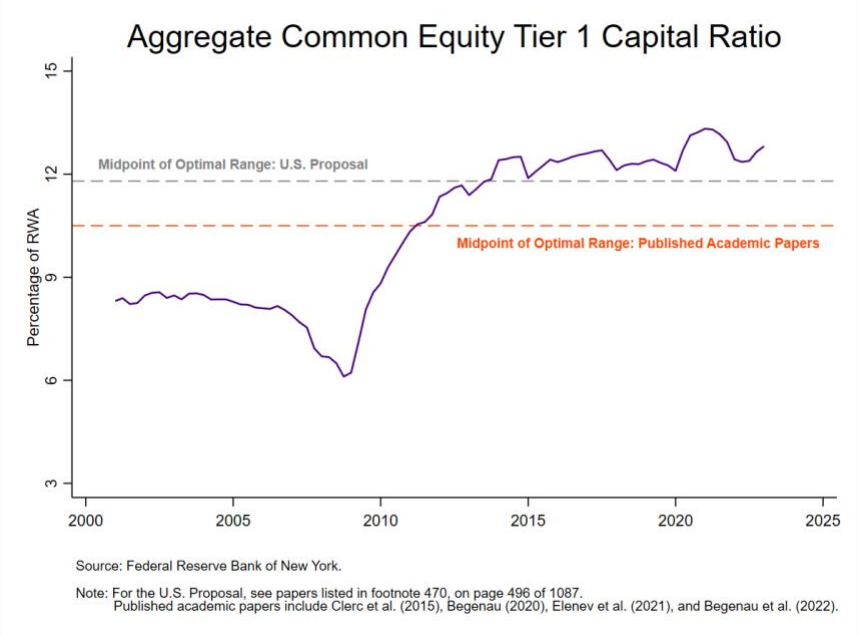
U.S. Bank Capital Levels: Aligning With or Exceeding Midpoint Estimates of Optimal

Francisco Covas & Bill Nelson | Sept. 18, 2023

The recently released proposal by the Fed OCC, and FDIC would substantially revise the capital requirements for large banks in ways that would result in significant increases in those requirements. As a partial justification for this change, the agencies stated that "current capital requirements in the United States are toward the low end of the range of optimal capital levels described in the existing literature."[1] Although this statement is frequently repeated, it is false.

Current bank capital levels actually fall in the middle of the range of optimal estimates cited by the banking agencies and are even closer to the upper end of recent academic estimates. As of the end of the second quarter of 2023, the ratio of common equity tier 1 capital to risk-weighted assets (or "CET1 capital ratio"), the best regulatory measure of loss-absorbing capacity on a going-concern basis, stood at 12.8 percent for all U.S. bank holding companies and for the largest ones as well.[2] The banking agencies cite a range of optimal estimates between 6 and 17.5 percent, with a midpoint of 11.8 percent. Moreover, recent academic papers provide estimates that range from 6 to 14.5 percent, with a midpoint of 10.3 percent.



[1] https://www.federalreserve.gov/aboutthefed/boardmeetings/frn-basel-iii-20230727.pdf, p. 496.
[2] The data on banks' common equity tier 1 capital ratios is available at: https://www.newyorkfed.org/research/banking_research/quarterly_trends

In this note, we first present some background information and then discuss the estimates of optimal levels of capital that the banking agencies cited in their request for comment. We then delve into greater detail regarding the two types of estimates. The older literature identifies the optimal level of bank capital as the level at which the net public benefit is maximized. In this context, the benefit of higher capital is a reduced probability of financial crises; the cost is more expensive bank credit, which in turn leads to a lower level of GDP.

More recent academic literature determines the optimal level of capital using quantitative macroeconomic models, calibrated to match various data features, both in terms of macroeconomic quantities and prices. In these models, the optimal level of bank capital is the one that maximizes lifetime consumption for households in the economy. The primary benefit of higher bank capital is a reduced probability of bank failure and attendant reduction in GDP from bankruptcy costs. However, the main cost is a smaller banking sector, resulting in decreased business borrowing and investment, along with a decline in GDP.

A key question we aim to answer in this post concerns the credibility and reliability of estimates from existing literature. Our analysis indicates that recent academic papers deserve more attention from policymakers, as they have undergone rigorous peer review and have been published in top academic journals. These papers also employ more stringent calibration methods, thereby reducing the authors' ability to arbitrarily adjust underlying assumptions to achieve estimates that match the researchers' priors about the optimal level of capital. By contrast, quantitative macroeconomic models subject to peer review must match many features of the data.

But one limitation of the academic literature is that these models often omit important specifics, such as variations in types of regulatory capital or the impact of post-crisis reforms. For example, they may not account for new liquidity and long-term debt requirements when estimating optimal levels of regulatory capital. This drawback would lead to an overestimation of the optimal capital levels, all else being equal.

Background

As we noted, the older literature on optimal level of bank capital estimates both the public benefit and the public cost of capital, identifying the optimal level where net social benefit is maximized—that is, where marginal social benefit from increasing capital equals marginal social cost. The public benefit of increasing bank capital is estimated as the reduction in the probability of a financial crisis multiplied by the present value of the GDP cost of such a crisis. The public cost of increasing capital is calculated as the increased cost of bank business loans and the consequent reduction in GDP.

Typically, in the older literature, the estimated net public benefit functions plateau at the maximum.[3] As a result, these estimates are imprecise—because the net benefit does not change significantly with material changes in the amount of capital at the estimated optimum, there is considerable uncertainty about where the exact optimum level is. Researchers rarely provide confidence intervals—the range within which they are confident the true estimate lies—but these ranges are unquestionably wide.

The estimates of optimal capital are also highly sensitive to underlying assumptions. For example, economists at the Sveriges Riksbank conclude that the optimum CET1 capital ratio for large Swedish banks lies between 25 and 60 percent, also depending on assumptions (Almenberg et al (2017)). In most other branches of economic analysis, the main result's *insensitivity* to assumptions is cited as evidence of that result's robustness. If an estimate varies widely across reasonable assumptions, it is evidence that the correct answer is not known with any confidence.

[3] See, for example, graph 4, "Long-run expected annual net benefits of increases in capital and liquidity," Basel Committee on Banking Supervision (2010), p. 30.

However, in papers on the estimates of optimal capital, authors cite the range of estimates under different assumptions as an indication of the range within which the true optimum likely resides.

We can't emphasize enough that the ranges cited in the literature are not confidence intervals; rather, they are illustrations showing how estimates change when various assumptions are altered. These illustrations reflect poorly on the precision of the analysis. Generally, those arguing that capital is at the low end of the optimal range cite high estimates that result from certain combination of assumptions, such as the Riksbank's estimate of a 60 percent optimal CET1 capital ratio. In an important departure from this practice, for each study we select either the baseline estimate of optimal capital or the midpoint of the range if a range is provided.

In addition, the unit of the capital ratio varies across studies. For example, the BCBS (2010) study finds that optimal capital is 13 percent. However, this estimate uses pre-Basel III units. After adjusting for Basel III's changes in the definition of capital and risk weights, subsequent BIS analysis by Fender and Lewrick (2016) concludes that 1 percent pre-Basel III equals 0.78 percent post-Basel III. Therefore, in current CET1 capital units, the BCBS study estimates optimal CET1 is 10.1 percent. As another example, the IMF (2016) study focuses on loss absorbency, so it is about total loss absorbency capacity (which includes loss-absorbing long-term debt) rather than capital.[4] So, while its estimate of a 15- to 23-percent requirement necessary to prevent most banking crises is above the average U.S. large bank capital level of 12.8 percent, when long-term debt is included, the largest U.S. banks currently maintain a total loss absorbing capacity ratio of 30 percent, which is well above the upper end of the estimated range.

Finally, there is often ambiguity about whether the estimates refer to the optimal amount of bank capital or the optimal capital requirement. Banks fund themselves with more capital than required because it is extremely costly to fall below requirements and because banks are subject to multiple requirements, all of which influence their capital choice because each could bind in the future with some probability. Since the empirical analyses underlying these estimates use actual capital, not required capital, the conclusions should be taken to be about actual capital.

ESTIMATES OF OPTIMAL CAPITAL IN STUDIES CITED BY U.S. BANKING AGENCIES

There are many estimates of the optimal level of bank capital. In the older literature, these estimates can vary widely when the assumptions are changed, precisely because the estimates themselves are imprecise. As noted, in each case, we either identify the baseline estimate or take the midpoint of a range if only a range is given. In the more recent literature, just one optimal level of capital requirements maximizes the welfare of households.

The banking agencies cite seven papers in a footnote to support their statement that bank capital is at the bottom of the optimal range. Among the large numbers of papers that estimate optimal levels of capital, the agencies select five that state that capital should be higher than the current level of U.S. capital requirements, and two that suggest that it should be lower. We will discuss each of these papers in turn.

Studies listed as finding that U.S. bank capital levels should be higher

The first paper that finds capital levels should be higher is Miles, Yang, and Marcheggiano (2013). They find that the ratio of tier 1 capital to risk-weighted assets should fall within a range of 16 to 20 percent, which has a midpoint of 18 percent. The average risk-based tier 1 capital ratio for U.S. banks is 14.1 percent and 14.5 percent for large banks. Thus, for all large banks, the average tier 1 ratio exceeds the CET1 capital ratio by 1.5 percentage points. Subtracting this difference from the study's estimate of optimal yields an optimal CET1 capital ratio of 16.5 percent.

[4] See, Dagher, Dell'Ariccia, Laeven, Ratnovski, and Tong (2016)

The second is an IMF working paper by Dagher, Dell'Ariccia, Laeven, Ratnovski, and Tong (2016). The authors find that total loss-absorbing capital should be in a 15- to 23-percent range, which has a midpoint of 19 percent. They conclude that the range is "consistent with the recent Federal Reserve's proposal of a total loss-absorbing capacity amount of the greater of 18 percent of risk-weighted assets and 9.5 percent of total leverage exposure for global systemically important banks (Board of Governors of the Federal Reserve System, 2015)." The TLAC ("total loss-absorbing capacity," which includes equity and long-term debt) of large U.S. bank holding companies is 30 percent of RWA. So the study, by its own admission, does not in fact conclude that U.S. bank capital levels should be higher.

The third paper, published in a St. Louis Fed publication by Firestone, Lorenc, and Ranish in 2019, argues that the optimal range for Tier 1 capital to risk-weighted assets is 13 to 25 percent, with a midpoint of 19 percent which maps to a CET1 ratio of 17.5 percent. This midpoint is 4.7 percentage points higher than the current bank capital level.

The fourth paper is by Begenau and Landvoigt, published in *The Review of Economic Studies* in 2022. The authors conclude that the optimal level of capital is 16 percent. In academic papers, the units of capital are often unclear. We assume that the paper refers to the risk-based tier 1 capital ratio, given that this is the capital ratio utilized in a closely related paper by Begenau (2020). To convert to a CET1 capital ratio, we reduce the estimate of optimal by 1.5 percentage points since that is the difference in tier 1 and CET1 minimum capital requirements. The optimal estimate is nearly 2 percentage points higher than current bank capital.

The fifth paper is a Federal Reserve staff paper by Van den Heuvel, published in 2022. The paper does not offer an estimate of optimal capital because it only estimates the costs, not the benefits, or raising capital requirements. Instead, it notes that the social benefit calculated in the BCBS (2010) study of increasing capital from 7 to 15 percent exceeds the social cost that the author calculates for the same range. However, these BCBS estimates are in pre-Basel III units, equivalent to raising CET1 capital from 5.5 to 11.7 percent. Consequently, the costs and benefits are not comparable so no optimal level can be inferred.

Studies listed as finding that U.S. bank capital levels should be lower

The first paper that finds capital should be lower is by the Basel Committee on Banking Supervision, published in 2010. This foundational paper, titled "An assessment of the long-term economic impact of stronger capital and liquidity requirements" is generally referred to as the LEI. In their baseline scenario, assuming liquidity requirements are met, they find that a 13 percent capital requirement maximizes net benefits. However, this estimate is based on pre-Basel III metrics. As noted, later research by BIS economists shows that 1 percentage point of CET1 ratio equates to 0.78 percent of this earlier metric, suggesting that welfare is optimized at a CET1 capital ratio of 10.1 percent.

The second paper that finds capital should be lower is by Elenev, Landvoigt, van Nieuwerburgh, published in *Econometrica* in 2021. The authors find that the welfare of households is maximized at a 6-percent equity requirement. The discussion is unclear on whether the requirement is set in terms of CET1 capital or tier 1 capital.

Elsewhere in the U.S. Basel proposal, the banking agencies reference other studies on optimal capital. An OECD Economics Department working paper by Slovik and Cournède, published in 2011, finds that their cost estimates for higher capital requirements align with those of BCBS (2010), which concluded that a 10.1 percent CET1 capital ratio is optimal. A 2015 Bank of England working paper by Brooke and colleagues suggests that the tier 1 capital ratio should range between 10 and 14 percent. Notably, U.S. banks currently have a tier 1 capital ratio of 14.1 percent, which exceeds the range estimated in this paper.

List of Optimal Capital Papers Covered in the Analysis

Paper	Type	Published in an Academic Journal?	Regulatory Capital Ratio	Midpoint/ Estimate (%)	Adj. to CET1 Capital Ratio
Panel A: Papers Cited in Footnote 470 in the U.S. Proposal that Report Optimal Capital in CET1 Capital or Tier 1 Capital terms					
BCBS (2010)	LEI	No	Tangible Common Equity*	13.0	10.1
Miles et al. (2013)	LEI	**Yes**	Tier 1 Capital Ratio	18.0	16.5
Firestone et al. (2019)	LEI	No	Tier 1 Capital Ratio	19.0	17.5
Begenau and Landvoigt (2022)	DSGE	**Yes**	Tier 1 Capital Ratio	16.0	14.5
Elenev et al. (2021)	DSGE	**Yes**	CET1 Capital Ratio**	6.0	6.0
Midpoint					**11.8**
Average					**12.9**
Panel B: Published Academic Papers Using Calibrated Macroeconomic Models					
Clerc et al. (2015)	DSGE	**Yes**	CET1 Capital Ratio	10.5	10.5
Begenau (2020)	DSGE	**Yes**	Tier 1 Capital Ratio	12.4	10.9
Elenev et al. (2021)	DSGE	**Yes**	CET1 Capital Ratio**	6.0	6.0
Begenau and Landvoigt (2022)	DSGE	**Yes**	Tier 1 Capital Ratio	16.0	14.5
Midpoint					**10.3**
Average					**10.5**
Panel C: Other Often Cited Papers					
Brooke et al. (2015)	LEI	No	Tier 1 Capital Ratio	12.0	10.5
Nguyen (2015)	DSGE	No	Tier 1 Capital Ratio	8.0	6.5

Notes: (*) The BCBS (2010) estimate is in terms of pre-Basel III definition of capital and risk weighted assets and has been multiplied by 0.78 to transform to CET1 capital as recommended by Fender and Lewrick (2016). (**) The paper is unclear about whether the requirement is set in terms of CET1 capital or Tier 1 Capital and assume the former. In our analysis, we discuss the results by assuming the optimal is set in terms of common equity tier 1 capital and reduce those set in Tier 1 capital terms by 1.5 p.p.

ESTIMATES OF OPTIMAL CAPITAL AKIN TO THE LEI

As we noted, many of the earlier estimates of the optimal amount of capital use the approach started by the LEI. In these studies, the benefit of higher capital is the reduction in the probability of a financial crisis, and the cost of higher capital is a reduced supply of bank credit. The cost and benefit are each expressed in terms of GDP. For benefit, the analyses incorporate estimates of the GDP lost as a result of a financial crisis. The estimated reduction in GDP—which occurs during and after a crisis—is expressed in present-value terms. The reduction in the

probability of a crisis each year is then combined with the present value of the lost GDP that would result from a financial crisis starting that year, to derive the benefit in terms of current GDP. For cost, the analyses estimate how much higher bank lending rates will be higher as a consequence of the higher capital requirement. Lending rates go up because capital is more expensive than deposits or other funding, but the rise is offset by a reduction in the cost of capital and debt owing to the reduced likelihood the bank will fail. The classic result derived by Modigliani and Miller (1958) is that in a world free of taxes and information asymmetries, the offset is complete, and the total financing cost of a firm is independent of its capital structure. Each study chooses a M-M offset that is some fraction below 1. The higher lending rate is then translated into a reduction in GDP using a standard large-scale model of the macroeconomy, such as the Fed's FRB-US model.

Researchers have to make several assumptions that have profound effects on the results. For one, the studies have to choose whether and how to adjust the analysis for other changes in bank regulations that have also occurred since the financial crises used as inputs to the analysis. For example, an impact study of the TLAC rule by the FSB in 2015 concluded that the rule reduced the probability of bank defaults by 30 percent and reduced the cost of the failures by 10 percent. Drawing in part on the FSB analysis, Firestone and colleagues (2019) estimate that liquidity and TLAC requirements have cut the annual probability of a crisis by about 30 percent (table 3 in Firestone et al., 2019). By way of comparison, that is a larger reduction in probability than the authors calculate results from an increase in the tier 1 ratio from 11 to 14 percent if the results are not adjusted for the other regulations.

Another critical assumption is which estimate of the cost of a crisis to use. Estimates vary widely, and the choice shifts the estimate of optimal capital by a large amount. The present value of the GDP cost depends materially on whether a financial crisis is assumed to result in a permanent reduction in GDP. For example, the LEI reports estimates using no permanent effects, using moderate permanent effects, and using large permanent effects. Under no permanent effect, the estimated GDP cost of a crisis is 19 percent of GDP; under moderate permanent effect, it is 63 percent; and under large permanent effect, it is 158 percent. With no permanent effect, if we take the benefit of liquidity regulations into account, the estimated optimal CET1 ratio for the banking system is 7 percent.[5] With moderate permanent effect (the LEI baseline assumption), the optimal CET1 ratio is 10.1 percent. With large permanent effect, the net benefits keep increasing for the range shown, although the range only goes up to 11.7 percent. As a reminder, the average CET1 capital ratio of U.S. bank holding companies (all banks and large banks) is currently 12.8 percent.

More broadly, these estimates of optimal capital based on the LEI framework have serious conceptual shortcomings that have become particularly evident in recent years:

First, during the mid-to-late 2010s, economies were experiencing a prolonged phase of sluggish growth, leading many to speculate that the GFC had caused a permanent reduction in economic potential. However, the economy has since returned to trend growth, calling into question the assumption that financial crisis effects are permanent, the assumption used in many estimates of optimal capital levels.

Second, banks fund themselves with capital largely so that they don't fail whenever they make a loss, which avoids bankruptcy costs and preserves franchise value. Even though these are private benefits, they need to be considered when estimating optimal capital; taking these costs into account would result in higher estimates of optimal. Similarly, banks don't just make business loans; they also make loans to households, take deposits, and support capital market intermediation; taking these estimates into account would result in lower estimates of optimal.

[5] The estimates are taken from BCBS (2010), table 8, p. 29. Capital ratios in the table are adjusted using the Fender and Lewrick adjustment of 0.78 to express them in CET1 terms.

Third, many analysts have revised up their estimate of the level that interest rates are likely to average over time. This change reduces the estimated present value calculations for future crises, reducing the resulting estimates of optimal capital.

And **fourth**, current financial stability analysis has focused on the possibility that financial crises may be triggered by a lack of dealer capacity resulting in part from higher capital requirements.[6] Not only do models based on the LEI approach not only fail to account for this risk, the possibility reverses the assumed consequences of higher capital requirements on the probability of a financial crisis.

We next turn to more recent estimates that consider benefits and costs more comprehensively.

ESTIMATES OF OPTIMAL CAPITAL BASED ON QUANTITATIVE GENERAL EQUILIBRIUM MODELS

Recent academic literature on optimal capital relies on dynamic quantitative general equilibrium models to assess the optimal level of capital of banks.[7] With advancements in solution techniques and computational power, the academic literature on this topic has been expanding rapidly. The advantage of quantitative macroeconomic models is that all decisions made by households, firms, banks and nonbanks are fully endogenous and have a direct impact on the cost of bank debt and equity and the economy's growth rate. Moreover, the calibration of these models is subject to a high degree of rigor. This rigor leaves little room for altering the assumptions without first demonstrating that the new calibration matches key features of the data, both in terms of macroeconomic indicators and the level and volatility of important asset price variables, such as credit spreads. In addition, these models often include heterogenous banks and match the distribution of U.S. bank capital.

The quantitative general equilibrium models used in the various academic papers are based on a common setup in which banks make loans to firms. These loans enable firms to invest in products and to pay wages and a return on capital. Banks finance these loans with both debt and equity. The Modigliani-Miller theorem, which implies that the total financing cost of a firm is independent of its capital structure, does not hold in these models for two main reasons. First, the investments that firms make are risky; and if they fail, the firm can default, leading to deadweight bankruptcy costs.[8] Second, households value deposits because they allow them to benefit from a convenience yield, namely the ability to make payments for goods and services. Therefore, the cost of deposits to banks is lower than if they had to fully remunerate depositors for default risk. In some of these models, deposit insurance may lower the cost of deposits for banks further.

In these quantitative general equilibrium models, if capital requirements are set too low, banks will make too many loans, resulting in too many firm defaults and bank losses in equilibrium. This leads to either too many bank failures or to government interventions to avoid large declines in output. In contrast, if capital requirements are set too high, banks will shrink and make fewer loans, which depresses investment and output. In equilibrium, these papers find the optimal level of capital by maximizing the welfare of households, which corresponds to their lifetime consumption.

Several papers use quantitative models (also known as DSGE models) that include banks to analyze the optimal level of capital, two of which were cited in the Basel proposal. Academic papers focus on different aspects of the economy, and for that reason, they vary in the optimal capital estimates they offer. As noted earlier, one of the

[6] See, for example, Duffie (2023).

[7] Dynamic quantitative general equilibrium models use modern macroeconomic theory to simulate an economy that is built up from individual components including households, firms, and financial institutions calibrated to match observed economic behavior. They are the leading tool for making assessment about the effects of changes in policy in an open and transparent manner (see Christiano et al. (2018)).

[8] Banks face costs associated with services rendered by professionals like lawyers and accountants during bankruptcy proceedings. These expenses can be particularly steep in the case of complex resolutions. Such direct costs diminish a firm's value below its intrinsic worth, creating a "deadweight loss." Additionally, bankruptcy incurs indirect costs, including the depreciation of assets tied up in the process.

cited papers is by Elenev and colleagues (2021). A key innovation of this paper is the introduction of a financial section in an otherwise standard model of the macroeconomy. This model can generate infrequent but large financial crises.[9] The authors find that the welfare of households is maximized with a capital requirement equal to 6 percent. As we noted earlier, the paper is unclear whether the requirement is set in terms of CET1 capital or tier 1 capital.[10]

The second paper cited in the Basel proposal is by Begenau and Landvoigt (2022). Before we describe the differences in this paper, it would be helpful to discuss an earlier paper by Begenau (2020). This earlier work was also published in an academic journal and places greater emphasis on households' preferences for holding deposits. So, relative to the paper by Elenev et al. (2021), households have a large demand for the provision of liquidity from banks, driven by a strong preference for holding deposits. In equilibrium, there is a significant scarcity of deposits, and increases in capital requirements can further lower the cost of deposits for banks. This results in more lending. Under these assumptions, Begenau (2020) shows that the optimal level of tier 1 capital ratio is 12.4 percent.

The key difference in the paper by Begenau and Landvoigt (2022) compared with Begenau (2020) is the introduction of a nonbank sector that competes with banks in offering credit to businesses. In the 2022 paper, banks hold insured deposits and pay a fee to the government for deposit insurance. Banks are also subject to capital requirements. In contrast, nonbanks hold uninsured and risky deposits and are susceptible to bank runs. According to the authors' calculations, if capital requirements for banks are increased, the banking sector shrinks. However, the nonbank sector expands, picking up some of the lending activities formerly handled by banks. This offsets the impact of increased capital requirements on both investment and economic output. Consequently, their analysis suggests that the optimal capital requirement rises to 16 percent. Given that Begenau (2020) focused on the tier 1 capital ratio, we infer that the 2022 paper does as well, translating to an optimal 14.5 percent in CET1 capital ratio terms.

Across these three papers that rely on quantitative general equilibrium models, the range of the optimal CET1 capital ratio is between 6 and 14.5 percent, with a midpoint of 10.3 percent. This suggests that the current level of U.S. banks is closer to the upper end of the range than to the midpoint of the range of optimal capital levels. In addition, the optimal levels of capital found in the quantitative general equilibrium models do not consider the introduction of long-term debt requirements that reduce bank incentives to take on risk and the costs of a financial crisis. The main reason is that the quantitative models of bank regulation are already quite complicated. Adding these features makes it more difficult to calculate the optimal behavior of households, banks, nonbanks, businesses and the government.

[9] The authors achieve this by modeling banks as making long-term loans to firms and allowing for endogenous (or strategic) defaults by firms. The model also employs innovative numerical methods that track the endogeneity of the wealth distribution among households.
[10] We assume the optimal is being set in terms of common equity tier 1 capital.

Conclusion

The need to estimate optimal capital levels after the GFC gave rise to a body of literature that evaluates the tradeoffs between the costs and benefits of higher capital requirements. In this note, we examined the evolution of these papers, beginning with BCBS's seminal work on this important topic. However, estimates of optimal capital based on the LEI framework have notable conceptual shortcomings that have become increasingly apparent in recent years. For instance, the crises in March and April 2020 were triggered by a lack of dealer capacity in financial markets, a risk not accounted for in LEI-based studies.

More recent academic literature considers these costs and benefits more comprehensively and merits greater attention from policymakers. Current bank capital levels are above the midpoint of the range of optimal estimates cited by banking agencies and are close to the upper end of recent academic estimates. Therefore, the partial justification given by the banking agencies to substantially revise the capital requirements for large banks, stating that "current capital requirements in the United States are toward the low end of the range of optimal capital levels described in the existing literature," is false.

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