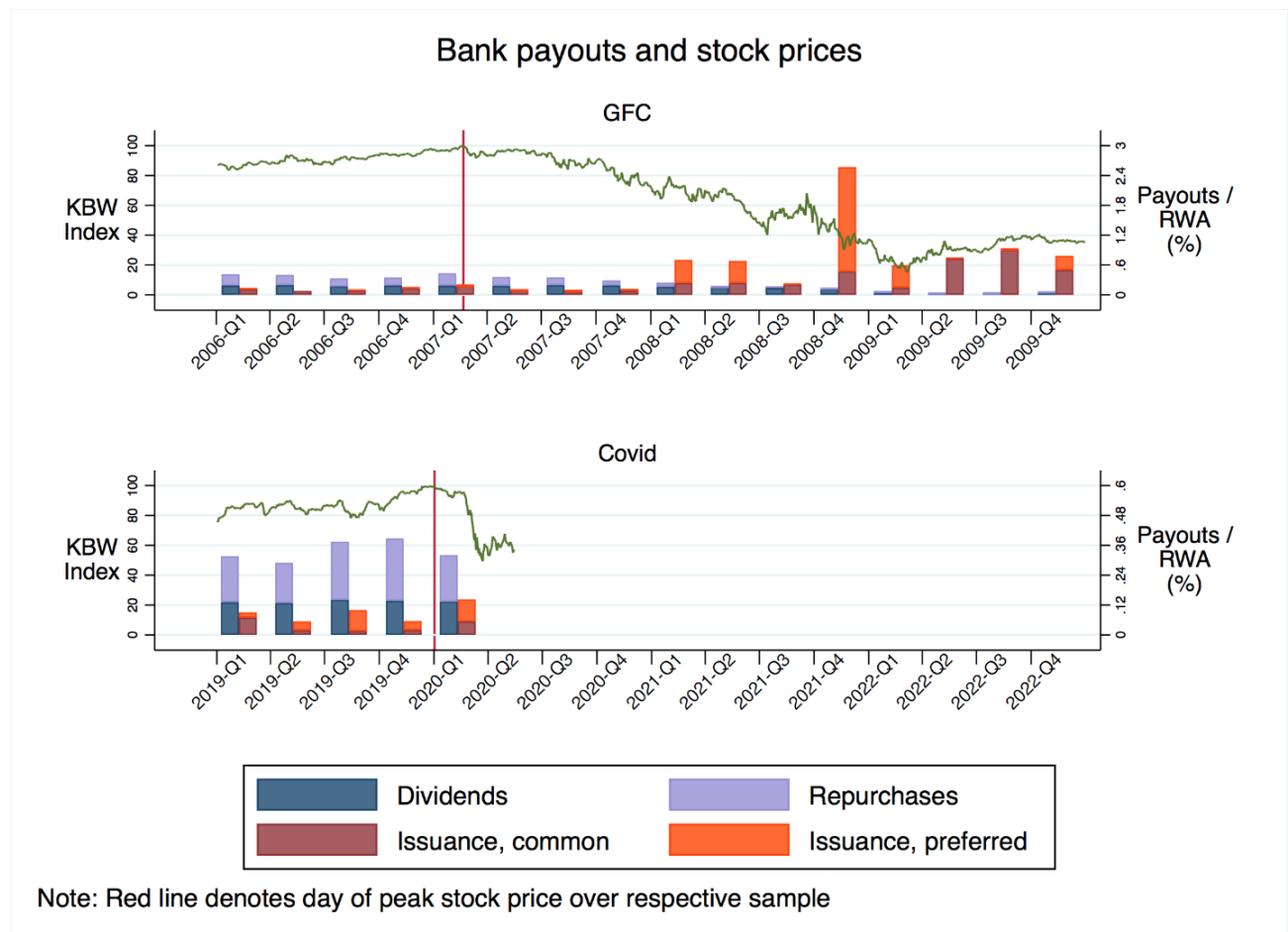
Figure 3: Evolution of CET1 ratios during the GFC and before the COVID-19 crisis. This figure shows the path of U.S. BHC CET1 ratios during the Global Financial Crisis (GFC) and before the current COVID-19 crisis as well as cumulative impact of BHC earnings and capital actions beginning in 2007:Q1 for the GFC and in 2019:Q1 for the COVID-19 crisis. Specifically, for publicly traded US BHCs, we show cumulative earnings, cumulative payouts to common shareholders (dividends and repurchases), and cumulative issuance of common equity, all beginning in 2007Q1 for the GFC (or 2019Q1 leading up the COVID-19 crisis) and as a fraction of quarter-end risk-weighted assets (RWA). For the COVID-19 crisis, we track the cumulative impact of earnings and capital actions beginning in 2019Q1—well before the global COVID-19 pandemic and economic crisis began in 2020Q1—to illustrate the evolution of bank capital ratios in "normal times." Specifically, in normal times, there is almost zero common equity issuance by banks and capital ratios are nearly constant since total payouts to common shareholders (dividends plus repurchases) are very close to the level of earnings—i.e., banks' "payout" ratios are near 100% in steady-state, normal times. In the GFC plot, the CET1 and components numbers exclude Goldman Sachs and Morgan Stanley, which became BHCs in 2008Q3; this is to prevent the entry of these entities into the FR Y-9C data from inducing series breaks.
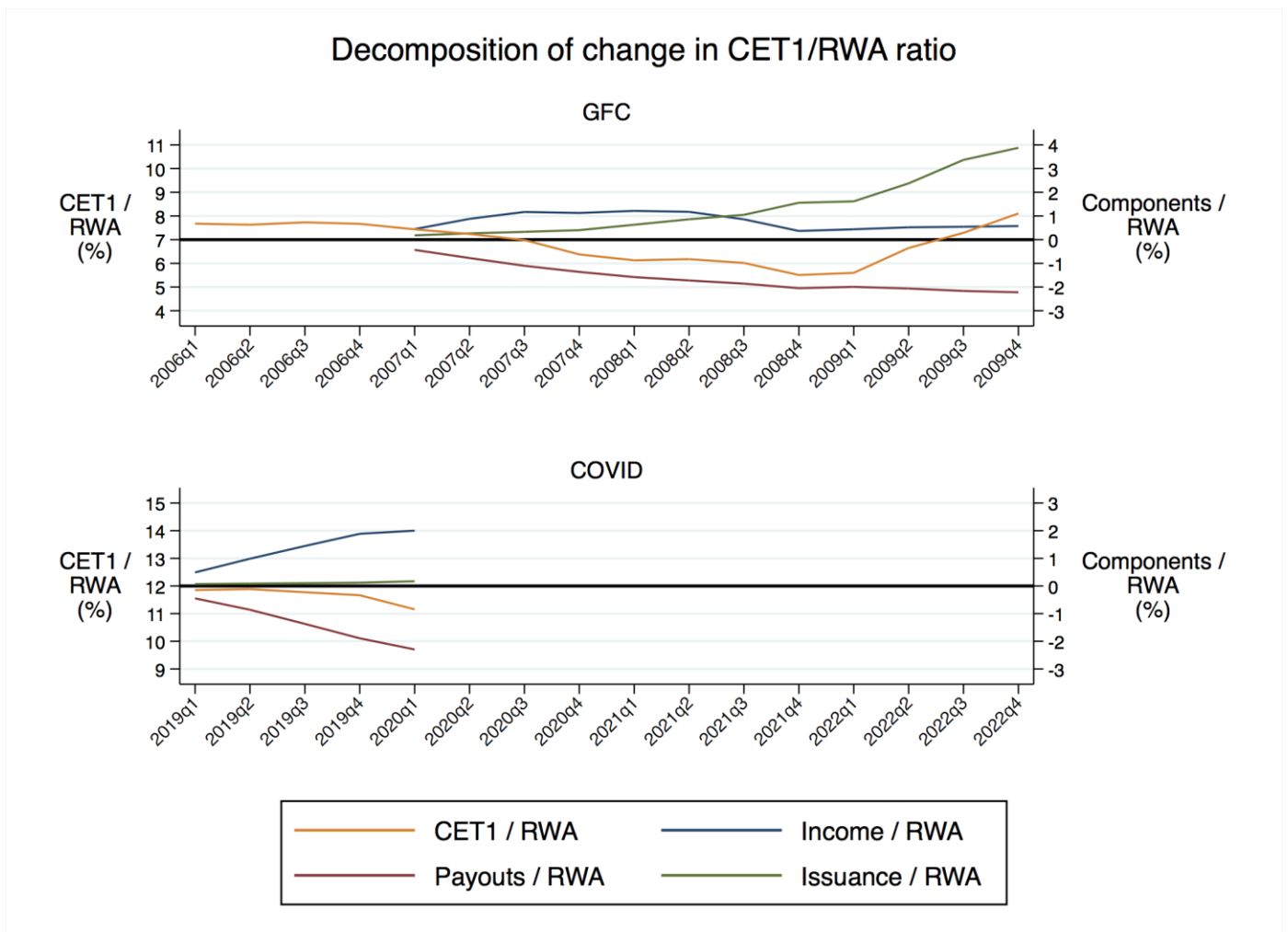

Decomposition of change in CET1/RWA ratio

Figure 4: Post-Lehman loan loss provisions versus pre-Lehman stock price decline in the GFC. This figure shows bin scatter plots of U.S. public BHCs' post-Lehman loan loss provisions versus their pre-Lehman decline in share prices and CET1 ratios. Specifically, we plot the sum of 2008Q4 to 2009Q4 loan loss provision as a percent of 2008Q3 loans versus each BHC's stock percentage decline from 12/31/2006 to 9/13/2008 (the Friday before Lehman Brothers' failure) and the change in each BHC's CET1 ratio from 2006Q4 to 2008Q2 . Only U.S. public BHCs that file a FR Y-9C for each quarter in 2008Q3-2009Q4 are included, so that each observation has provisions data over the full post-Lehman time period. For the stock price plot, the corresponding regression coefficient is $\beta = -0.04$, implying that a 1 standard deviation larger percentage point decline (38 percentage points) in a BHC's stock price change before Lehman's bankruptcy was associated with a 1.50 percentage point higher provisioning ratio over the following five quarters (around 0.6 standard deviation). The regression has an adjusted R^2 of 24%. For the CET1 plot, the corresponding regression coefficient is $\beta = -0.28$, implying that a 1 standard deviation larger percentage point decline (2 percentage points) in a BHC's CET1 ratio before Lehman's bankruptcy was associated with a 0.56 percentage point higher provisioning ratio over the following five quarters (around 0.22 standard deviation). The regression has an adjusted R^2 of 5%.

Crisis provisions vs. pre-Lehman indicators

Stock prices

(Post-Lehman Provisions) = 1.49 - 0.04*(Pre-Lehman %-change in stock price)

R2 = 0.24

CET1 ratio

(Post-Lehman Provisions) = 2.54 - 0.28*(Pre-Lehman change in CET1 ratio)
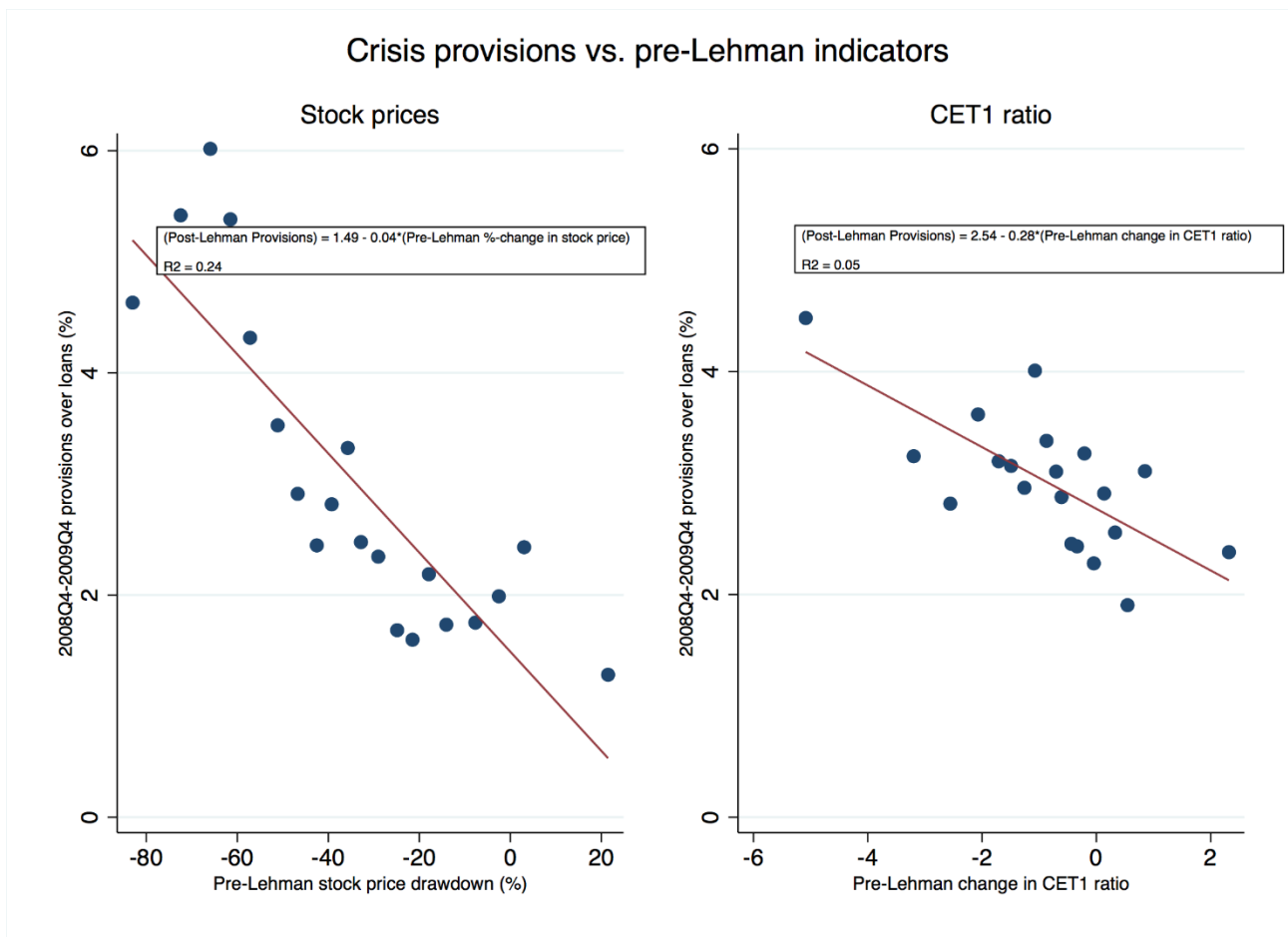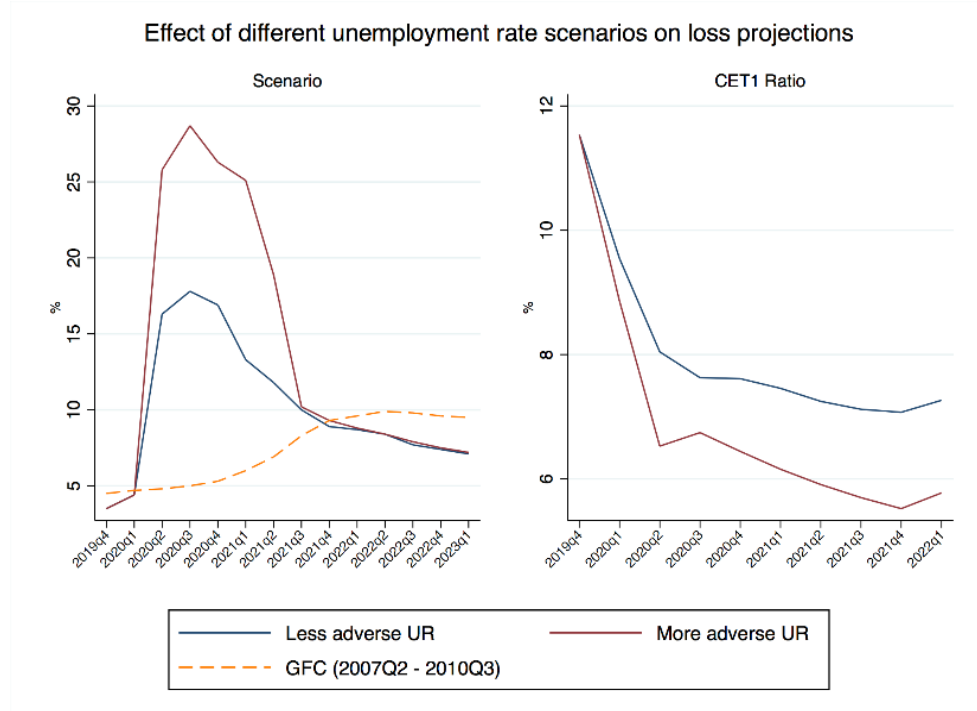
R2 = 0.05

Figure 5: Impact of COVID-19 macroeconomic scenarios in CET1 Ratios for U.S. BHCs.
These figure shows CLASS-model derived estimates of the impact of macroeconomic scenarios on CET1
Ratios for the 21 U.S. BHCs in the 2020 CCAR. For all graphs but that in (4), we show in the CET1 Ratio
panel the path of the aggregate CET1 ratio when varying the severity of the scenario for the given
macroeconomic variable scenario, setting the scenario the other two macroeconomic variables at their
medium severities. See the text for details.

(1)

(2)

(3)

Effect of different commercial RE index scenarios on loss projections

Scenario

Index (2019Q4=100)

CET1 Ratio

%

— Less adverse CPPI — More adverse CPPI
- - - GFC (2007Q4 - 2011Q1)

(4)

Effect of scenario severity on CET1 ratio

%

— All less adverse — UR more adverse, HPI and CPPI less adverse
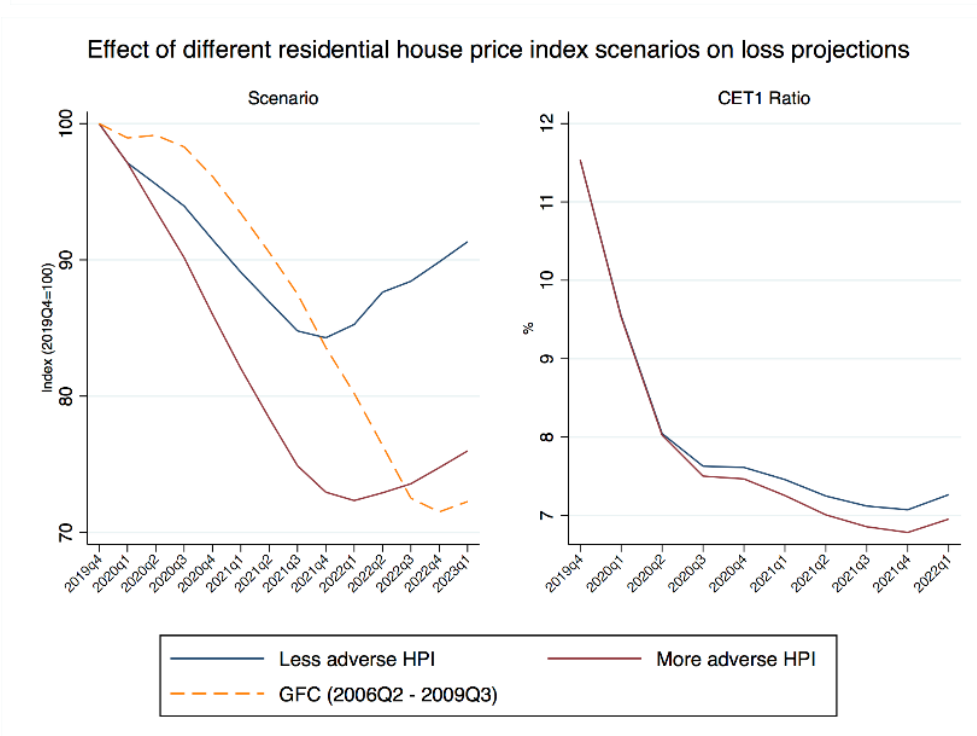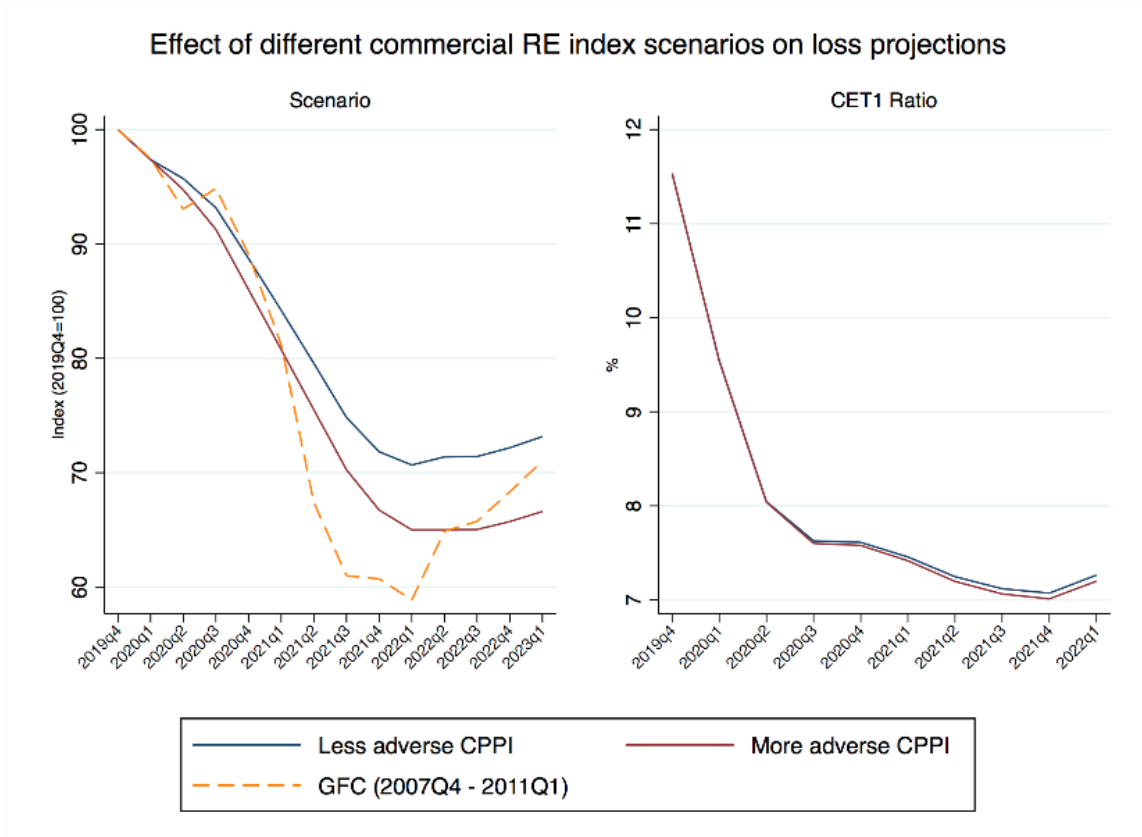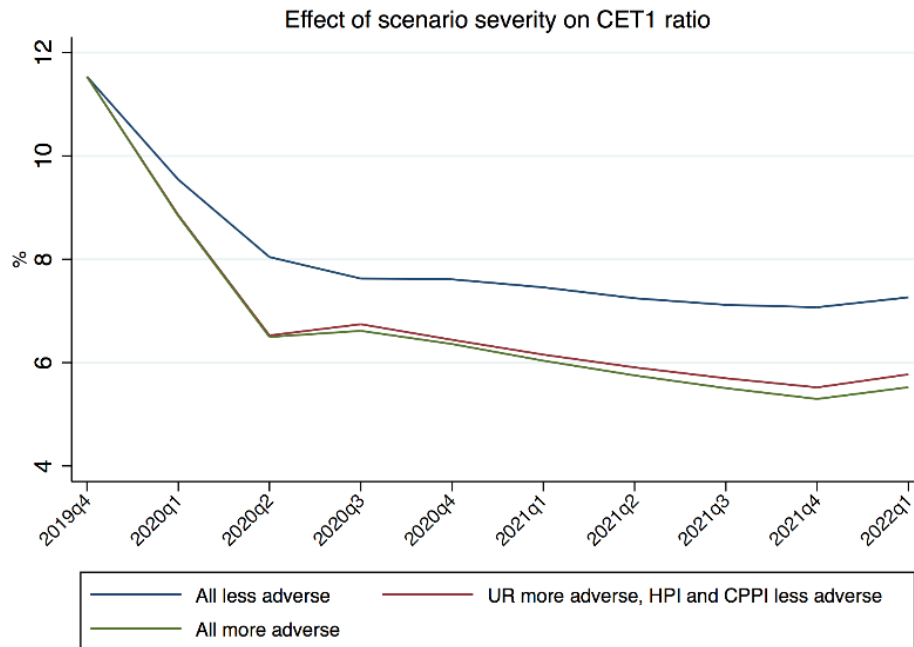— All more adverse

Figure 6: Impact of COVID-19 macroeconomic scenarios on loan charge-off ratios for U.S. BHCs. These figure shows CLASS-model derived estimates of the impact of macroeconomic scenarios on cumulative loan loss charge-offs at the 21 U.S. BHCs in the 2020 CCAR for residential real estate loans, commercial real estate loans, commercial and industrial (C&I) loans, and consumer loans. With the exception of C&I loans, these loan classes are an aggregate of multiple underlying loan categories for which the CLASS model separately forecasts charge-offs. For instance, consumer loans are broken down into credit card loans and other consumer loans. The numbers are scaled by the amount of 2019Q4 loan balances in the given category.
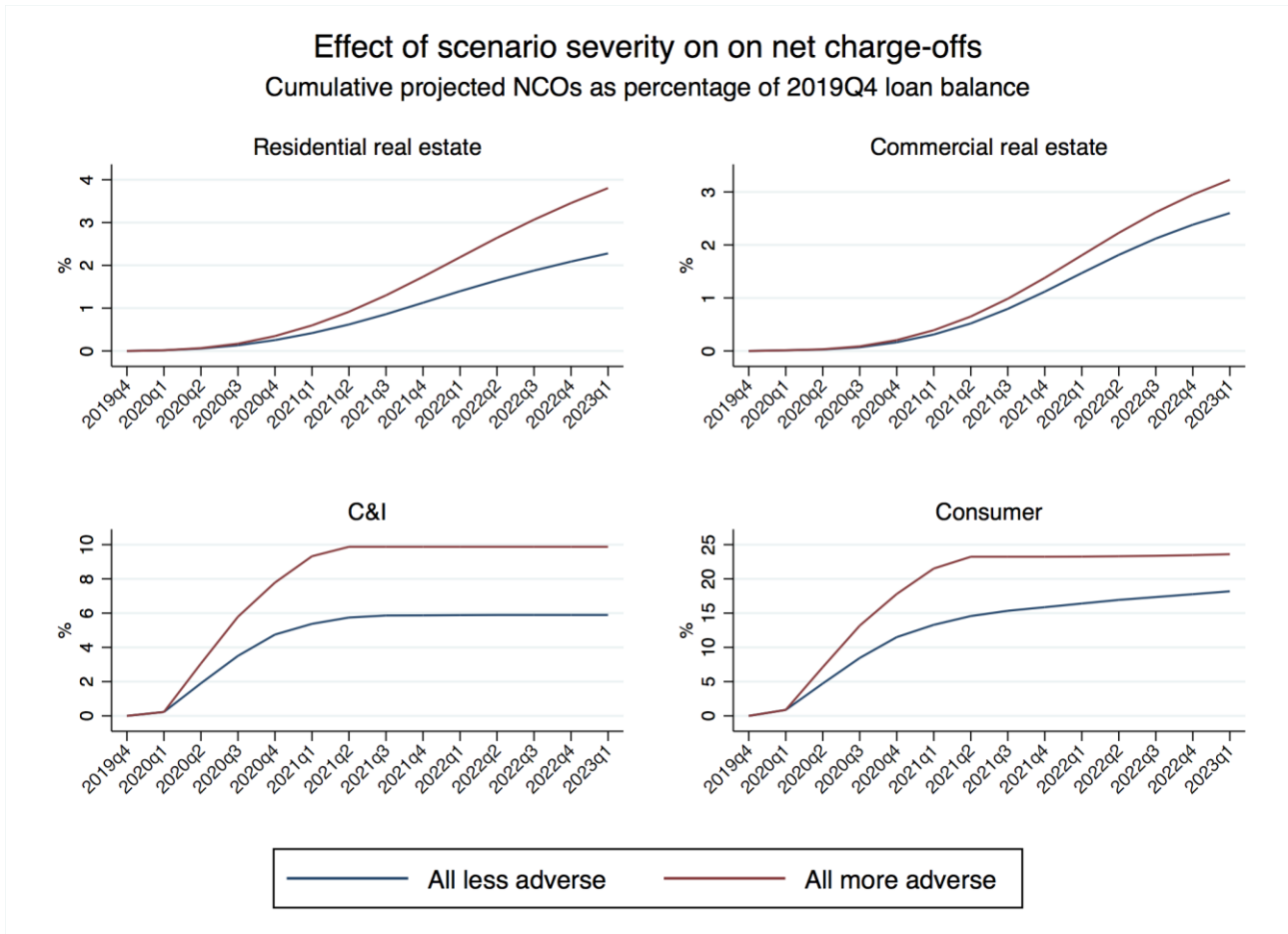
Table 1: Cross-sectional relationship between bank stock declines and balance sheet exposures during the Global Financial Crisis and the COVID-19 crisis. This table reports the results of cross-sectional regressions of a BHC's stock price decline during the early phase of each crisis episode on its pre-crisis balance sheet exposures. For the Global Financial Crisis, we measure each publicly traded U.S. BHC's stock price decline from 12/31/2006 to 9/13/2008 (the last trading day before Lehman Brother's failure) and we measure each BHC's pre-crisis balance sheet exposures using data from the 2006Q4 FR Y-9C. For the COVID-19 Crisis, we measure each publicly traded U.S. BHC's stock price decline from 12/31/2019 to 5/27/2020 and we measure each BHC's pre-crisis balance sheet exposures using data from the 2019Q4 FR Y-9C. Core deposits refer to the sum of domestic transaction and savings deposits.

	Global Financial Crisis % Stock Price Decline: 12/31/2006 to 9/13/2008	COVID-19 Crisis % Stock Price Decline: 12/31/2019 to 5/27/2020
	(1)	(2)
Residential Real Estate Loans / Assets	-0.296 (-1.56)	-0.298*** (-2.86)
Commercial Real Estate Loans / Assets	-1.263*** (-10.00)	-0.285*** (-4.21)
C&I Loans / Assets	-0.062 (-0.30)	-0.559*** (-4.74)
Consumer Loans / Assets	-0.385 (-1.25)	-0.362*** (-5.20)
Other Loans / Assets	-0.473 (-1.26)	-0.309* (-1.79)
Trading / Assets	-1.411 (-1.54)	0.039 (0.22)
Core Deposits / Assets	0.269 (1.50)	0.037 (0.63)
Equity / Assets	0.003 (0.01)	0.151 (0.66)
ln (Assets)	-0.021* (-1.82)	-0.008 (-1.09)
Constant	44.860** (2.15)	3.673 (0.28)
Observations	338	213
Adjusted R^2	34.9%	17.1%

Table 2: Movements in financial market Prices during the COVID-19 crisis. This table shows the movements in relevant financial market prices during the COVID-19 crisis. For each market price, we report its maximum decline from its most recent peak, its current value of May 25, 2020, and the percentage rally from the bottom. The maximum and current drop from peak are from each asset classes' most recent highwater mark. These highwater marks generally occurred in January or February 2020. However, for small-capitalization stocks, the maximum and current drop from peak are from 12/31/2019 since small stocks most recently peaked in August 2018. For all asset classes, the maximum drops occurred in mid- to late-March: specifically, the maximum drops occur between 3/18/2020 and 3/23 for U.S. equities, on 3/23 U.S. bank stocks, on 3/23 for leveraged loans, and on 3/25 for CMBS. For CMBS prices, we use a weighted average decline in the prices of the Markit Series 12 CMBS.NA.AAA, CMBS.NA.A, CMBS.NA.BBB-, and CMBS.NA.BB, where the weights are designed to reflect the capital structure of recent CMBS deals. All data is from Bloomberg.

	Maximum drop from peak	Current drop from peak	Current rally from bottom
U.S. Equity Prices			
Bank stocks (BKX Index)	50.8%	40.4%	21.0%
All stocks (Russell 3000 Index)	35.1%	13.4%	33.4%
Growth	32.0%	6.4%	37.5%
Value	39.0%	21.8%	28.2%
Large-cap stocks (Russell 1000 Index)	34.7%	12.9%	33.3%
Growth	31.5%	6.0%	37.3%
Value	38.6%	21.2%	28.3%
Small-cap stocks (Russell 2000 Index)	40.6%	18.8%	36.8%
Growth	37.5%	8.6%	46.2%
Value	44.6%	29.4%	27.5%
U.S. Credit Market Prices			
C&I: Leveraged Loans (S&P / LSTA)	21.7%	10.0%	14.9%
CRE: Weighted CMBS prices (Markit CMBX)	13.2%	9.0%	4.9%

Table 3: Impact of COVID-19 macroeconomic scenarios on aggregate U.S. BHC CET1 ratios.
Panel A decomposes the aggregate change in Common Equity Tier 1 (CET1) from 2019Q4 to 2022Q1 for the
21 U.S. BHCs in the 2020 CCAR if both unemployment and real estate prices follow the less adverse
scenario. Panel B illustrates the impact on different macroeconomic scenarios for the unemployment rate
and real estate prices (residential and commercial) on the aggregate CET1 ratio for the 21 U.S. BHCs in the
2020 CCAR. For each scenario, we report the dollar decline in aggregate BHC CET1 from 2019Q4 to
2022Q1, the aggregate CET1 ratio in 2022Q1, and the minimum aggregate CET1 ratio between 2020Q1 and
2022Q1. In the less/more adverse real estate price drop severity scenario the scenarios for both residential
and commercial real estate prices being set to their less/more adverse severities. See the text for further
details.

Panel A: Aggregate CET1 in the less adverse scenario for both unemployment and real estate

	$ billions	% of RWA
Starting CET1 (2019Q4)	**1050.4**	**11.54%**
+ Net income before taxes =	-319.8	-3.51%
+ Pre-provision net revenue =	242.5	2.66%
+ *Net interest income*	*674.4*	*7.41%*
+ *Noninterest income*	*623.0*	*6.84%*
− *Noninterest expense*	*1054.9*	*11.59%*
+ Realized gains/losses on securities (AFS/HTM)	4.6	0.05%
− Provisions	374.1	4.11%
− Trading and counterparty losses (AFS/HTM)	80.0	0.88%
− Operational risk losses	112.9	1.24%
− Taxes	13.1	0.14%
− Dividends	57.9	0.64%
+ Other items	1.9	0.02%
= Ending CET1 (2022Q1)	**661.4**	**7.26%**

Panel B: Impact of different macroeconomic scenarios on U.S. BHC aggregate CET1 ratios

Unemployment Rate Severity	CLASS Model Outcome in Macroeconomic Scenario	Real Estate Price Drop Severity	
		Less adverse	More adverse
	Change in CET1, 2019Q4 to 2022Q1 ($b)	-389.0	-423.3
Less adverse	Aggregate CET1 ratio, 2022Q1 (%)	7.26%	6.89%
	Aggregate CET1 ratio, minimum until 2022Q1	7.07%	6.72%
	Change in CET1, 2019Q4 to 2022Q1 ($b)	-524.6	-547.4
More adverse	Aggregate CET1 ratio, 2022Q1 (%)	5.77%	5.52%
	Aggregate CET1 ratio, minimum until 2022Q1	5.52%	5.30%

Table 4: Impact of COVID-19 macroeconomic scenarios on U.S. BHC CET1 requirement violations. This table illustrates the impact of different macroeconomic scenarios for the unemployment rate and real estate prices on CET1 ratio requirement violations. For all of the 21 U.S. BHCs in the 2020 CCAR, we report the average CET1 ratio in 2022Q1, the average minimum CET1 ratio between 2020Q1 and 2022Q1, and the fraction of BHCs whose CET1 ratios falls below the required minimum (4.5% plus any applicable GSIB surcharges). We then report these same figures for the set of eight U.S. GSIBs. See the text for further details.

Unemployment Rate Severity	CLASS Model Outcome in Macroeconomic Scenario	Real Estate Price Drop Severity	
		Less adverse	More adverse
Less adverse	Average CET1 ratio, 2022Q1 (%)	7.88%	7.55%
	Average min. CET1 ratio (%)	7.19%	6.90%
	BHCs with CET1 violation, by count (%)	28.6%	28.6%
	BHCs with CET1 violation, by assets (%)	60.1%	60.1%
	Average GSIB CET1 ratio, 2022Q1 (%)	8.23%	7.98%
	Average GSIB min. CET1 ratio (%)	7.82%	7.60%
	GSIBs with CET1 violation, by count (%)	50.0%	50.0%
	GSIBs with CET1 violation, by assets (%)	70.6%	70.6%
More adverse	Average CET1 ratio, 2022Q1 (%)	6.20%	5.95%
	Average min. CET1 ratio (%)	5.47%	5.25%
	BHCs with CET1 violation, by count (%)	42.9%	47.6%
	BHCs with CET1 violation, by assets (%)	76.1%	78.1%
	Average GSIB CET1 ratio, 2022Q1 (%)	7.21%	7.05%
	Average GSIB min. CET1 ratio (%)	6.83%	6.69%
	GSIBs with CET1 violation, by count (%)	62.5%	62.5%
	GSIBs with CET1 violation, by assets (%)	87.3%	87.3%

Appendix A: A Simple Model of Bank Capital Regulation

In this Appendix, we outline the simple model of bank capital regulation from Greenwood et al 2017. We use the model to formalize the following argument: *A regulatory framework that relies on minimum risk-based capital is appropriate in normal times, but is inadequate in the wake of a large adverse shock to the banking system. Following such a shock, it is critical to emphasize dynamic resilience: regulation needs to both (i) focus on getting banks to raise new dollars of equity capital while also (ii) relaxing marginal capital charges to support the flow of new bank credit.* To make this argument, we first sketch how the model works in the steady state: in normal times the flow costs of raising new equity play no role. We then explain how the model works once the banking system has been hit with a large adverse shock: here the flow costs of raising equity play a central role.

A.1 Capital Regulation in Normal Times

The "normal times" or "steady-state" version of the model makes five assumptions. Taken together, these assumptions deliver the result that the first-best outcome in the steady state can be implemented by a single constraint on equity as a fraction of risk-weighted assets.

1. Banks make loans of varying riskiness that create positive but diminishing returns for society. The lending market is frictionless, so banks fully internalize the social benefits from lending.

2. Bank failures are costly for society. However, banks do not fully internalize the costs of their own failures due to fire-sale and credit-crunch externalities (Hanson, Kashyap and Stein [2011]). The probability of bank failure is increasing in risky lending and decreasing in bank equity and is assumed to depend solely on the ratio of bank equity to a risk-weighted linear combination of bank assets as in Gordy (2003).

3. The *ex-ante* riskiness of any loan type can be observed by regulators.

4. There is a social cost associated with *having* more bank equity capital—i.e., the Modigliani–Miller (1958) capital structure irrelevance principle fails for banks. When modeling deviations from the MM benchmark, it is important to distinguish between stock and flow costs of equity or, equivalently, between balance sheet and new issuance costs of equity. Stock costs are factors that make equity capital more expensive on an ongoing basis even if it is accumulated over time via retained earnings. Flow costs are associated with the process of raising new external equity and correspond to a notion that practitioners sometimes refer to as "dilution."

    In the steady-state version of the model, the only cost of equity we incorporate is one that depends on the stock of equity capital and that does not depend on flow considerations. One way to think of the stock costs of equity is that requiring banks to finance themselves with more equity and less debt entails forgoing some of the valuable "monetary services" that businesses and households enjoy when they hold bank deposits and other forms of safe, short-term bank debt.[25] We assume the private stock costs that banks perceive when they finance themselves with more

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25. See Gorton and Metrick (2012); Stein (2012); Krishnamurthy and Vissing-Jorgensen (2012, 2016); Greenwood, Hanson, and Stein (2015); and Sunderam (2015).

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equity equal these social costs.[26] Thus, the steady-state version of the model speaks to the situation where the dollar value of bank equity has gravitated to its long-run, first-best level, so we can ignore the flow costs associated with raising external equity.

5. All banks have identical lending opportunities and impose the same social cost of failure, so we can consider the case of a single representative bank. Greenwood et al. 2017 allow for heterogeneity across banks in lending opportunities and in the social costs of failure, which naturally leads to a G-SIB surcharge for risk-based capital ratios.

Formally, our assumptions correspond to the following objective functions. Social welfare is:

$$W = \sum_{i=1}^{N} f_i(A_i) - c(E) - X\pi(k), \quad (A1)$$

where $f_i(A_i)$ represents the risk-adjusted net return to loans in category i, with $f(\cdot)$ being an increasing, concave function; $c(E)$ is the social cost of bank equity capital E, with $c(\cdot)$ being an increasing, convex function; X is the social cost of a bank failure; and $\pi(k)$ is the probability of such a failure, where $k \equiv E/(\sum_{i=1}^{N} w_i A_i)$, w_i represents the risk contribution of loans in category i, and $\pi(\cdot)$ is a decreasing, convex function. The bank's private profit-seeking objective is to maximize:

$$B = \sum_{i=1}^{N} f_i(A_i) - c(E) - (1 - \phi)X\pi(k). \quad (A2)$$

The only divergence between the private and social objectives is that, due to fire-sale and credit-crunch externalities, banks do not internalize fraction ϕ of the costs their failures impose on society. As a result, the unregulated outcome features excessive bank risk-taking and insufficient bank equity capital, leading to a probability of a banking crisis that is excessive from society's point of view. The goal of capital regulation—a goal that is macro-prudential in nature—is to force banks to internalize these financial stability externalities. In this setting, we can establish the following proposition.

Proposition 1. *A regulator can implement the first-best outcome—i.e., can maximize the social welfare function W—in a decentralized fashion by imposing a single risk-based capital rule of the form $E \geq k^* \times \sum_{i=1}^{N} w_i A_i$. This rule mandates a risk-based capital ratio of k^*, which is associated with a nonzero failure probability of $\pi(k^*)$, and a set of risk weights for loans in each category that are equal to their risk contributions, w_i. With this risk-based rule in place, the bank is free to choose its level of equity E and level of lending in each category A_i so long as it complies with the rule. The optimal level of risk-based capital ratios k^* is higher when the social cost of bank failure X is higher, the cost of having more bank equity is lower, and when the social returns to risky lending are lower.*

Proposition 1 speaks to the adequacy of system of risk-based capital requirements in normal times. The optimal level of capital ratios hinges on the same trade-off identified in prior research: the financial stability benefits of higher capital requirements versus their cost in terms of more limited credit

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26. This means that we are ignoring the tax deductibility of interest, which makes the private stock cost to banks of relying on equity higher than the social costs. We make this assumption not for realism, but to provide a benchmark. When private costs of equity finance equal social costs, a familiar looking form of risk-based capital regulation can implement the first-best outcome in steady state. If we allow private costs of equity finance to exceed social costs, the regulator needs another tool, namely, the ability to control the dollar value of equity in the banking system.

availability in normal times. These findings are unsurprising because the model was designed to deliver them.

A.2 Dynamic Resilience Following an Adverse Shock

We now ask how bank capital regulation should be designed away from the steady state when a negative shock reduces bank equity well below the first-best level. Now the flow costs of raising new outside equity capital take center stage.

Concretely, we assume that a shock has lowered bank equity at time 0 to E_0, which is below the first-best value of E^* given in Proposition 1. We further assume that banks will have worked their way out of this capital shortfall by time 2—say, by retaining sufficient earnings—and the economy will return to the first-best steady state. As a result, the social planner's only dynamic problem lies in deciding what should happen at time 1—that is, deciding on the transition path back to the steady state.

Thus, at time 1, the planner is faced with the following social welfare function:

$$W_1 = \sum_{i=1}^{N} f_i(A_{i1}) - c(E_1) - \lambda(E_1 - E_0) - X\pi(k_1), \qquad \text{(A3)}$$

where $k_1 \equiv E_1/(\sum_{i=1}^{N} w_i A_{i1})$. This looks similar to the welfare function in the steady-state case, with the addition of one term, $\lambda(E_1 - E_0)$, where $\lambda(\,\cdot\,)$ is an increasing, convex function that captures the flow cost of adjusting equity upward from E_0 to E_1 between time 0 and 1. The planner now faces a new tension: If the goal is to get lending moving back toward its first-best level, without tolerating an increased probability of failure at time 1, this will involve bearing some flow costs of external finance.

Similarly, the bank's objective function is now to maximize:

$$B_1 = \sum_{i=1}^{N} f_i(A_{i1}) - c(E_1) - (1 + \theta)\lambda(E_1 - E_0) - (1 - \phi)X\pi(k_1). \qquad \text{(A4)}$$

Now there are two sources of divergence between the bank and the planner. First, as before, the bank under-internalizes the social costs of failure; this is captured in the $(1 - \phi)$ term in its objective function. Second, the bank now also views the flow costs of raising new external finance to be higher than the planner; this is reflected in the assumption that $\theta > 0$. This latter wedge can be thought of as rooted in external financing frictions due to debt overhang (Myers [1977]) or asymmetric information (Myers and Majluf [1984]). These frictions make new equity issues costly from the private perspective of existing bank shareholders. However, because they simply involve transfers between existing shareholders and creditors (in the case of debt overhang) or transfers between existing and new shareholders (in the case of asymmetric information), they do not represent a social cost. With these assumptions in place, we can establish the following proposition:

Proposition 2. *Optimal capital regulation in the wake of a large adverse shock to the banking system can be characterized as follows: (i) The cross-sectional risk weights, w_i, are unchanged from the steady-state; (ii) there is temporary "capital ratio relief": the required capital ratio at time 1, k_1^*, is set at a lower value than the steady-state optimum of k^*, implying a higher probability of failure, $\pi(k_1^*)$; and (iii) banks must be forced to raise new external equity at time 1: the regulator requires banks to have equity of E_1^*, which is higher (and thus closer to the long-run, steady-state optimum E^*) than would be chosen by the bank if it only facing a ratio-based capital requirement. In other words, to implement the*

first-best outcome following a large adverse shock, the regulator must requires banks to have equity equal to $E_1^* \in [E_0, E^*]$ and then allows banks to choose loan amounts A_{i1} subject to a risk-based capital rule of the form $E_1^* \geq k_1^* \times \sum_{i=1}^{N} w_i A_{i1}$.

Thus, the appropriate response to an adverse shock is twofold; banks should be temporarily allowed to operate at lower capital *ratios* than in normal times, but at the same time they should be compelled to raise new *dollars* of external equity finance. The intuition for the first piece is most easily seen by considering the extreme case where the social flow costs of raising finance are infinite. In this case, bank equity is fixed at a level lower than the first-best one, and the planner faces the following trade-off: Keep the same capital ratio requirement as before, in which case bank lending will be cut below the first-best level, or reduce the capital ratio requirement and accept a higher probability of bank failure. Optimality involves adjustment on both margins; hence, the motive for capital ratio relief.

The logic for compelling new equity issuance comes through most clearly when the social flow costs of raising external equity are small but the private flow costs of raising equity are large, that is, when $\lambda(\cdot) \approx 0$ and $\theta \gg 0$. Here, a bank left to its own devices would be inclined to cut lending sharply to comply with a given capital ratio requirement, because this allows it to avoid having to raise new equity. However, the planner, who does not care nearly as much about the flow costs of raising equity, wants the bank maintain its lending and, therefore, must compel the bank to issue equity.

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