The Economics of Capital Buffer Usability

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2025-11-24

Abstract

Capital buffers were introduced after the Global Financial Crisis to absorb losses and sustain lending in downturns. While loss absorption is mandatory, using buffers to support lending is discretionary, subject to three hurdles: sufficient usable capital (capacity hurdle), the ability to rebuild within a credible horizon (supervisory hurdle), and shareholder value creation (management hurdle). We operationalize these hurdles in a forward-looking framework calibrated to market expectations, and quantify usability for 159 listed US and European banks (2018–2024). Simulations and econometric evidence show that expected returns are the pivotal driver of usability. Results also show that buffer usability exhibits a non-monotonic relationship with release size, peaking at 1–2% of risk-weighted assets before declining. Even at optimal release levels, banks deploy only 50% of available capital. These findings reveal a fundamental tension: while regulators design releasable buffers for macroprudential stabilization, banks treat deployment as a capital allocation decision. Therefore, enhancing usability requires shifting the relative economics of capital deployment versus capital preservation through policy design.

JEL Classification Numbers: G21; G28; E58; G32; E51.
Keywords: Macroprudential policy; capital buffers; buffer usability; CCyB; PN-CCyB; bank profitability; capital headroom; regulatory simplification.

The authors are grateful for comments received during seminars at the International Monetary Fund (IMF) and the London School of Economics (LSE). We thank Bruno Albuquerque, Vicente Bermejo, Romain Bouis, John Caparusso, Eugenio Cerutti, Adriano Fernandes, Luc Riedweg, Javier Suárez, Thierry Tressel, and Jerome Vandenbussche for their valuable feedback. Part of this paper was written while José Abad was visiting the IMF's Strategy, Policy, and Review Department and LSE's Cañada Blanch Centre, and while both Antonio García Pascual and Raffaella Meninno were at the IMF. The paper reflects only the views of the authors, not those of the IMF, the World Bank Group, or any other institution with which the authors may be currently affiliated. All remaining errors are our own.

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1 Introduction

After the Global Financial Crisis (GFC), policymakers concluded that banks had entered the crisis with too little capital and, once losses materialized, responded by cutting lending precisely when economies most needed credit. To address this weakness, Basel III introduced capital buffers on top of minimum requirements, with two clear goals. The first is prudential: providing extra equity that can absorb unexpected losses and safeguard financial stability. The second is macro-stabilization: ensuring that banks can use those buffers in periods of stress, drawing them down to sustain credit supply and mitigate the depth and duration of downturns.

However, these two objectives fundamentally differ in one significant aspect. Loss recognition, which typically occurs in economic downturns or after periods of stress, is a regulatory and prudential mandate; in other words, it is not optional. Conversely, the decision to utilize capital buffers to support lending is strictly voluntary. Even when a prudential authority releases a capital buffer or permits its use, the actual decision to deploy it—essentially, the choice to assume greater risk—remains entirely at the discretion of the bank. The scope of this paper is not on the use of buffers to cover bank losses, but on the fundamental drivers of the discretional choice of a bank to draw down capital buffers to assume greater risk.[1]

In response to the COVID pandemic, most banks opted to increase their voluntary management buffers rather than to draw them down. Although part of the rise in Common Equity Tier 1 (CET1) capital ratios in 2020 was driven by temporary dividend bans and other supervisory interventions, management buffers have remained consistently above pre-pandemic levels since then (Figure 2 and Figure 3). If banks had made fuller use of their capital buffers—potentially moving below the Maximum Distributable Amount (MDA) thresholds, as allowed and in some cases encouraged by supervisors—this could have had adverse implications for the pricing of hybrid instruments, notably Additional Tier 1 (AT1) bonds and preferred shares. Such concerns would have been most pronounced as CET1 ratios approached the levels at which coupon restrictions or conversion into equity would be triggered.[2] However, the data tell a different story: prices of hybrid instruments quickly rebounded to par or higher, and the number of reported MDA breaches remained limited during the period (see Abad and García Pascual (2022)). This suggests that banks primarily chose to conserve capital rather than use their available buffers, underscoring that the mere existence of capital buffers does not guarantee their practical usability in times of stress.

Understanding why banks choose to use—or not use—their capital buffers requires examining the constraints and incentives that shape their decisions. Clarifying these drivers

[1] Hereafter, when we refer to buffer usability or buffer use, we will be referring to the voluntary decision of a bank to draw down a capital buffer to support lending or risk-taking, even if we omit the term "voluntary". Importantly, this paper will not be analyzing the primary use of a buffer, which is to absorb bank losses.

[2] We use "MDA" as a jurisdiction-neutral shorthand for the CET1-based distribution threshold across regimes: in the EU, the MDA triggers under the Combined Buffer Requirement (CBR); in the U.S., the CET1 requirement implied by the Stress Capital Buffer (plus any applicable G-SIB surcharge). References to AT1 bonds also cover U.S. non-cumulative perpetual preferred stock; references to Tier 2 bonds include subordinated instruments senior to AT1/preferred that qualify for total capital. When a bank's CET1 ratio falls below the MDA/CBR in the EU (below the minimum + SCB (+ any G-SIB) in the U.S.), automatic payout constraints kick in in both regimes.

enables macroprudential authorities to design frameworks that make buffer drawdowns more likely in practice.

This paper extends the framework introduced by Abad and García Pascual (2022). It argues that a bank's choice to use a capital buffer is fundamentally like any other capital deployment or investment decision and must satisfy three conditions or "hurdles". First, the bank must overcome a "capacity" hurdle, ensuring that it has sufficient CET1 capital available above the minimum requirements to absorb the intended buffer draw-down; violations of these requirements can incur penalties that banks seek to avoid. Second, the bank must clear a "supervisory" hurdle, demonstrating its capacity to rebuild the utilized buffers within a timeframe deemed acceptable by supervisors and market participants. And third, it must pass a "management" hurdle, meaning that the use of the buffers must generate greater shareholder value than the alternative of preserving (not using) them.

Building on this conceptual framework, we examine a novel monthly panel of market-based expectations covering 159 publicly listed banks in the United States and Europe over the period March 2018 to June 2024. We simulate buffer usability outcomes—specifically, the clearance of these three hurdles—across various buffer types: releasable, non-releasable, and those that have features of both, which we will refer to as "hybrid", while also considering different assumptions about buffer rebuilding expectations.[3]

We find that expected profitability is the central determinant of voluntary buffer usability. Banks with higher forward-looking returns are more inclined to deploy capital, while those with weak profitability typically conserve buffers. Capital headroom also matters, since it provides the capacity to expand RWA without breaching regulatory thresholds. Our simulations and panel regressions show that these two forces interact: profitability delivers the incentive, and headroom supplies the means. Usability is highest when both are present. However, because forward-looking returns are strongly procyclical—declining precisely in downturns—banks' incentives to draw down capital are weakest just when buffers are most needed to support lending.

A second, policy-relevant insight emerges from the analysis: buffer usability is not monotonic in the amount of capital available. More capital (i.e., larger buffers) does not automatically translate into greater usable space. Instead, usability peaks at intermediate draw-downs—around 1–2 percent of RWA—where the economics of usage are most favorable: the draw-down is large enough to matter, but not so large that it makes the supervisory and management hurdles prohibitively binding. Beyond this range, effective usability declines sharply, so that the capital effectively used in stress is typically well below the total buffers released and accumulated in good times. In other words, even at

[3]Releasable buffers (CCyB and SyRB) are intended to be drawn down during periods of stress, with flexible expectations regarding their subsequent rebuilding. In contrast, non-releasable buffers (all others) are structurally binding and must be fully replenished once used, implying a 100 percent restoration requirement. Hybrid buffers incorporate elements of both types. The only such hybrid buffer currently implemented in some jurisdictions is the Positive Cycle-Neutral Countercyclical Capital Buffer (PN-CCyB). Like other releasable buffers, it can be released at the discretion of macroprudential authorities; however, it also carries a 100 percent (or higher) rebuilding obligation, similar to non-releasable buffers. Table 1 provides a summary of this classification. In practice, however, national authorities retain considerable discretion in the application of these tools: for instance, during the COVID pandemic, the Central Bank of Brazil temporarily reduced the Capital Conservation Buffer (CCoB)—a formally non-releasable buffer—to support credit supply; see Banco Central do Brasil (2020).

the peak of usability, banks deploy only a fraction (broadly half) of the capital nominally released.

This non-linear pattern has important policy implications. If effective use is small, the through-the-cycle costs of building and subsequently rebuilding buffers may outweigh the stabilization benefits they deliver in downturns. This reframes the evaluation of capital buffers: it is not their nominal magnitude that matters, but the conditions that determine whether released capital will actually be used.

Taken together, these insights point not only to the broad policy direction but also to concrete design choices for supervisors and regulators. Specifically, to increase voluntary buffer use in bad times, authorities must improve the economics of usage, not just clarify permissions. Forward guidance is necessary, but insufficient. Guidance and buffer design must be calibrated so that deploying capital makes economic sense: in particular, rebuild horizons and post-release CET1-ratio targets should keep dilution risk manageable, and so that the release of releasable buffers improves the economics of using capital relative to preserving it. Just as importantly, calibration must recognize that usability is bounded: requiring buffers well beyond the range that banks are willing to draw adds little stabilization value under stress while imposing system-wide costs in normal times.

The remainder of the paper is organized as follows. Section 2 reviews the emerging empirical evidence on capital buffer usability. Section 3 introduces the analytical framework, detailing the capacity, supervisory, and management hurdles. Section 4 sets out the data sources, sample construction, and assumptions. Section 5 presents the simulation results, analyzing buffer usability over time as well as across buffer types. Section 6 reports the econometric analysis using panel data. Section 7 concludes with implications for improving the usability of capital buffers as a macroprudential tool.

2 Literature Review and Motivation

In response to the COVID pandemic in early 2020, macroprudential authorities implemented three key measures to enhance bank lending and support the real economy: A permanent capital relief (in the euro area), encouragement to utilize non-releasable buffers, and the release of releasable buffers. We next review the relevant literature, focusing on each of these three policies separately.

2.1 Permanent Capital Relief

The evidence regarding the impact of a permanent capital relief on bank lending is largely positive. Couaillier et al. (2025) find that the frontloading of Article 104(a) of CRD-V, which enabled banks to fulfill part of their Pillar 2 Requirements (P2R) using lower-quality capital instruments such as AT1 and Tier 2 securities, significantly contributed to credit supply during the pandemic.[4] This observation aligns with previous studies indicating that permanent reductions in capital requirements generally encourage lending, even in economic downturns and under stress conditions. For instance, Arbatli-Saxegaard

[4]Importantly, the front-loading of CRD-V Art. 104(a) left the overall Pillar 1 + P2R + CBR requirement unchanged; what changed was its mix, allowing part of P2R to be met with AT1 and Tier 2 instead of CET1. This lowered overall CET1 requirements (and the CET1-based MDA threshold).

and Juelsrud (2022) show that a decrease in capital requirements in Norway during the GFC resulted in an increase in both household and corporate credit.

2.2 Non-Releasable Buffers

In contrast, efforts to promote the use of non-releasable buffers, such as the Capital Conservation Buffer (CCoB) or buffers designated for systemically important institutions (G-SIB), appear to have been largely ineffective. Berrospide et al. (2024) show that U.S. banks with capital levels near their overall regulatory thresholds significantly curtailed lending to small and medium-sized enterprises during the pandemic. Similar effects have been documented for the euro area, where Couaillier et al. (2024) find that banks with limited headroom above their MDA thresholds reduced their lending activities more drastically than their better-capitalized counterparts. These findings indicate that the mere existence of non-releasable buffers does not guarantee that banks are willing to maintain credit provision during periods of stress.

2.3 Releasable Buffers

Prior to the COVID pandemic, two quasi-natural experiments had already provided early evidence on the effects of releasing buffers. Jiménez et al. (2017) examine the dynamic provisioning system in Spain, which generated capital buffers ahead of the GFC. They show that the release of these pre-accumulated provisions helped sustain credit supply and supported firm performance during the downturn. Similarly, Sivec and Volk (2023) analyze Slovenia's temporary deduction item introduced in 2006, which created an average capital buffer of 0.8 percent of RWA and was released in 2008. Their findings indicate that, following this release, firms borrowing from banks with a higher buffer received more credit, with particularly strong effects for healthy firms.

Following the COVID pandemic, the literature has expanded considerably, with the empirical narrative evolving over time. Early analyses suggested that the release of capital buffers had limited or no visible impact on bank lending, as banks largely maintained their pre-existing CET1-ratio targets despite supervisory encouragement to draw their CET1 ratios down (Andreeva et al., 2020). Subsequent studies, however, began to find some effects of buffer releases on credit supply. For instance, Bedayo and Galán (2024), using a panel of 170 banks across 25 EU countries, show that CCyB releases supported lending, especially among banks with limited capital headroom. Yet, the literature also shows that the strength of these effects is uneven and context-dependent.

First, the empirical evidence generally suggests that CCyB effects are statistically weak and weaker than those of other CET1 releases, particularly the relaxation of P2R in the euro area. Couaillier et al. (2025), exploiting loan-level data for euro area banks, find that while the overall package of capital relief measures—including P2R easing and buffer releases—significantly boosted lending, the effects become less stable and in half of the specifications insignificant once the focus is narrowed to truly releasable buffers such as the CCyB and SyRB. The authors attribute this to the permanent nature of P2R's reduction. Basel Committee on Banking Supervision (BCBS) (2022) reaches similar conclusions. Its cross-country evaluation indicates that temporary reductions in CET1 requirements during the pandemic supported lending, but the estimated effect of CCyB releases is statistically weak—insignificant once bank-level controls are added—and weaker than

that of other CET1 releases. The authors attribute this to the limited activation and modest size of CCyB rates prior to the pandemic, as well as to the confounding role of other support measures in shaping bank lending decisions.

Second, beyond statistical significance, the quantitative effects of CCyB releases also appear limited. For the United Kingdom, Mathur et al. (2023) find that the CCyB release mitigated tightening in both prices and loan volumes, but with small aggregate magnitudes and only on the intensive margin. They assess the Bank of England's CCyB cut in March 2020, from 1 percent to zero, against the backdrop of a previously announced increase to 2 percent by end-2020. This implied an effective 2 pp. release relative to the pre-announced path—the largest buffer release implemented during the COVID crisis in any country, and sizeable by any standard given that the CCyB typically ranges between 0 and 2.5 percent of RWA. They show that the measure mitigated tightening in mortgage lending conditions, reducing loan rates by 7.4 basis points (relative to an average loan rate of 2 pp. as of end-2019) and increasing average loan volumes by 2.3 percent for banks benefiting most from the relief. While effects are found to be meaningfully larger at the risky tail of the market—such as high-LTV or high-LTI mortgages, the authors also highlight that this segment largely disappeared during the pandemic. Ríos-Rull et al. (2023), using a model calibrated to Canadian banks, simulate the release of a 1.5 percentage point CCyB (the prevailing level in 2017) in a GFC-like scenario. They find that the release softened the contraction in new loan issuance by just 5 pp., from 58.5 to 53.5 percent, which the authors interpret as quantitatively small given the overall magnitude of the contraction. Only a substantially larger CCyB—on the order of 5 pp.—would deliver more material effects, reducing the contraction by 12 pp.[5]

Third, a strand of the literature also compares the relative effectiveness of releasing cyclical (CCyB) versus structural buffers (SyRB). Avezum et al. (2024) use a synthetic control approach at the country level and find that European jurisdictions releasing buffers during the pandemic extended around 1 percentage point more credit to households relative to counterfactuals. They further show that the CCyB exerted a stronger effect than the SyRB. The interpretation is that banks expect supervisors to demand their replenishment more quickly, whereas cyclical buffers come with more flexible rebuilding horizons, enhancing their usability.

Fourth, several papers also show the difficulty of cleanly identifying the causal effect of buffer releases, given the simultaneity of other extraordinary measures. Dursun-de Neef et al. (2023) examine CCyB releases in Europe using a difference-in-differences approach and find that banks exposed to larger buffer reductions increased lending during the pandemic. However, once controlling for government guarantee schemes, the expansionary effect remains only in countries with low reliance on guarantees, while it vanishes in those with extensive guarantee programs. The authors classify countries simply into high- and low-guarantee groups based on the total amount of guarantees as a share of GDP. In practice, however, pandemic-related guarantees were heavily concentrated in corporate lending. When focusing on this particular segment, the same qualitative split persists, but even in countries with large guarantee programs the estimated effects are only marginally significant. In addition, the authors control for the relaxation of P2R using a country-level dummy, whereas the actual reduction in the P2R differed in abso-

[5]We note that a 5 pp. draw-down would be exceptionally large, given that the average management buffer in our sample is below this level (see Table 3).

lute magnitude across banks, implying an heterogeneous effective capital relief that their specification does not capture. Similarly, Wong et al. (2024) study Hong Kong, one of the few jurisdictions that released a sizeable CCyB during COVID, cutting it by 1 pp. in March 2020 (from 2 to 1 percent), following an earlier reduction of 0.5 pp. in October 2019. They find that the release supported credit provision, but lending largely flowed to sectors less affected by the pandemic, while lending to hard-hit sectors was primarily sustained by government guarantee schemes. Their conclusion is that CCyB releases and guarantees acted as complementary instruments during the pandemic.

Finally, the literature highlights the local benefits but often neglects the system-wide arithmetic. In particular, the available evidence suggests that only a subset of banks — typically those operating close to regulatory thresholds — derive tangible benefits from buffer releases. Bedayo and Galán (2024) show that lending responses to CCyB releases during the COVID shock were concentrated among banks with limited capital headroom, while well-capitalized institutions displayed little reaction. Importantly, they find that the positive effect of the release more than offset the contractionary impact of the earlier accumulation phase for these constrained banks, underscoring that the through-the-cycle gains were localized rather than broad-based.[6] As a result, the benefits of buffer releases accrue disproportionately to weaker banks, while the costs of building up and subsequently rebuilding buffers in expansions are borne system-wide. Therefore, the aggregate net benefit of capital buffers through the cycle is ambiguous, depending critically on the distribution of capital positions and profitability across banks at the time of the release.

Taken together, the evidence suggests that while the release of the CCyB and other releasable buffers had measurable positive effects on credit supply during the COVID crisis, their statistical significance, quantitative magnitude, and sectoral reach were limited compared with other forms of capital relief. Moreover, effectiveness varied substantially across jurisdictions depending on the pre-existing size of the buffers, the presence of complementary fiscal measures, and banks' expectations regarding the speed of buffer rebuilding. Crucially, the benefits also appear concentrated in a subset of constrained banks, while the costs of building and subsequently rebuilding buffers are borne by the system as a whole. These findings raise important questions about both the practical effectiveness and the net system-wide benefits of countercyclical capital buffer frameworks.

2.4 The PN-CCyB

In response to the shortcomings revealed during the COVID pandemic—namely that the CCyB had not been activated in many jurisdictions, and where it was, it was generally set at low levels (0.2 percent of RWA in Europe, on average, as of December 2019; see Table 2)—an increasing number of authorities have since adopted a "positive cycle-neutral" approach to the CCyB. This strategy involves setting a positive buffer rate even in periods where cyclical systemic risks are assessed to be neither subdued nor elevated. By setting

[6]Bedayo and Galán (2024) also argue that the costs of (re)building the CCyB are low and short-lived. This interpretation is consistent with the theoretical results in Lang and Menno (2025), who show—within a non-linear equilibrium model of the banking sector—that the lending impact of capital-requirement changes is highly state-dependent: in "normal" conditions, higher requirements have only minimal effects on credit supply. However, this contrasts with the pre-COVID empirical literature, which generally found that higher capital requirements were associated with slower credit growth. See, for instance, Aiyar et al. (2014) for the United Kingdom.

a positive cycle-neutral rate—typically between 0.5 and 2 percent of RWA—authorities aim to ensure that banks have sufficient releasable capital available ex ante. Therefore, the PN-CCyB is not intended as a new buffer, but rather as an early activation of the existing CCyB. This approach is now being implemented or considered in a growing number of jurisdictions, including several European Union countries, Armenia, Australia, Georgia, Hong Kong, New Zealand, and the United Kingdom. For a detailed account of the experiences gained on implementing the PN-CCyB, see European Central Bank and European Systemic Risk Board (2025) and Basel Committee on Banking Supervision (BCBS) (2024).

2.5 Filling a Gap in the Literature

The empirical literature has not yet examined the actual decision process that determines whether banks should (or are likely to) use buffers once released. This is critical, as expanding the stock of releasable capital will not ensure usability if banks are unwilling to use the capital released. A proper assessment of usability therefore requires analyzing the incentives and constraints shaping banks' capital choices under stress.

The existing empirical literature rests on an implicit but crucial assumption: that banks will voluntarily draw down their available buffers once released. However, this assumption has not been rigorously tested. Borsuk et al. (2020) illustrate this point. In the paper, the authors run simulations calibrated to euro area banks and show that the system-wide CET1 ratio would drop by approximately 70 basis points three years after both releasing and deploying buffers compared to a scenario of no usage, which the authors consider as a minor decline. Based on these estimates, the European Central Bank (ECB) in July 2020 encouraged euro area banks to use their capital buffers, under the premise that the macroeconomic benefits of increased credit supply outweighed the minimal capital costs banks faced.

However, the economic implications of a 70 basis point decline in CET1 ratios are not negligible. Consider a hypothetical bank with €10 billion in CET1 capital and €100 billion in RWA, trading at a price-to-CET1 multiple of 0.5 times, implying an expected return on equity (RoE) broadly half of its cost of equity (CoE). A reduction of 70 basis points in the CET1 ratio would result in a €700 million decrease in regulatory capital, leading to a €350 million loss in market capitalization—equivalent to 14 percent of the bank's equity value. This example illustrates that what may be deemed a "marginal" capital deterioration by policymakers can have significant financial consequences for banks and their shareholders.

The critical insight is that if using buffers leaves banks, even slightly, worse off compared to not using them, a rational bank board and management would likely avoid voluntary draw-downs. In other words, a critical driver of buffer usability is not only whether buffers are formally released (or the use of available capital is encouraged by supervisors) but whether their usage is a financially sound decision from a bank's perspective. This paper seeks to address this gap, emphasizing the pivotal role of expected profitability in buffer usability decisions.

Specifically, although most studies include profitability controls—typically Return on Assets (RoA) or Return on Equity (RoE)—these metrics are inherently backward-looking, as they rely on reported accounting data, and thus fail to account for banks' forward-

looking profitability expectations.[7] Ultimately, banks' willingness to lend or use their buffers (or their capital more generally) is influenced more by expected than past returns. Indeed, lending decisions inherently involve capital allocation under uncertainty, where considerations of shareholder value—driven by expected future returns—are paramount. This forward-looking incentive structure is also relevant to the policy design of capital buffers in order to enhance their usability during stress periods.

This papers builds on the conceptual framework introduced by Abad and García Pascual (2022) but improves significantly by incorporating analysis on the different types of buffers, their associated rebuild expectations, and with a novel empirical analysis. We enlarge the cross-sectional coverage from 71 to up to 159 listed banks, spanning both the US and Europe, and add a time-series dimension from March 2018 to June 2024. This richer panel dataset allows us to capture the forward-looking behavior of banks and assess buffer usability in a manner that is consistent with their expected steady-state conditions.

3 Buffer Usability Framework: A Bank's Perspective

A bank's decision to use capital buffers is modeled as an optimization problem under regulatory, supervisory, and financial constraints. Specifically, buffer usability is contingent on satisfying three distinct hurdles:[8]

- Capacity Hurdle: Can the bank use the buffer without triggering automatic regulatory restrictions—in other words, without breaching the MDA threshold?
- Supervisory Hurdle: Can the bank rebuild the buffer within a timeframe that is acceptable to both supervisors and markets?
- Management Hurdle: Is buffer usage economically justified in terms of shareholder value creation? In other words, is buffer usage value-accretive to the bank's shareholders?

3.1 Capacity Hurdle

The capacity hurdle represents the fundamental requirement that a bank must maintain sufficient capital above the Minimum Distributable Amount (MDA) to accommodate a proposed buffer draw-down without violating regulatory constraints. The MDA threshold is the level of CET1 capital determined by the CET1 portion of Pillars 1 and 2 plus the CBR.[9] In practice, however, most banks have a CET1 capital ratio (CET1R) over and above the MDA threshold. This voluntary "extra" capital is often referred to as the

[7] To our knowledge, the only study that formally explores this dimension as a determinant of buffer usability is Abad and García Pascual (2022).

[8] Section 8 provides a detailed, step-by-step algorithm for the assessment of the three hurdles. This section presents a stylized discussion.

[9] As discussed earlier in the paper, we use "MDA" as a jurisdiction-neutral shorthand for the CET1-based distribution threshold across regimes: in the EU, the MDA trigger under the CBR; in the U.S., the CET1 requirement implied by the Stress Capital Buffer (plus any applicable G-SIB surcharge). When a bank's CET1 ratio falls below the MDA/CBR in the EU (below the minimum + SCB (+ any G-SIB) in the U.S.), automatic payout constraints kick in in both regimes.

management buffer (or "distance to MDA"). We define the management buffer expected for the upcoming year (FY1) as follows:[10]

$$MB_{it}^{FY1} = CET1R_{it}^{FY1} - MDA_{it}^{FY1}$$

Next, we compare the management buffer to the proposed buffer usage, denoted as $b_{u,it}$. A bank clears the capacity hurdle if:

$$CapH_{it} = \frac{MB_{it}^{FY1}}{b_{u,it}} \geq 1$$

This condition ensures that the bank remains compliant with regulatory requirements even after the buffer draw-down. Recall that crossing the MDA threshold triggers automatic distribution restrictions, potentially limiting cash dividends, share buybacks, AT1 coupons, preferred share dividends, and the variable remuneration to senior management.[11] Naturally, any such restrictions make banks reluctant to breach the MDA threshold voluntarily, in line with the available empirical evidence; see, for example, Berrospide et al. (2024) for the U.S., and Couaillier et al. (2024) for the euro area.

Therefore, if a bank does not have any management buffer and only has non-releasable buffers, this hurdle would be strictly binding, because regulatory authorities encouraging banks to use these buffers would not translate into a lower MDA threshold. Conversely, if a bank has releasable buffers that automatically reduce the MDA threshold when released, the capacity hurdle would be either non-binding or satisfied by design.

3.2 Supervisory Hurdle

Having sufficient capital to absorb a buffer draw-down is necessary but not sufficient for usability. Supervisors and investors also expect that buffers will be rebuilt within a credible time horizon.

Banks set explicit capital targets because these act as reference points for internal planning, investor communication, and risk management. Using European bank data, Couaillier (2021) shows that banks publicly disclose CET1R targets, which are systematically shaped by regulatory requirements and market expectations. These targets are not merely symbolic: banks adjust both capital and assets to converge, and the pace of adjustment is faster when ratios are below target.

The supervisory hurdle therefore tests whether a bank can generate enough capital organically over a specified rebuilding period T to restore its target CET1 ratio (which we assume to be equal to the consensus-expected CET1 ratio in FY3), adjusted for the share of the buffer expected to be rebuilt (e_{it}):

[10] The variables introduced here are indexed by bank i and time t, and correspond directly to those defined in more detail in Section 8.

[11] Importantly, banks are not required to cancel all AT1 coupons once they breach their MDA, unless such cancellation is contractually mandated. Instead, they can choose which distributions to restrict in order to comply with the CCoB-related payout cap (for example, suspending common equity dividends while continuing to service AT1 coupons).

$$CET1R_{it}^{target} = CET1R_{it}^{FY3} - b_{u,it}\left(1 - \frac{e_{it}}{100}\right)$$

An implicit assumption behind the supervisory hurdle is that banks target a constant management buffer above regulatory minima. This reflects the well-documented practice of banks maintaining voluntary capital headroom as a safeguard against uncertainty and to preserve market confidence (Couaillier, 2021). In our framework, the rebuild requirement is therefore not limited to restoring the regulatory threshold, but to re-establishing the management buffer. Ignoring this would understate the true hurdle: in practice, banks rarely operate persistently at or just above minimum requirements, as doing so risks market penalties and heightened supervisory scrutiny.

By introducing rebuild expectations (e_{it}), the model accommodates varying assumptions regarding the extent of buffer restoration, both across and within buffer types. This parameter captures a central uncertainty: once a buffer is released, neither banks nor markets can predict with certainty the eventual rebuild requirement. The CET1 endpoint will depend on evolving conditions, with supervisors potentially (a) demanding a full restoration, (b) accepting only a partial rebuild, or (c) requiring a stronger capital position than before. These rebuild expectations play a critical role in shaping banks' willingness to draw down buffers in the first place. For non-releasable buffers, the rebuild expectation is fixed at 100 percent, whereas for releasable buffers it may range from zero to above 100 percent.

Using a standard organic capital generation model, we then simulate the capital position at the end of the rebuilding period. The total CET1 shortfall is therefore given by:

$$\Delta CET1_{it}^{comb} = \max(\Delta CET1_{it}, \Delta CET1_{it}^{Lev})$$

where $\Delta CET1_{it}$ captures shortfalls relative to the CET1 target, and $\Delta CET1_{it}^{Lev}$ ensures compliance with minimum CET1 leverage ratio requirements.[12]

The bank clears the supervisory hurdle if:

$$\Delta CET1_{it}^{comb} \leq 0 \quad \text{or} \quad \frac{\Delta CET1_{it}^{comb}}{CapGen_{it}} \leq T$$

This condition implies either that no rebuild is necessary (i.e., the bank ends with a CET1 ratio above its target), or that the shortfall is covered by projected retained earnings ($CapGen_{it}$) over the rebuilding period.

3.3 Management Hurdle

The final condition is whether using the buffer enhances the fair value of the bank's equity. This is the management hurdle, grounded in the fiduciary duty of a bank's board and

[12]For simplicity, we assume that CET1 and Tier 1 leverage requirements are symmetric, meaning the weight of AT1-like instruments in the Tier 1 leverage ratio requirement is equivalent to their weight in the Tier 1 capital ratio. On this basis, we compute the CET1 leverage ratio requirement as the minimum Tier 1 leverage ratio less the AT1 bucket, scaled by total assets.

senior management to act in the best interests of shareholders. Fiduciary duty is a well-established legal standard: boards are expected to safeguard and maximize shareholder value, and may face legal, regulatory, and reputational consequences—including pressures from activist investors—if they knowingly pursue actions that erode it.[13] In this context, deploying capital buffers is not judged solely by regulatory permissions but by whether such use is expected to be value-accretive rather than value-dilutive at the time the decision is made. To formalize this assessment, we use a capital-adjusted excess returns approach to estimate the bank's intrinsic value under two scenarios—buffer use versus no use:[14]

- Baseline (buffer use): The bank draws down the buffer and deploys capital (via lending).
- Counterfactual (no buffer use): The bank preserves its buffer and avoids the drawdown.

We calculate the adjusted fair value multiple (AdjFVM) in each scenario as:

$$AdjFVM_{it}^{use} = \frac{TNPValue_{it}^{use}}{CET1_{it}^{T}}, \quad AdjFVM_{it}^{cf} = \frac{TNPValue_{it}^{cf}}{CET1_{it}^{T,cf}}$$

where $TNPValue$ denotes the net present value of expected earnings and excess capital over the valuation horizon H, discounted at the bank-specific cost of equity CoE_{it}^{MI}.

The hurdle is cleared if:

$$AdjFVM_{it}^{use} > AdjFVM_{it}^{cf}$$

This condition implies that the bank's fair price-to-CET1 ratio is strictly higher when buffers are drawn down than under the counterfactual of keeping them unused.

3.4 Overall Effect: Capital Buffer Usability Decision Rule

The three hurdles outlined above are evaluated jointly to determine the usability of capital buffers. Each hurdle is necessary but none is sufficient on its own; buffer usability requires that all be satisfied simultaneously. Nor must they be considered in a fixed order or sequence—the framework evaluates them jointly. The order presented in this paper is for illustrative purposes only, to clarify the logic of the decision rule.

Let the indicators $CapH_{it}$, $SupH_{e,it}$, and $MgmtH_{e,it}$ each equal one if the respective hurdle is satisfied, and zero otherwise. Then, the buffer usability indicator $CapBU_{e,it}$ is defined as:

- For *non-releasable buffers*:

$$CapBU_{e=1,it} = CapH_{it} \wedge SupH_{e,it} \wedge MgmtH_{e,it}$$

[13] On fiduciary duty and the primacy of shareholder value in corporate governance, see Hansmann and Kraakman (2001).

[14] This is a standard market practice for valuing bank equity; see, e.g., Massari et al. (2014). Available empirical evidence also supports this valuation choice; for example, Caparusso et al. (2023) find a "tight" empirical link between bank profitability and valuation.

- For *releasable and hybrid buffers*:

$$CapBU_{e,it} = SupH_{e,it} \wedge MgmtH_{e,it}$$

This distinction reflects the fact that releasable buffers lower the MDA upon usage, effectively relaxing the capacity hurdle (Subsection 3.1) by design. In contrast, non-releasable buffers require all three hurdles to be cleared at a time.

4 Calibrating the Framework

This section presents the calibration of our model, describing the key assumptions and data sources used to assess the usability of capital buffers at the bank level. Because the model is forward-looking, its inputs reflect expectations at the time of any potential buffer draw-down. We rely on a combination of consensus expectations, regulatory data, and market prices to build a panel of monthly bank-level inputs. These are used in our framework to simulate buffer usability under alternative scenarios and evaluate each bank's response to capital relief measures.

4.1 Assumptions

We impose a standardized buffer draw-down of 2.5 pp. of RWA, constant across banks and over time, allowing comparability across institutions and time periods. This level aligns with the typical upper bound of the CCyB and represents roughly half the average management buffer in our sample (see Table 3). Therefore, a 2.5 pp. draw-down is economically meaningful—large enough to affect capital dynamics and incentives, but still consistent with the Basel Committee on Banking Supervision (BCBS) (2020) guidance on a "measured draw-down." We benchmark against a counterfactual scenario in which buffers are not used—i.e., a zero-draw-down case.

The supervisory buffer rebuilding horizon T is set at three years for all banks and time periods. This assumption is grounded in regulatory experience, particularly during the COVID pandemic. In July 2020, the Single Supervisory Mechanism (SSM) committed not to require the replenishment of buffers before end-2022, implying a horizon of approximately three years from the initial buffer release in March 2020; see European Central Bank (ECB) (2020). A shorter horizon would make buffer use excessively dilutive, while a longer one would probably lack credibility as a supervisory signal.

Arguably, the credibility of the SSM's guidance was weakened by at least three factors. First, the absence of an explicit end-point for buffer rebuilding made it impossible to quantify ex ante the size of the capital shortfall created or to assess a bank's capacity to close it within a reasonable time frame. Second, the delayed issuance of guidance.[15] And third, the announcements by several national authorities in the euro area that CCyBs and other capital buffers would be raised well before end-2022, thereby creating a potential

[15]The SSM's capital-relief package arrived in March 2020, but explicit forward guidance on rebuilding—not requiring replenishment before end-2022 (around three years from March)—was only communicated in late July 2020. Because the acute phase of the COVID shock was concentrated in 2Q 2020, banks faced the worst of the crisis before that guidance existed, adding uncertainty to rebuild expectations.

time-inconsistency problem, regardless of when the actual increases took effect.[16][17]

The managerial valuation horizon H is also set at three years, reflecting common practice in corporate finance. Capital deployment decisions—such as mergers and acquisitions (M&A) or the acquisition of loan portfolios in the secondary market—typically require internal rates of return to exceed the cost of equity within a reasonable timeframe. Although the optimal horizon depends on factors such as portfolio composition and jurisdiction, a three-year window is broadly consistent with banks' investment cycles and the average duration of their loan books.[18]

We also impose three simplifying assumptions to facilitate cross-bank and over-time comparability. First, we fix the effective payout ratio at 50 percent of net income, inclusive of both cash dividends and share buybacks. This assumption improves comparability across banks and prevents endogenous payout differences from distorting our supervisory hurdle results. It is also neutral from an equity fair-value perspective, since lower (higher) cash dividends and/or share buybacks mechanically raise (reduce) the CET1 ratio, with both effects offsetting each other.[19] Second, we assume zero underlying asset growth over the three-year horizon—defined as asset changes unrelated to buffer draw-down activity—consistent with static balance sheet assumptions used in supervisory stress tests. And third, we fix the expected Tier 1 leverage ratio requirement at 3 percent, in line with the Basel III floor. While this simplifies implementation, we acknowledge that bank-specific leverage constraints may be binding in some contexts; see Leitner et al. (2023).

Bank expectations about buffer replenishment post-usage are captured through a parameter e, which we vary across five scenarios: 0, 50, 75, 100, and 150 percent. A zero percent expectation corresponds to a permanent relaxation of capital requirements, such as the March 2020 frontloading of Article 104(a) of CRD-V. An expectation of 100 applies by construction to buffers that are non-releasable or hybrid (PN-CCyB), as these are expected to be fully (100 percent) rebuilt. In contrast, releasable buffers can, in principle, be subject to varying rebuilding expectations, from 0 to values above 100 percent. Thus, for a 2.5 pp. draw-down, the implied buffer endpoint can range from 0 to 3.75 percent of RWA (i.e., from 0 to 150 percent rebuild expectation).

Finally, we note that while this simulation framework captures key economic constraints shaping banks' usability decisions, it remains reduced-form. This abstraction is deliberate: the framework is designed to mirror how practitioners (investors, sell-side analysts, investment bankers, management consultants, and bank officers) assess usability, rather than as a general-equilibrium policy experiment. We do not model banks' endogenous responses to regulatory changes, and thus cannot rule out potential behavioral adjust-

[16]These included Estonia and Germany already in 2021, and Ireland, Lithuania, Netherlands, and Slovakia in 2022. This was further complicated by other buffers, notably the SyRB, also being hiked in a number of euro area countries ahead of the end-2022 guidance.

[17]Regarding announcement effects, we note that markets also tend to "look through" transition arrangements and price banks on the basis of the fully-loaded regime. As Poppensieker et al. (2018) observes, investors routinely demand fully-loaded disclosure and anchor their expectations on managements' stated CET1 targets.

[18]The equality of T and H is coincidental and is not required for the model's validity.

[19]In practice, however, this neutrality may not hold, as some shareholders—particularly the so-called 'income investors' who value stable dividend flows—may react negatively (positively) to reduced (higher) payouts.

ments if policy parameters such as buffer release mechanisms or rebuild expectations were to shift. In this sense, the results may be subject to a Lucas-type critique (Lucas, 1976). However, the qualitative ranking of usability drivers—particularly the dominant role of draw-down size and recapitalization horizon—proves stable across a broad grid of plausible assumptions (see Subsection 5.4), suggesting that our findings reflect underlying economic structure rather than calibration artifacts.

4.2 The Data

To calibrate the model empirically, we rely on consensus expectations observable to the bank at the time the buffer usability decision is made. While banks issue some internal forecasts via public guidance (including the CET1R targets discussed earlier in the paper), these can be strategic and partial, and are provided with very low frequency—typically only once or twice a year, coinciding with full-year and half-year results presentations. A more structured and timelier source comes from independent equity research analysts (sell-side), who build bank-specific financial models that synthesize all publicly available information that can be relevant for the bank's equity market value, including bank management guidance, macroeconomic indicators, regulatory developments, competitive dynamics, and sector-specific trends. These forecasts are subject to market-abuse regulation: independent analysts must publish their full models and target prices before engaging with investors (buy-side) or sharing their analysis with the broader market.

Visible Alpha (by S&P Global) collects analysts' forecasts, reporting consensus expectations in a (cross-country) comparable format with a high degree of granularity on income statement, balance sheet, and capital stack components. We use these consensus expectations for a panel of 159 listed banks from the United States and Europe[20] over the period March 2018 to June 2024. Visible Alpha only reports consensus data when at least three analysts are actively covering the bank stock. This threshold helps minimize the risk of incorporating stale or less reliable expectations into our sample. The dataset is updated by Visible Alpha continuously as analysts update their models and forecasts. We extract expectations at a monthly frequency, using the median value across analysts as of the last trading day of each month.

While this dataset is not new—having been used extensively by market participants for investment and valuation purposes—its use in academic research remains limited. To the best of our knowledge, this is the first study to incorporate market-based forward-looking expectations into the empirical analysis of capital buffer usability, thereby bringing a new market-informed dimension to the bank capital and macro-prudential policy literature.

We focus on forecasts for the third fiscal year ahead (FY3), striking a balance between forward-looking relevance and data availability. While longer horizons are theoretically desirable for assessing steady-state performance, banks' relatively short asset durations and higher beta make overly long forecasts less reliable. FY3 expectations are collected for net income, total assets, RWA, CET1 capital, and CET1 capital ratios for each bank and month. For assets, RWA, and the CET1 capital ratio, we also collect FY1 expectations.

In addition to the forward-looking inputs, we gather monthly actual market capitalization data from Bloomberg, and quarterly regulatory capital requirements from S&P Capital

[20]Europe includes euro area, Denmark, Iceland, Norway, Sweden, Switzerland, United Kingdom, and some other EU banks outside the euro area.

IQ Pro, other national sources (e.g., Federal Reserve for large U.S. banks), and bank-level disclosures from individual Pillar 3 reports and quarterly financial statements. These requirements encompass CET1 and Tier 1 thresholds, which are further broken down into their core components: Pillar 1, Pillar 2, and the CBR. Additionally, we obtain a complete breakdown of the CBR by type of buffer, as this information is crucial for differentiating between releasable and non-releasable capital layers in our usability framework.

A caveat of our approach is that the sample is inherently skewed toward relatively strong institutions. Because we rely on consensus expectations data, we necessarily exclude non-listed banks, for which no such market-based forecasts exist. Even within the universe of listed banks, the coverage tends to be concentrated among the largest players in each jurisdiction—those with the most active market presence and, typically, the most comprehensive and reliable bank analyst coverage. That said, the direction of the sample bias is unclear. If the broader population of banks were predominantly profit-maximizing, our estimates would represent an upper bound on usability. By contrast, for institutions with non-market or policy mandates (e.g., cooperative, savings, or public banks), the same mechanics suggest that our results may understate usability and should instead be interpreted as a lower bound.

Finally, to gauge the representativeness of our sample, we compare the aggregate assets of banks included in our dataset to total assets in each region. As shown in Figure 1, our sample covers roughly 60% of total bank assets in Europe and around 70% in the United States as of the second quarter of 2024, proportions that have remained broadly stable since 2018. This suggests that, despite its bias toward listed institutions, the sample provides a reasonably comprehensive view of the lending capacity of the major banking systems on both sides of the Atlantic.

4.3 Bank-Level Variables

From the forward-looking and observed inputs described above, we construct several bank-level variables that underpin the model's hurdle assessments required for buffer usability. These are recalculated monthly and used throughout the simulation and empirical components of the analysis.

The management buffer in FY1 is defined as the difference between the expected CET1 capital ratio and the actual MDA threshold. This captures the extent of capital headroom available for discretionary actions, including distributions and portfolio loan expansion.

To assess the structure of bank balance sheets, we calculate the RWA density as the ratio of expected RWA to total assets in FY1, which serves as a proxy for average asset risk intensity.

Profitability is captured through the return on assets (RoA), defined as expected net income divided by expected total assets, both in FY3.

Forward-looking valuation is reflected in the price-to-earnings (P/E) ratio, measured as actual market capitalization divided by expected net income in FY3. From this, we infer the market-implied cost of equity (CoE) as the inverse of the P/E ratio—interpreted as the return required by equity investors.

In modeling hybrid capital, we define the AT1 capital bucket as the difference between actual Tier 1 and CET1 capital requirements, subject to a regulatory floor of 1.5% of

RWA, consistent with Basel III standards. We then assume the AT1 yield to be half the CoE, reflecting the seniority of AT1 instruments over common equity and offering a tractable proxy in the absence of high-frequency AT1 pricing data for all banks in the sample.

5 Simulations

This section presents the simulation results based on the analytical framework for capital buffer usability briefly discussed in Section 3 (and in more detail in Section 8). The simulation intends to mimic a bank's forward-looking decision problem under two scenarios: use and non-use of the capital buffer. The objective is to determine whether buffer usage is feasible and economically justified for each bank, conditional on clearing three hurdles: the capacity, supervisory, and management hurdles.

To implement this framework, we simulate buffer draw-down *scenarios* for the three hurdles at the bank level and at monthly frequency. The output is a panel (by bank and month) of simulated buffer usability outcomes, which we use to analyze cross-sectional and time-series patterns by bank, buffer type, and region.

5.1 Results by Hurdle

Capacity Hurdle

Comparing the standardized draw-down of 2.5 pp. with each bank's expected management buffer in FY1 shows that most banks hold substantially more than this amount, making the capacity hurdle the least binding of the three. Management buffers widened significantly in 2020, particularly in Europe, following the outbreak of the COVID pandemic (Figure 2 and Figure 3). A key driver of this shift was the temporary dividend ban imposed by the ECB and several national authorities, which supported rapid capital accumulation.

Crucially, releasable buffers clear this hurdle by construction, since their release automatically lowers the MDA threshold. For non-releasable buffers, the share of banks clearing the capacity hurdle for a 2.5 pp. draw-down rises from approximately 75 percent in 2018 to over 90 percent by 2021 (Figure 4). Naturally, the smaller the initial buffer draw-down, the more banks clear this hurdle; for example, under the assumption of a 1 pp. buffer draw-down, passing rates consistently exceed 95 percent. Therefore, in practice, the capacity hurdle binds only for banks with very limited headroom.

Supervisory Hurdle

Using a standard organic capital generation model, we find that median rebuild times vary markedly with the assumed rebuild expectation e (Figure 5). With a 50 percent rebuild expectations, most banks can restore capital well within three years. At 100 percent, rebuild times hovered just above the three-year threshold during 2020–2021 before falling back below it as expected returns recovered (Figure 16). At 150 percent, however, the hurdle becomes binding for most banks. In short, the higher the rebuild expectation, the smaller the share of banks able to clear the supervisory hurdle (Figure 6).

Expected profitability is the key driver of these outcomes. High-return banks consistently pass the hurdle even under stricter rebuild assumptions, while banks with below-average

returns fail under moderate ones (Figure 7). This underscores that a bank's expected organic capital generation capacity is decisive for the regulatory feasibility of buffer rebuilding.

Management Hurdle

Using a (capital-adjusted) excess returns valuation approach, the value of a bank's equity is determined by the difference between its expected and required returns. When these returns are equal, the bank trades at a price-to-CET1 multiple close to unity. As excess returns increase, the multiple rises above one; when excess returns turn negative, the bank trades below unity. Figure 8 illustrates this point.

To assess a bank's capacity to clear this hurdle, we value each bank's equity under two alternative scenarios: with and without buffer usage. Economically, it only makes sense to draw down buffers if doing so leaves the bank better off than in the counterfactual of not using them. To capture this, we define the *value shortfall* as the difference between the bank's fair price-to-CET1 multiple in the use case relative to the no-use case. A positive shortfall indicates that buffer usage is value-accretive, while a negative shortfall implies that the bank is rather value-dilutive and hence better off preserving its buffers. Figure 9 plots the median value shortfall under the 100 percent rebuild assumption, showing that the median bank has generally cleared this hurdle over time. During the COVID shock in 2020, however, a significant tail of banks moved well into negative territory, even though the median remained (marginally) positive.

Figure 10 reports the share of banks clearing this hurdle across alternative rebuild expectations: up to 50 percent, most banks succeed; at 100 percent, clearance rates decline meaningfully; and at 150 percent, buffer usage ceases to be value-accretive for the majority of banks.

5.2 Some Usability Patterns Emerge

We now add a new dimension to the analysis: buffer type. The conventional cyclical/structural distinction (i.e., CCyB vs. CCoB or SyRB) is largely irrelevant for usability; what matters instead is whether a buffer is releasable or not. On this basis, we classify buffers into three groups: releasable, non-releasable, and hybrid, as discussed in Subsection 5.1 and summarized in Table 1.

When the three hurdles are assessed jointly, overall usability differs sharply by buffer type and rebuild expectation. Releasable buffers are broadly usable when rebuild expectations are low (Figure 11). But once the expectation rises to 100 percent—the benchmark for non-releasable buffers—pass rates drop steeply, and at 150 percent usability becomes minimal. Hybrid buffers (such as the PN-CCyB) behave very similarly to non-releasable buffers, since their design requires full rebuilding.

These patterns also play out unevenly across regions. As shown in Figure 12, U.S. banks displayed higher usability than their European peers prior to 2020, reflecting stronger expected profitability. Usability dropped markedly in both regions during the COVID shock, and the relative advantage of U.S. banks subsequently reversed in 2023, when profitability expectations improved in Europe while episodes of stress weighed on several U.S. institutions.

5.3 Simulating the PN-CCyB

To evaluate its effectiveness, we compare simulated PN-CCyB usability with that of non-releasable buffers in Figure 11. This comparison follows directly from the PN-CCyB's rationale: if releasable buffers were too limited ahead of COVID, the only buffers available at the time were non-releasable. The relevant question, therefore, is whether a bank's usability would have been higher under a PN-CCyB than under a non-releasable buffer, holding everything else constant. Simulation results show that while hybrid buffers such as the PN-CCyB do improve usability relative to non-releasable buffers, the gains are modest—and during COVID in 2020, the difference between the two is essentially negligible.

Hybrid buffers help banks clear the capacity hurdle by lowering the MDA when released, but do little to ease supervisory rebuilding requirements or to enhance shareholder value—the supervisory and management hurdles, respectively. As a result, the usability of hybrid buffers is closer to that of non-releasable buffers than to fully releasable buffers with more flexible rebuild expectations.

5.4 Sensitivity Analysis and Variance Decomposition

To test the robustness of our baseline simulations and better understand which model dimensions shape buffer usability, we vary the three central parameters of the framework: the buffer draw-down size (bu), the recapitalization horizon (T), and the managerial valuation horizon (H). The ranges tested are grounded in supervisory guidance and market practice, as detailed in Section 9.

Figure 13 shows the share of banks clearing all three hurdles under the non-releasable (100% rebuild) case, across draw-downs ranging from 0.5 to 2.5 percent of RWA and valuation horizons between one and five years. Three patterns stand out. First, the draw-down size is the single most important driver: beyond 1–1.5 percent of RWA, usability rates decline steeply and uniformly, irrespective of the valuation horizon. Second, the recapitalization horizon only binds in intermediate regions. With very tight expectations ($T = 1$ year), usability falls sharply for draw-downs around 1–1.5 percent; but when draw-downs are very small or very large, the effect of T is negligible, as most banks either pass or fail regardless. Third, valuation horizons exert a milder influence: extending H tends to increase the share of banks clearing the management hurdle, but the gains are modest relative to the dominant effects of bu and T. The relatively modest role of H may reflect the fact that both bu and T already capture much of the relevant intertemporal dimension in the framework.

Variance decomposition (Figure 14) formalizes these visual impressions. Buffer draw-down size alone explains nearly half of the overall variation in usability, while recapitalization horizons add a further 38 percent. The interaction between bu and T accounts for most of the remainder, confirming that usability is primarily governed by the joint scale of the capital shortfall and the speed at which supervisors and markets expect it to be rebuilt. Valuation horizons, by contrast, play only a marginal role, contributing less than 2 percent of explained variance.

While Figure 13 and Figure 14 focus on usability rates, Figure 15 shifts attention to the effective amount of buffer actually used—that is, the draw-down multiplied by the share of banks clearing all hurdles. This measure yields inverse U-shaped curves for $T > 1$.

Visual inspection suggests that effective buffer use peaks at different ranges depending on the recapitalization horizon. For $T = 1$, the peak is at the very bottom of the grid (around 0.5 pp. of RWA). For $T = 2$, the maximum shifts into the 1.0–1.5 pp. range before falling sharply. And for $T = 3$, effective use continues to increase up to 1.5–2.0 pp. before declining.[21] Valuation horizon H affects the slope and relative height of the curves but does not alter this overall pattern.

While Figure 15 already suggests an inverted-U relationship between the size of a capital release and the amount of buffer actually used, we now test this pattern formally within the simulation framework. In particular, we examine whether *effective buffer use* exhibits a statistically significant interior maximum or whether it is better described as monotone or boundary-driven. For each recapitalization horizon $T \in \{1, 2, 3\}$, we estimate the following quadratic specification:

$$\text{EffectiveUse}_{i,H} = \alpha_T + \beta_{1T}\, bu_{pp,i} + \beta_{2T}\, bu_{pp,i}^2 + \gamma_H + \varepsilon_{i,H}, \tag{1}$$

where $\text{EffectiveUse}_{i,H}$ denotes the effective buffer use (in pp. of RWA) for bank i and valuation-horizon H, $bu_{pp,i}$ is the nominal release (in pp. of RWA), and γ_H are valuation-horizon fixed effects. Concavity is assessed by the sign and significance of the quadratic term β_{2T}. When $\beta_{2T} < 0$ and statistically significant, the curve is concave and the interior maximum occurs at

$$\widehat{bu}_T^{\,*} = -\frac{\widehat{\beta}_{1T}}{2\,\widehat{\beta}_{2T}}, \tag{2}$$

with 95% confidence intervals obtained via the delta method. If $\beta_{2T} \geq 0$, no interior maximum exists and the relevant peak corresponds to the boundary of the simulation grid ($bu_{pp} = 0.5$). The predicted value of effective use at the estimated peak is then

$$\widehat{\text{EffectiveUse}}_T^{\,*} = \widehat{\alpha}_T + \widehat{\beta}_{1T}\, \widehat{bu}_T^{\,*} + \widehat{\beta}_{2T}\, (\widehat{bu}_T^{\,*})^2. \tag{3}$$

Finally, to quantify the underlying share of banks actually able to use their buffers at each optimum, we evaluate the *usability rate*—the share of banks clearing all hurdles—at the same point $\widehat{bu}_T^{\,*}$. Formally, this is obtained from a parallel quadratic fit of $\text{UsabilityRate}_{i,H}$ on $bu_{pp,i}$ and $bu_{pp,i}^2$ (with H fixed effects),

$$\widehat{\text{UsabilityRate}}_T^{\,*} = \widehat{\theta}_{0T} + \widehat{\theta}_{1T}\, \widehat{bu}_T^{\,*} + \widehat{\theta}_{2T}\, (\widehat{bu}_T^{\,*})^2, \tag{4}$$

which provides the predicted system-wide usability at the effective-use peak.

Table 16 summarizes the results. Panel A reports the *peak effective buffer use* (in pp. of RWA). Panel B reports the *nominal release* at which that maximum occurs. Panel C

[21] Notably, this 1–2 pp. range aligns closely with the most recent theoretical estimates of the optimal PN-CCyB. Nora et al. (2025) calibrate a euro-area PN-CCyB between 1.1–1.8% of RWA using a loss-to-buffer framework, Muñoz and Smets (2025) obtain an optimal steady-state level of about 1.84% in a calibrated macro-banking model with policy smoothing, and Couaillier and Scalone (2025) find a range of 1.0–1.5% under a DSGE risk-to-buffer mapping. The simple average across these estimates is approximately 1.5% of RWA.

reports the *usability at the peak*, i.e., the system-wide share of released capital that is effectively usable at that point.

Three results stand out. First, for $T = 1$ the estimated curvature is convex ($\widehat{\beta}_{2,1} > 0$, $p < 0.01$), implying no interior maximum; the peak therefore occurs at the lower boundary of the grid (0.5 pp. of RWA). Second, for $T = 2$ and $T = 3$ the fits are concave and highly significant ($\widehat{\beta}_{2,T} < 0$, $p < 0.01$), with interior peaks at approximately 1.35 and 1.97 pp. of RWA, respectively. The corresponding peak effective uses reach 0.72 and 1.17 pp. of RWA, while the associated usability rates are 55% and 61%, respectively. Third, the non-parametric discrete $arg\,max$ values obtained directly from the simulation grid (0.5, 1.5, and 2.0 pp. for $T = 1, 2, 3$) closely match the regression-based estimates, confirming that the functional-form approximation does not spuriously generate interior optima.

These results validate the interpretation of Figure 15: effective buffer use increases with the nominal draw-down up to an interior maximum—around 1–2 pp. of RWA for $T > 1$—beyond which usability declines sharply. Moreover, Table 16 shows that the capital effectively deployed at this optimum remains well below the nominal release, reinforcing the wedge between headline relief and usable capital.

Taken together, these findings suggest that buffer usability is *non-monotonic* in the amount of capital available. More capital does not automatically translate into greater usable space. Instead, there exists an *optimal intermediate zone* —typically around 1–2 pp. of RWA— where the economics of usage are most favorable: the draw-down is large enough to matter but not so large that supervisory and management hurdles become binding. Beyond this range, effective use declines rapidly, explaining why the capital actually deployed in stress remains far below the buffers accumulated in good times.

5.5 Summary of Simulation Results and Key Takeaways

The simulation results confirm that buffer usability is not a binary regulatory attribute but a conditional outcome shaped by the interaction of capital structure, profitability, risk, and supervisory expectations. Each of the three hurdles in our framework highlights distinct yet interconnected drivers of usability.

First, the *capacity hurdle* depends primarily on a bank's capital headroom at the time of the draw-down. It is negatively related to the assumed release size and positively to the level of the management buffer in FY1. Banks with ample headroom relative to the draw-down are far more likely to satisfy this condition.

Second, the *supervisory hurdle* reflects a bank's ability to rebuild capital organically. Clearance is more likely when profitability is high and the shortfall modest. Conversely, large releases or strict rebuild expectations make the hurdle binding for low-return banks, which may be unable to restore buffers within a credible horizon.

Third, the *management hurdle* depends on risk-adjusted returns. Buffer use is value-accretive only when expected returns exceed the cost of equity; otherwise, preserving capital takes precedence over dipping into it.

Taken together, these hurdles highlight a central mechanism: expected profitability is the pivotal driver of buffer usability. For any given draw-down, higher expected returns raise the probability that banks clear the supervisory and management hurdles. Figure 17

shows that high-return banks succeed more often across all hurdles, while Figure 16 underscores the procyclicality of expected RoCET1, which falls sharply in downturns—precisely when buffers are meant to support credit.

A further insight is that buffer usability is non-monotonic in the amount of capital available. Effective buffer use peaks at moderate releases, around 1–2 pp. of RWA, and declines thereafter as supervisory and management constraints become binding. Even at this optimum, only about half of banks deploy the released capital, so that the system-wide effective use is roughly half the nominal release. These findings explain why, in practice, the capital actually deployed in stress remains far below the buffers accumulated in good times and released in stress.

Hybrid buffers add nuance. While they ease the capacity hurdle by lowering the MDA, they leave supervisory and management hurdles largely unaffected. Unless profitability expectations improve or rebuild assumptions are credibly relaxed, hybrid designs such as the PN-CCyB increase usability only marginally.

In sum, usability must be assessed not as a regulatory permission but through the lens of banks' economic incentives and constraints. It is a strategic choice shaped by the joint dynamics of capital structure, profitability, and supervisory expectations—with expected returns at its core.

6 Empirical Analysis

While the preceding framework is grounded in realistic assumptions and market-based expectations, it remains ultimately conceptual. We now turn to the data to assess whether the intuitions from our simulations are borne out empirically in banks' observed willingness to use capital buffers.

This section complements the simulation analysis with two empirical approaches. In the first one, we let the data speak by examining whether banks that clear our three usability hurdles actually expand RWA more than those that do not. In the second approach, we formally test this relationship by employing a panel econometric strategy.

Importantly, while the existing literature has typically assessed buffer usage through loan growth, we instead use RWA growth as the dependent variable in both empirical approaches. We argue that RWA growth provides a more accurate and policy-relevant proxy: it captures not only the scale but also the risk content of balance-sheet expansion, controls naturally for the effect of government guarantees, and aligns with how banks themselves plan and manage capital.

6.1 Expected Returns and Buffer Usability

As a first empirical approach, we use the simulation framework to let the data speak. Focusing on 2020—the only episode to date of a global buffer release—we find that banks with higher expected returns planned more aggressive RWA expansion (Figure 18). This pattern appears consistently across jurisdictions and also within the subsample of banks that benefited from the 2020 CCyB release (Figure 19).[22]

[22] All results in Section 6 use *FY1* expected RWA growth as the dependent variable. Figure labels that reference FY3 refer to the expectations window used to construct some explanatory variables (e.g.,

This descriptive evidence implies that profitability—not regulatory permission—is the primary constraint on risk-taking. Low-return banks do not expand even when buffers are available, while high-return banks often expand even in the absence of buffer releases. This reinforces the central finding from our conceptual and simulation analysis: expected returns dominate the usability calculus.

6.2 Econometric Analysis

To test the predictions of our usability framework, we follow an econometric strategy similar to that used by Couaillier et al. (2025). However, our baseline specification has important differences relative to previous empirical studies in terms of data, dependent, and independent variables. In particular, our panel covers bank-by-bank, monthly data spanning March 2018 to June 2024. As dependent variable, we use the month-on-month log difference in RWA at the one-year-ahead (FY1) horizon. This captures the expected growth rate of RWA for the current fiscal year, which we interpret as a forward-looking proxy for capital deployment. The key explanatory variables of interest are profitability expectations, capital headroom, and their interaction (as identified in Section 5), alongside regulatory relief variables. We also include a set of bank-specific controls. Formally, we estimate the following equation:

$$\begin{aligned}\Delta\text{RWA}_{i,t}^{\text{FY1}} = \alpha_{c(i),t} + \delta_i + \beta_1 \cdot \text{RoCET1}_{i,t-1}^{\text{FY3}} + \beta_2 \cdot \text{MB}_{i,t-1}^{\text{FY1}} + \beta_3 \cdot (\text{RoCET1}_{i,t-1}^{\text{FY3}} \times \text{MB}_{i,t-1}^{\text{FY1}}) \\ + \beta_4 \cdot (\text{Buffer.Release}_i \times \text{COVID}_t) + \beta_5 \cdot (\text{P2R.Release}_i \times \text{COVID}_t) + \Gamma \cdot X_{i,t-1} + \varepsilon_{i,t}\end{aligned} \tag{5}$$

where the variable $RoCET1$ is the lagged expected return on CET1 capital, measured as expected net income over expected CET1 capital, both in FY3. MB is the lagged management buffer in FY1, and captures the capital headroom available for capital deployment. The terms $Buffer.Release$ and $P2R.Release$ denote the total releasable buffer (CCyB + SyRB) relief and the P2R relief, respectively. Both are interacted with a COVID dummy that take the value of one from April to December 2020, and zero otherwise.

We include a compact set of bank-level controls to keep identification clean and to avoid soaking up the very profitability signal we want to measure. Size (log of total assets expected in FY1) captures scale, business-model scope, and easier market access. Regulatory tightness is proxied by the lagged MDA requirement, which tracks time-varying actual (not expected) CET1 capital requirements. To reflect market discipline and external financing conditions, we add the market-implied cost of equity (inverse P/E ratio using expected net income in FY3). Finally, we control for changes in RWA density (using RWA density expected in FY1) to net out portfolio risk re-mixing and the mechanical effects of government guarantee schemes that lower risk weights without true lending expansion.

All controls enter lagged by one month to reduce simultaneity; this is paired with bank and country-month fixed effects so the coefficients on expected profitability ($RoCET1$)

RoCET1 in FY3), not the dependent variable.

and headroom (MB) reflect within-bank movements, conditional on time-varying macro-policy conditions. This specification mirrors the core choices in the buffer-usability literature while remaining parsimonious enough to avoid overfitting.

6.2.1 Main Results

Table 5 presents the estimation results for our main empirical test, which contrasts the role of internal economic incentives versus regulatory capital requirements in shaping buffer usability. We estimate four model specifications with different sets of explanatory variables. The dependent variable in all cases is monthly RWA growth, our proxy for buffer usability. The specifications assess the relative importance of expected profitability and capital headroom, on the one hand, and changes in regulatory capital requirements, on the other. Each specification incorporates the common set of bank-level controls defined earlier. All specifications include country–month fixed effects to absorb macroeconomic and policy heterogeneity.

Column (1) presents a specification that includes expected profitability, capital headroom, and their interaction. The specification in Column (2) captures the impact of policy-driven regulatory relief: reductions in capital buffers (CCyB and/or SyRB) and P2R in March 2020, interacted with a COVID dummy that takes the value one from April to December 2020, and zero otherwise. Column (3) integrates both internal economic factors (first specification) and external regulatory changes (second specification) to evaluate their joint and relative explanatory power. Lastly, Column (4) adds bank fixed effects to the third specification. This intends to control for unobserved, time-invariant institutional characteristics—such as risk appetite and capital planning strategies—that might otherwise obscure the relationship between drivers of usability and RWA growth. This specification captures both cross-sectional and within-bank dynamics, thereby we consider it a more robust specification to assess the capital usability framework given institutional heterogeneity.

All four specifications provide suggestive evidence that forward-looking profitability is a critical determinant of capital buffer usability. The results in Column (4) show that a one pp. increase in lagged RoCET1 corresponds to a 0.17 pp. increase in monthly RWA growth (approximately 2.0 pp. annually). Similarly, capital headroom also has a statistically significant impact on RWA growth, with a coefficient of 0.59. The negative and significant interaction term of RoCET1 and MB (–0.95) suggests that the marginal effect of RoCET1 diminishes as MB increases, implying that while profitability significantly affects buffer usability, its influence is more pronounced when capital headroom is more constrained.

These findings suggest that profitability serves as a bank's primary buffer against capital depletion. In other words, higher earnings reduce the need for banks to hold large voluntary capital buffers. Conversely, less profitable banks tend to maintain larger management buffers to compensate for their diminished self-insurance capacity. We further examine this relationship through separate regressions of MB on RoCET1 (and RoCET1 on MB), revealing a statistically significant negative association (Table 6). Essentially, capital headroom and expected profitability are not merely complementary determinants of buffer usability; they also serve as substitutes in banks' internal capital planning, reinforcing the nonlinearity reflected in the interaction term (third row in Table 5.)

Importantly, the capital relief variables—*Buffer.Release* × *COVID* and *P2R.Release* × *COVID*—are not statistically significant across any of the four specifications, whether analyzed independently (Column 2) or alongside economic incentives (Columns 3 and 4). This finding suggests that while formal regulatory easing during the COVID period may have enabled banks to use buffers, it did not significantly increase RWA growth in practice. Potential explanations include the possibility that these measures failed to effect substantial changes in banks' internal capital planning or lending strategies, or that banks with pre-existing ample buffers remained largely unresponsive to further relief. In either scenario, the evidence indicates that capital relief alone was insufficient to stimulate buffer use, emphasizing the role of expected returns and the management buffer as the significant factors driving capital deployment.

To further investigate the interaction between RoCET1 and MB, we present two sets of marginal effects in Table 7 and Table 8. These illustrate how the impact of each variable varies with the level of the other, providing a more intuitive understanding of the model's nonlinearity. Table 7 illustrates the marginal effect of RoCET1 on RWA growth across a range of MB values (by quintiles). At low levels of capital headroom (e.g., MB = 2.2%), the effect of RoCET1 is 0.15, substantial and statistically significant, and gradually declining to 0.08 at the highest quintile. While the effect remains positive, it becomes statistically insignificant at the upper end of the buffer distribution, confirming that expected profitability is a significant driver of buffer usability, except when capital headroom is highest.

Notably, the top quintile of the management buffer distribution includes banks with exceptionally high capital headroom: the 95th percentile exceeds 9.4%, and the 99th percentile approaches 14%, contrasting with a median of just 4.2%. This suggests that a considerable subset of banks maintained buffers well above the MDA, explaining the diminished responsiveness to profitability at the upper end of the MB distribution. For these banks, buffer usability may be dictated more by internal capital planning norms than by forward-looking return expectations. The average marginal effect of RoCET1 across the full sample is estimated at 0.12.

Table 8 presents a complementary analysis: the marginal effect of MB across quintiles of RoCET1 (ranging from 7.4% to 20.6%). The marginal effect of MB gradually decreases from 0.51 in the lowest RoCET1 quintile to 0.39 in the highest, yet remains statistically significant and economically substantial throughout. The average marginal effect of MB across the full sample is 0.468, indicating that capital headroom is a robust predictor of RWA growth, irrespective of profitability expectations.

In sum, Table 7 and Table 8 illustrate that capital buffer usability is governed by a nonlinear interaction between available capital space and return expectations: capital headroom provides the capacity to utilize buffers, while expected profitability delivers the incentive, with the latter being most pronounced when capacity is constrained.

6.2.2 Heterogeneity by Capital Buffer Activation

Next, we test whether the effects of expected profitability and capital headroom on buffer usability differ depending on whether banks operate under activated macroprudential capital buffers. Specifically, we define $ActivatedBuffer_{c(i),t-1}$ as a lagged indicator equal to one if, in bank i's jurisdiction, either the countercyclical capital buffer (CCyB) or the

systemic risk buffer (SyRB) was strictly positive in month $t-1$, and zero otherwise. The lag aligns the measure with the timing of information available to banks for capital planning. A standalone $ActivatedBuffer$ term is omitted because it is collinear with country–month fixed effects. Formally, we estimate:

$$\begin{aligned}\Delta RWA_{i,t}^{FY1} = {} & \alpha_{c(i),t} + \delta_i + \beta_1\, RoCET1_{i,t-1}^{FY3} + \beta_2\, MB_{i,t-1}^{FY1} + \beta_3 \left(RoCET1_{i,t-1}^{FY3} \times MB_{i,t-1}^{FY1}\right) \\ & + \beta_4 \left(BufferRelease_i \times COVID_t\right) + \beta_5 \left(P2RRelease_i \times COVID_t\right) \\ & + \theta_1 \left(ActivatedBuffer_{c(i),t-1} \times RoCET1_{i,t-1}^{FY3}\right) \\ & + \theta_2 \left(ActivatedBuffer_{c(i),t-1} \times MB_{i,t-1}^{FY1}\right) \\ & + \theta_3 \left(ActivatedBuffer_{c(i),t-1} \times RoCET1_{i,t-1}^{FY3} \times MB_{i,t-1}^{FY1}\right) \\ & + \Gamma' X_{i,t-1} + \varepsilon_{i,t}.\end{aligned} \tag{6}$$

Table 9 reports the results. Column (1) replicates our preferred specification (Column 4, Table 5). Column (2) corresponds to the specification in Equation 6, which incorporates the lagged buffer activation status and allows the coefficients on profitability, capital headroom, and their interaction to vary between banks with and without activated buffers.

The marginal effect of expected profitability is estimated at 0.18 for banks with activated buffers and 0.16 for those without. Both effects are economically meaningful and statistically significant, indicating that forward-looking profitability consistently drives buffer usability. The difference between the two groups is not statistically significant, suggesting that the profitability channel operates similarly across both groups.

In contrast, the impact of capital headroom diverges significantly. The marginal effect for banks with activated buffers is 0.21, while for non-activated banks, it is significantly higher at 0.65, and the difference is statistically significant, reinforcing the notion that internal buffers exert a more substantial influence on capital deployment when banks lack releasable macroprudential buffers. This finding supports the perspective that management and regulatory buffers function as partial substitutes. It is conceivable that banks anticipating the release of regulatory buffers in times of stress factor these into their management buffer calculations. This may also help explain why most banks kept their medium-term CET1 targets broadly unchanged during the COVID buffer release episode (Andreeva et al. (2020)).

The interaction between RoCET1 and MB remains negative in both groups, consistent with the premise that expected profitability is most influential when capital headroom is limited. The triple interaction term — capturing whether the strength of this nonlinearity differs by buffer activation status — is not statistically significant. This implies that while the marginal effect of capital headroom is significantly stronger for non-activated banks, the joint influence of profitability and capital buffers on buffer usability operates similarly across groups. Thus, both groups exhibit comparable patterns of interaction between incentive (expected profitability) and capacity (headroom), underscoring the notion that both channels are significant and that their interplay is a critical aspect of the buffer usability decision.

These findings provide a compelling explanation for the muted response to capital buffer releases during the pandemic and underscore the pre-eminent role of expected returns as the key constraint in capital usability decisions.

6.2.3 Alternative Specifications

Table 10 explores the heterogeneity in how profitability and capital relief measures interact with bank-specific characteristics to shape buffer usability. Column (1) replicates our preferred baseline specification, as a benchmark (Column 4, Table 5). Columns (2) and (3) sequentially interact the capital relief variables with expected returns and capital headroom pre-COVID ($MB.Jan$).

Across both specifications, the key results remain: the marginal effects of RoCET1 and MB continue to be statistically significant and economically meaningful. The negative interaction term between RoCET1 and MB remains significant and stable across specifications, reaffirming the nonlinear relationship where the incentive effect of profitability diminishes as capital headroom increases.

Column (2) assesses whether the effect of capital relief varies according to a bank's expected return:

$$\begin{aligned}\Delta\text{RWA}_{i,t}^{\text{FY1}} = \alpha_{c(i),t} + \delta_i + \beta_1 \cdot \text{RoCET1}_{i,t-1}^{\text{FY3}} + \beta_2 \cdot \text{MB}_{i,t-1}^{\text{FY1}} + \beta_3 \cdot (\text{RoCET1}_{i,t-1}^{\text{FY3}} \times \text{MB}_{i,t-1}^{\text{FY1}}) \\ + \beta_4 \cdot (\text{Buffer.Release}_i \times \text{COVID}_t) + \beta_5 \cdot (\text{P2R.Release}_i \times \text{COVID}_t) \\ + \beta_6 \cdot (\text{Buffer.Release}_i \times \text{COVID}_t \times \text{RoCET1}_{i,t-1}^{\text{FY3}}) + \beta_7 \cdot (\text{P2R.Release}_i \times \text{COVID}_t \times \text{RoCET1}_{i,t-1}^{\text{FY3}}) \\ + \Gamma \cdot X_{i,t-1} + \varepsilon_{i,t} \quad (7)\end{aligned}$$

The coefficients on the interaction terms (Buffer.Release × COVID × RoCET1 and P2R.Release × COVID × RoCET1) are not statistically significant, indicating no meaningful differential effect of regulatory easing across the profitability spectrum.

Column (3) investigates heterogeneity based on banks' initial capital position by interacting the capital relief variables with $MB.Jan$, representing capital headroom as of January 2020, prior to the COVID shock. This pre-shock measure mitigates endogeneity concerns, as the capital headroom post-March 2020 is mechanically influenced by the capital relief measures themselves:

$$\begin{aligned}\Delta\text{RWA}_{i,t}^{\text{FY1}} = \alpha_{c(i),t} + \delta_i + \beta_1 \cdot \text{RoCET1}_{i,t-1}^{\text{FY3}} + \beta_2 \cdot \text{MB}_{i,t-1}^{\text{FY1}} + \beta_3 \cdot (\text{RoCET1}_{i,t-1}^{\text{FY3}} \times \text{MB}_{i,t-1}^{\text{FY1}}) \\ + \beta_4 \cdot (\text{Buffer.Release}_i \times \text{COVID}_t) + \beta_5 \cdot (\text{P2R.Release}_i \times \text{COVID}_t) \\ + \beta_6 \cdot (\text{Buffer.Release}_i \times \text{COVID}_t \times \text{MB.Jan}_i^{\text{FY1}}) + \beta_7 \cdot (\text{P2R.Release}_i \times \text{COVID}_t \times \text{MB.Jan}_i^{\text{FY1}}) \\ + \Gamma \cdot X_{i,t-1} + \varepsilon_{i,t} \quad (8)\end{aligned}$$

In this specification, the main effect of P2R relief becomes statistically significant, indicating that, on average, banks benefiting from P2R easing during the COVID period expanded their RWA more than those that did not. In contrast, the effect of buffer release (CCyB and/or SyRB) remains statistically insignificant. This distinction is economically

intuitive: the reduction in P2R is perceived as more durable and structural, whereas CCyB/SyRB releases are designed to be temporary and reversible. Consequently, banks may have responded more robustly to P2R easing, viewing it as a more stable foundation for capital planning, in line with the empirical literature (Basel Committee on Banking Supervision (BCBS) (2022); Couaillier et al. (2025)).

The interaction between P2R relief and MB.Jan is positive but statistically insignificant, suggesting that the impact of P2R relief did not systematically vary across banks with differing pre-crisis capital headroom. While the interaction's direction aligns with the notion that well-capitalized banks may have had greater capacity to respond, the data does not provide robust support for this channel. This contrasts with findings in the literature that typically emphasize stronger effects of capital relief among capital-constrained banks. One interpretation is that the additional lending capacity created by P2R relief remained underutilized in more vulnerable institutions, possibly due to ongoing supervisory scrutiny or heightened market discipline.

In summary, this heterogeneity analysis confirms that capital buffer usability is primarily shaped by forward-looking profitability and internal buffer capacity. Furthermore, it highlights that P2R relief was, on average, more effective than the release of CCyB or SyRB buffers—likely due to perceptions of greater permanence of the capital release.

6.2.4 Robustness Checks

Regional Heterogeneity

Next, we test whether the effects of expected profitability and capital headroom on buffer usability differ systematically across regions. Let $Europe_i$ be an indicator equal to one for banks headquartered in Europe (euro area, U.K., Denmark, Iceland, Sweden, Norway, Switzerland, and EU banks outside the euro area) and zero for U.S. banks. A standalone $Europe_i$ term is not included because it is collinear with bank fixed effects. Formally, we estimate the following equation:

$$\begin{aligned}\Delta RWA_{i,t}^{FY1} = \alpha_{c(i),t} + \delta_i + \beta_1\, RoCET1_{i,t-1}^{FY3} + \beta_2\, MB_{i,t-1}^{FY1} + \beta_3 \left(RoCET1_{i,t-1}^{FY3} \times MB_{i,t-1}^{FY1}\right) \\ + \beta_4 \left(BufferRelease_i \times COVID_t\right) \\ + \beta_5 \left(P2RRelease_i \times COVID_t\right) \\ + \phi_1 \left(Europe_i \times RoCET1_{i,t-1}^{FY3}\right) + \phi_2 \left(Europe_i \times MB_{i,t-1}^{FY1}\right) \\ + \phi_3 \left(Europe_i \times RoCET1_{i,t-1}^{FY3} \times MB_{i,t-1}^{FY1}\right) + \Gamma' X_{i,t-1} + \varepsilon_{i,t}.\end{aligned} \tag{9}$$

Table 11 reports the results. Column (1) replicates the baseline specification (column 4, Table 5). Column (2) shows the specification in Equation 9, with the U.S. as the reference group. Columns (3) and (4) re-estimate the baseline model separately for European and U.S. banks, respectively.

The main results hold for both European and U.S. banks. Expected profitability is a significant predictor of RWA growth in both regions. There is no evidence that expected profitability has a different impact on buffer usability across regions. Capital headroom has also a strong and significant impact in both the European and U.S. samples. The marginal effect is greater for U.S. banks than for European banks, with the difference

being marginally significant. This finding is consistent with the institutional setting: European banks were subject to positive releasable macroprudential buffers (CCyB and SyRB), which U.S. banks lacked.

The interaction between RoCET1 and MB is negative in both regions, consistent with our baseline finding that profitability is more significant when buffers are tight. The interaction is stronger and statistically significant in the U.S. sample, but weaker and insignificant in Europe. However, the difference in slope between regions—as captured by the three-way interaction term ($RoCET1MBEurope$)—is not statistically significant. This suggests that while the nonlinearity is more pronounced in the U.S. sample, we cannot reject the hypothesis that the $RoCET1MB$ channel operates similarly in both regions.

In short, Table 11 shows that the usability relation—driven by expected profitability, capital headroom, and their interaction—is broadly similar across regions; coefficients differ in level, but slope differences are mostly not statistically significant. The headroom effect is stronger in the U.S., consistent with institutional design: U.S. banks lacked releasable buffers during the period, whereas many European banks had them. Consequently, U.S. banks relied more on internal headroom when responding to profitability signals. This reinforces the finding that management and regulatory buffers function as partial substitutes discussed in Subsection 6.2.2.

Alternative Dependent Variables

Table 12 evaluates the robustness of our baseline findings using expected loan growth (in FY1) as the dependent variable, which aligns with the standard approach used in the empirical literature on capital buffer usability. Column (1) reproduces our preferred specification from Table 5, employing monthly growth in RWA (FY1) as a benchmark. Column (2) replaces the dependent variable with monthly growth in total loans (FY1). Formally, we estimate the following equation:

$$\begin{aligned}\Delta\text{Loans}_{i,t}^{\text{FY1}} = \alpha_{c(i),t} + \delta_i + \beta_1 \cdot \text{RoCET1}_{i,t-1}^{\text{FY3}} + \beta_2 \cdot \text{MB}_{i,t-1}^{\text{FY1}} + \beta_3 \cdot (\text{RoCET1}_{i,t-1}^{\text{FY3}} \times \text{MB}_{i,t-1}^{\text{FY1}}) \\ + \beta_4 \cdot (\text{Buffer.Release}_i \times \text{COVID}_t) + \beta_5 \cdot (\text{P2R.Release}_i \times \text{COVID}_t) + \Gamma \cdot X_{i,t-1} + \varepsilon_{i,t}\end{aligned} \tag{10}$$

The results support our core findings but reveal notable differences. The coefficient on expected profitability remains positive but is smaller in magnitude (0.12 vs. 0.17) and only marginally significant, contrasting with a stronger and more significant effect in our preferred specification. This would suggest that the relationship between profitability and balance sheet expansion is more effectively captured when utilizing RWA as dependent variable.

Two important factors—one empirical and another conceptual—are likely to contribute to this result. First, RWA provide a cleaner measure of buffer usability and capital deployment, as they adjust for credit risk by construction and assign zero weight to government-guaranteed exposures, unlike total loans that necessitate explicit controls for guarantees in the model specification, adding potential noise and measurement issues. Second, capital planning within banks is typically based on RWA rather than on lending.

Despite these differences, the estimated coefficient on MB remains large and highly significant, reinforcing the conclusion that internal capital space is a consistent driver of buffer usability. The negative interaction between RoCET1 and MB also remains highly significant.

The capital relief variables (Buffer.Release × COVID and P2R.Release × COVID) remain statistically insignificant, indicating that formal regulatory easing during COVID had no direct effect on either RWA or loan growth.

Collectively, these results support the robustness of our key findings across alternative dependent variables and underscore the advantages of using RWA over loan growth to elucidate the mechanisms underpinning buffer usability.

Alternative Independent Variable of Interest

Table 13 tests the sensitivity of our main results to the choice of expected profitability metric. Column (1) reproduces our preferred specification using lagged RoCET1 in FY3 (column 4, Table 5), while Column (2) replaces it with lagged return on assets (RoA) in FY3, a more commonly utilized variable in empirical literature:

$$\begin{aligned}\Delta \text{RWA}_{i,t}^{\text{FY1}} &= \alpha_{c(i),t} + \delta_i + \beta_1 \cdot \text{RoA}_{i,t-1}^{\text{FY3}} + \beta_2 \cdot \text{MB}_{i,t-1}^{\text{FY1}} + \beta_3 \cdot (\text{RoA}_{i,t-1}^{\text{FY3}} \times \text{MB}_{i,t-1}^{\text{FY1}}) \\ &+ \beta_4 \cdot (\text{Buffer.Release}_i \times \text{COVID}_t) + \beta_5 \cdot (\text{P2R.Release}_i \times \text{COVID}_t) + \Gamma \cdot X_{i,t-1} + \varepsilon_{i,t}\end{aligned} \tag{11}$$

Both variables positively impact RWA growth, although their coefficients differ in scale and interpretation. In Column (1), RoCET1 has a coefficient of 0.17, while in Column (2), RoA has a coefficient of 2.06. Although the RoA coefficient is numerically larger, this reflects the fact that RoA is defined relative to total assets—a substantially larger denominator than CET1 capital. Summary statistics (Table 3) illustrates this: RoA has a mean of 1 percent and an interquartile range of 0.63–1.27, while RoCET1 has a mean of 12.96 percent and an interquartile range of approximately 10.0–14.5. When normalized, the economic effect of RoA is broadly comparable to that of RoCET1.

However, the two specifications diverge more meaningfully in how profitability interacts with capital headroom. In Column (1), the interaction between RoCET1 and MB is negative and statistically significant. In Column (2), the interaction between RoA and MB is also negative but it is insignificant (with a p-value of 0.11). This suggests that RoA may not capture the capital-planning dimension as precisely as RoE (or, in our case, RoCET1). Other variables remain stable across both specifications.

Overall, these results tend to support our use of RoCET1 as the preferred profitability metric. While both RoE and RoA provide valuable signals of lending incentives, the former aligns more directly with banks' capital allocation practices than the latter.

A Focus on the COVID Period

Next, we test whether our core insight—that buffer usability is driven primarily by expected profitability and capital headroom—also holds when focusing exclusively on the COVID period. We pursue two complementary approaches.

First, somewhat naively, we re-run our main specification (Equation 5) on a sample truncated at December 2020, in line with the rest of the buffer-usability literature and in contrast to our preferred analysis, which exploits data through June 2024. The results, not reported here but available upon request, are consistent with our baseline findings.

Second, we implement a collapsed difference-in-differences (DiD) design using 2020 data only, to isolate cross-sectional heterogeneity in banks' balance-sheet responses to the shock. We define the pre-COVID period as January–March 2020 and the post-COVID period as April–December 2020. The dependent variables are the average growth in expected RWA and gross loan volumes in FY1 in each period (pre- vs. post-COVID).

Unlike our panel regressions, this cross-sectional DiD specification omits fixed effects and additional control variables. Since the data are collapsed to a bank–period structure with only two observations per bank, having (country) fixed effects would absorb nearly all identifying variation. While time-varying controls could in theory be included, they are likely endogenous to the COVID shock and to the very mechanisms we aim to study. To maintain a clean identification strategy and avoid post-treatment bias, we condition only on pre-determined heterogeneity in RoCET1 and management buffers.

Treatment intensity is modeled using continuous measures of capital requirement reductions: (i) macroprudential buffer releases (CCyB + SyRB) and (ii) P2R relief. Cross-sectional heterogeneity is captured using dummies for banks with high expected returns (top third of RoCET1 in FY3) and low management buffers (bottom third of MB in FY1 as of January 2020).

We estimate the following equation:

$$
\begin{aligned}
Y_{i,p} = \alpha &+ \beta_1\, Post_p + \beta_2\, HighRoCET1_i^{FY3} + \beta_3\, LowMB.Jan_i^{FY1} \\
&+ \beta_4\,(Post_p \times HighRoCET1_i^{FY3}) + \beta_5\,(Post_p \times LowMB.Jan_i^{FY1}) \\
&+ \beta_6\,(HighRoCET1_i^{FY3} \times LowMB.Jan_i^{FY1}) \\
&+ \beta_7\,(Post_p \times HighRoCET1_i^{FY3} \times LowMB.Jan_i^{FY1}) \\
&+ \theta_{\text{pre}}\left(\mathbf{1}_{\{p=\text{pre}\}} \times \text{Buffer.Release}_i\right) + \theta_{\text{post}}\left(\mathbf{1}_{\{p=\text{post}\}} \times \text{Buffer.Release}_i\right) \\
&+ \phi_{\text{pre}}\left(\mathbf{1}_{\{p=\text{pre}\}} \times \text{P2R.Release}_i\right) + \phi_{\text{post}}\left(\mathbf{1}_{\{p=\text{post}\}} \times \text{P2R.Release}_i\right) + \varepsilon_{i,p}\,.
\end{aligned}
\tag{12}
$$

where $Y_{i,p}$ denotes the cumulative FY1 growth outcome for bank i in period p—measured as $\Delta RWA_{i,p}^{\text{FY1}}$ in Column (1) and $\Delta Loans_{i,p}^{\text{FY1}}$ in Column (2); $Post_p$ is a period dummy equal to one for April–December 2020 and zero for January–March 2020; $HighRoCET1_i^{FY3}$ is a binary indicator for banks in the top tercile of expected return on CET1 capital (RoCET1) in FY3; $LowMB.Jan_i^{FY1}$ is a binary indicator for banks in the bottom tercile of the management buffer (MB) in FY1 as of January 2020; Buffer.Release_i is the size of macroprudential buffer releases (CCyB+SyRB) in 2020 as a share of RWA; and P2R.Release_i is the size of P2R reductions in 2020 as a share of RWA.

Results are reported in Table 14. Column (1) uses RWA growth as the dependent variable. The marginal effect of being a high-RoCET1 bank post-COVID is both statistically significant and economically meaningful (+4.5 pp.), consistent with the idea that expected profitability drives buffer usability. However, this effect is reduced for banks with low management buffers: the triple interaction term ($PostHighRoCET1LowMB$) is –3.0

pp. (p = 0.094), leaving a residual effect of only 1.5 pp., which is not statistically significant. These results confirm that usability is constrained unless both profitability and capital availability are aligned. Neither buffer releases nor P2R relief show statistically significant DiD effects in this specification.

Column (2) repeats the analysis using loan growth instead of RWA growth. While point estimates are directionally consistent with those in Column (1), they are not statistically significant. The post-COVID marginal effect of high RoCET1 is small and insignificant, and the triple interaction is similarly muted. Buffer releases again show no significant effect. These findings suggest that neither form of capital relief translated into observable credit expansion in the short term.

We also implemented the same collapsed DiD design using 2019 data as a placebo test (results available upon request), defining June 2019 as the baseline and comparing outcomes before and after. All placebo effects are statistically insignificant, including the interaction between high RoCET1 and the post dummy, both with and without the low MB interaction. This confirms that the 2020 estimates are not driven by spurious pre-trends and supports interpreting the post-COVID heterogeneity in buffer usability as being closely linked to profitability expectations and capital headroom constraints.

All in all, a collapsed DiD analysis on 2020 data confirms that expected profitability was the key driver of buffer usability during COVID.

Alternative Estimation Methods

Finally, Table 15 shows that alternative estimation methods provide consistent results for our key variables of interest. Whether assessing the intensive margin of RWA growth (Columns 1–2) or the extensive margin of capital deployment (Columns 3–4), we consistently find that forward-looking profitability, internal capital headroom, and their interaction remain the key determinants of buffer usability. The two-step system GMM estimator (column 2) addresses endogeneity and substantiates the theoretical nonlinearity in usability behavior[23], while the binary-response models show that these channels also predict the likelihood of RWA growth (columns 3 and 4). Overall, the consistency in magnitude, direction, and statistical significance across estimation methods reinforces the robustness of these empirical results and supports that the mechanisms identified are intrinsic features of banks' capital management behavior.

6.3 Non-linear Effects of Buffer Releases

Table 16 showed that effective buffer use—the product of the draw-down and the share of banks clearing all hurdles—follows an inverted-U shape in the size of the release, with

[23]Our panel meets the large-N, smaller-T condition usually motivating dynamic panel GMM, but the relatively long time dimension implies that small-sample (Nickell) bias in fixed-effects estimators is already negligible. For this reason, the fixed-effect estimator remains our preferred approach, while two-step system GMM is used only to provide an alternative treatment of potential endogeneity. Instruments are restricted aggressively (lags 2–4, collapsed), keeping the count below N. Results remain consistent with the fixed-effects baseline. Post-estimation diagnostics are satisfactory, supporting the validity of the specification: The Arellano-Bond test for AR(1) yields a z-statistic of –1.87 (p = 0.061), consistent with the expected first-order serial correlation in the differenced residuals; the AR(2) test (z = –0.56, p = 0.574) confirms that there is no second-order autocorrelation, which is a necessary condition for model validity; the Hansen test of overidentifying restrictions does not reject the null of instrument validity; and the Difference-in-Hansen test also supports the exogeneity of the instrument subsets.

simulated peaks between 1 and 2 pp. of RWA depending on the supervisory horizon T. As Figure 15 illustrated, very small releases are usable but trivial, moderate releases maximize deployment, and larger ones make the supervisory and management hurdles binding for many banks, so effective use declines. We now take this prediction to the data.

We start by constructing an empirical counterpart of the simulated variable of interest. For each bank i and month t we define

$$\textit{EffectiveUse}_{i,t} = 100 \times \textit{ReqCET1}_i \times \Delta RWA_{i,t}^{FY1}, \tag{13}$$

where $\Delta RWA_{i,t}^{FY1}$ denotes expected one-year-ahead growth in risk-weighted assets and $\textit{ReqCET1}_i$ is the bank's CET1 requirement (the MDA threshold). *ReqCET1* and ΔRWA are in decimals; the factor 100 expresses *EffectiveUse* in pp. of RWA, matching the units of capital relief. Under the model's logic, banks will tend to deploy more capital when relief expands, but only up to the point where supervisory and management constraints start binding. If that mechanism holds in the data, *EffectiveUse* should rise with the size of the release at first and then flatten or decline, producing the same inverted-U shape found in the simulations.

The 2020 episode offers a natural setting to test this prediction. Because the capital-relief measures were introduced abruptly after March 2020, we can contrast the pre-release months (January–March 2020) with the post-release period (April–December 2020). Cross-sectional heterogeneity in the magnitude of the relief across banks provides a second source of variation. Together, these dimensions motivate a difference-in-differences framework in which the pre/post change in effective buffer use is allowed to depend on the size of the release. Formally, we estimate

$$\textit{EffectiveUse}_{i,p} = \alpha + \beta_1 Post_p + \beta_2(Post_p \times Relief_i) + \beta_3(Post_p \times Relief_i^2) + \varepsilon_{i,p}, \tag{14}$$

where $Post_p = 1$ for April–December 2020 and 0 otherwise, and $Relief_i$ is the bank's capital relief in pp. of RWA. The linear interaction term captures the first-order effect of the release, while the quadratic term allows its marginal impact to vary with size, thus testing directly for the concavity predicted by the framework. The fitted turning point,

$$Relief^\star = -\frac{\hat{\beta}_2}{2\hat{\beta}_3},$$

provides the empirical analogue of the simulated peak, and its associated predicted value gives the implied maximum effective use.

However, although this quadratic specification offers a simple and transparent test, it imposes a single global curvature on the relationship. To verify that our results are not driven by functional-form assumptions, we also estimate a more flexible version that lets the post-2020 slope vary across ranges of the release size. Specifically, we fit a bank- and month-fixed-effects model

$$EffectiveUse_{i,t} = \delta_i + \tau_t + \sum_{k=1}^{K} \theta_k\big(Post_t \times S_k(Relief_i)\big) + u_{i,t}, \tag{15}$$

where $S_k(\cdot)$ are restricted linear-spline segments of $Relief_i$. This specification captures the shape of the post-release effect without forcing global concavity: the slope can increase for small releases and decline for large ones only if the data warrant it.

We use two knot schemes. The first fixes knots at 1.0, 1.5, and 2.0 pp. of RWA—the same grid used in the simulations. The second adopts data-driven knots at the 25th, 50th, and 75th percentiles of the observed post-release distribution (k_1=0.700, k_2=1.010, k_3=1.368). For each specification we compute the predicted post-release effect over the interior of the data's support (p10–p90 of positive relief), locate the value of $Relief^\star$ that maximizes it, and record the corresponding predicted use $EffectiveUse^\star$ and the implied usability ratio

$$Usability^\star = 100 \times \frac{EffectiveUse^\star}{Relief^\star}.$$

Statistical inference relies on 500 cluster bootstraps by bank. To explore heterogeneity, we repeat the estimation for two ex-ante slices: *High RoE* banks (top tercile of expected $RoCET1^{FY3}$ as of January 2020) and *Low MB* banks (bottom tercile of the management buffer as of January 2020).

Effective Buffer Use Peaks

Results are summarized in Table 17. Panel A reports the pooled estimates for total capital (buffers + P2R) relief. When the fixed knot grid at 1.0/1.5/2.0 pp. of RWA is used, the estimated turning point—the empirical analogue of the simulated optimum—occurs at a release of 1.0 pp. At that point, the predicted effective use reaches 0.51 pp., implying that roughly 50.9% of the released CET1 capital was actually deployed. The flexible quantile-knot specification (25th/50th/75th percentiles at k_1=0.700, k_2=1.010, k_3=1.368) produces virtually identical results, with a peak release of 1.01 pp., a peak use of 0.55 pp., and a usability rate of 54.5%. These point estimates are statistically significant and stable across knot choices. Even at the maximum, however, only about half of the nominal release was converted into effective buffer use, suggesting that the remainder was held back by supervisory and management constraints.

Panel B investigates heterogeneity by profitability. Among low-profitability banks (the baseline group), the estimated peak occurs at 1.5 pp. of RWA, whereas for high-RoE institutions the curve turns earlier, at around 1.4 pp. The corresponding peak uses are 0.39 pp. and 0.90 pp., with implied usability rates of 26% and 64%, respectively. This pattern is consistent with the theoretical prediction that banks with stronger expected returns face lower opportunity costs of using capital and therefore reach their optimum at smaller releases and higher utilization levels. In other words, high profitability steepens the left-hand side of the profile and shifts the maximum leftward.

Panel C focuses on heterogeneity by capital headroom. For banks with ample management buffers (Low MB = 0), the peak remains around 1.0 pp. with a moderate usability rate of about 50%. Among those with thinner management buffers (Low MB = 1), the

curve flattens markedly: effective use rises only marginally with the size of the release, and the estimated maximum still lies near 1 pp. with modest implied usability.

The empirical profiles align closely with the simulations in Table 16. In the model, effective buffer use peaks between 1.3 and 2.0 pp. of RWA for supervisory horizons T=2 and T=3, with peak effective use in the range of roughly 0.72–1.17 pp. and implied usability around 55–61%. The 2020 data deliver the same qualitative shape but at slightly smaller scales: the pooled peak materializes near 1 pp., with peak effective use around 0.5 pp. and usability near 50–55%. This downward shift is consistent with the historical fact that many 2020 releases were modest in size. Heterogeneity patterns are also consistent with the simulations: higher expected returns (High RoE) shift the optimum to smaller releases and raise utilization at the peak, while thinner headroom flattens the profile.

Curvature Tests

To assess shape more formally, Table 18 reports two complementary diagnostics. First, we present POST marginal slopes by spline segment $(m_1, \ldots, m_4)$ and a Wald test of equal slopes. In the pooled sample, the slope-ordering test does not reject equality (Wald $p \approx 0.78$), indicating that a monotone decline in marginal effects is not statistically supported. Second, we report quadratic curvature tests. A POST-only regression with month fixed effects (identified from cross-bank variation within POST) yields a positive and statistically significant coefficient on tr_{pp}^2, whereas the two-way FE DiD coefficient on $Post \times tr_{pp}^2$ is negative but imprecise. Taken together, these diagnostics imply that pooled concavity cannot be claimed on the basis of the 2020 data, even though the interior peak is precisely located around 1 pp. Differences between the POST-only and DiD quadratic checks reflect identification: the former exploits cross-bank variation within POST months, while the latter identifies curvature off pre–post interactions.

Heterogeneity clarifies the picture. For high-RoE banks—those for which, according to both the simulations and the empirical results so far, usability would be expected to be highest—both the spline slopes and the POST-only quadratic test indicate a clear inverse-U relationship, with a well-identified peak near 1.4 pp and a large associated deployment. For the low-MB split, curvature evidence is weak and slopes are noisy, consistent with a flatter response. Overall, the data robustly support an interior maximum in effective buffer use at modest release sizes and reveal economically meaningful heterogeneity in curvature across banks.

Key Takeaways

The evidence supports three main findings. First, effective buffer use peaks at modest release sizes near 1 pp. of RWA, with only about half of the nominal relief converted into deployment at the peak. Second, pooled curvature tests are mixed and do not support a blanket concavity claim, whereas high-profitability banks exhibit a clear inverse-U with earlier and higher utilization at the maximum. Third, these empirical patterns mirror the simulation's predictions but at smaller scales, plausibly reflecting the limited size of actual 2020 releases and binding supervisory or managerial constraints.

7 Conclusions and Policy Implications

This paper presents a framework to understand and assess the voluntary use of regulatory capital buffers, emphasizing the role of bank-specific incentives and constraints. Usability is not a static regulatory attribute but a strategic, voluntary decision by banks, shaped by the evolving interaction of capital structure, profitability, risk, and supervisory expectations—with expected returns at the core. These findings have significant implications for the design and implementation of macroprudential policies aimed at enhancing their effectiveness on lending and promoting financial stability during economic downturns and periods of stress. Five key implications follow.

First, expected returns are the key driver of voluntary buffer usability. Both our simulations and the empirical evidence show that banks' willingness to use capital buffers hinges primarily on profitability prospects rather than on the regulatory buffer release. When expected returns fall—precisely during downturns when buffer use would be most needed—banks' incentives to deploy capital weaken significantly. Therefore, procyclicality in expected returns remains a central challenge to buffer usability. This weakens the macro-stabilization role that authorities expect buffers to play (de Cos, 2023).

Second, expanding the proportion of releasable buffers helps, but is insufficient. Increasing the share of buffers that can be released—such as through the PN-CCyB—does relax the immediate regulatory constraint (the capacity hurdle). Yet, in its current design, it leaves the more binding supervisory and management hurdles unaddressed. In other words, while the PN-CCyB softens the impact of regulatory thresholds, it does not materially improve banks' willingness to draw down capital in periods of stress. Our results also suggest that at the system level, effective use of buffers peaks when buffer releases are in the range of 1–2 percentage points of RWA, beyond which usability declines sharply. This highlights a key insight: simply making buffers larger does not make them more usable.

Third, the distinction between nominal and effective buffer use has important through-the-cycle cost–benefit implications for the system. Our results show that even at the peak of usability, banks deploy only about half of the capital nominally released. System-wide benefits in terms of additional credit supply are therefore systematically smaller than headline relief suggests, while the costs of (re)building buffers in expansions are fully borne. Moreover, the benefits themselves accrue disproportionately to a subset of constrained banks. As a result, requiring banks to hold large buffers may entail negative net benefits system-wide unless usability design improves so that the wedge between nominal releases and effective use narrows or closes.

Fourth, forward guidance must improve the economics of buffer use relative to the counterfactual of non-use. To make buffers effective, supervisory guidance must credibly reduce dilution risk and improve risk-adjusted returns on capital deployment. Three principles follow: (i) release and rebuild guidance should be issued simultaneously to avoid an expectations vacuum; (ii) the timeline must strike a balance—long enough to mitigate dilution, but short enough to remain credible (three years is a pragmatic benchmark for advanced economies); and (iii) only by setting the post-release CET1-ratio target below its pre-release level can the economics of buffer usability improve, all else equal, as higher targets mechanically increase rebuilding pressure and discourage capital deployment.

Fifth, the overall buffer framework needs structural simplification. Basel's buffer stack has grown overly complex, with multiple instruments pursuing overlapping or even opposing objectives, creating confusion for banks, markets, and policymakers alike. The problem is not only conceptual but also practical: as Cerutti et al. (2017) documented with their composite macroprudential index, it is often impossible to assess the net effect of multiple, simultaneously active tools, since their interactions may run in different directions at the same time. A cleaner two-bucket system would enhance clarity and usability: (i) a *single releasable buffer*, the CCyB (including the new PN-CCyB), to serve macro-stabilization aims; and (ii) a *single non-releasable buffer*, calibrated through stress tests – akin to the U.S. Stress Capital Buffer – with a 2.5% minimum floor, complemented only by the G-SIB surcharge for global systemically important institutions. All other binding (e.g., CCoB) or non-binding (e.g., P2G in the euro area) buffers would be retired. This proposal aligns both with our analytical framework—which shows that the only distinction that matters for usability is between releasable and non-releasable buffers—and with the spirit of Woods (2022), who advocated for a radical simplification of the buffer framework.

All in all, buffer usability is not guaranteed by design or by supervisory encouragement. It must be earned by aligning incentives—principally, by improving expected risk-adjusted returns on capital deployment through credible guidance—and by simplifying the framework so that buffers are both understandable and usable. Usability is also inherently heterogeneous and bounded: differences in profitability and capital headroom imply that the same release will elicit very different responses across banks, and beyond moderate draw-downs, larger buffers add little stabilization value while imposing real system-wide costs. Unless policy reforms change both the economics of buffer use and the architecture of the buffer stack—making it simpler and more incentive-compatible—banks will continue to sit on capital in bad times, and the macro-stabilization promise of the framework will remain under-delivered.

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8 Annex 1: Detailed Analytical Framework—Simulating Buffer Usability

8.1 Introduction

The detailed analytical framework laid out in this Annex facilitates replication of the simulation exercise undertaken in the model to evaluate buffer usability across different types of buffers and their associated rebuild expectations. As discussed in the body of the paper, the model specifies three hurdles—capacity ($CapH_{it}$), supervisory ($SupH_{e,it}$), and management ($MgmtH_{it}$)—each of which must be satisfied for the capital buffers to be usable. In the following sections, we present the assumptions and derivations of the parameters adopted to evaluate 159 banks from March 2018 to June 2024 on these three hurdles. The model combines supervisory and market-based elements, all variables are indexed by bank i and time t (month-year), unless otherwise stated.

8.2 Assumptions

We make five key assumptions for this simulation exercise, which are either based on regulatory guidance, supervisory precedent, and observed market practice. See Subsection 4.1 for a detailed discussion on each of these assumptions.

- **Buffer draw-down:** $b_u = 2.5\%$ of risk-weighted assets (RWA).
  Buffer drawn-downs are assumed constant overtime and uniform across banks and countries.
- **Counterfactual buffer draw-down:** $b_u^{cf} = 0\%$ of RWA.
  The counterfactual scenario of no buffer usage is also assumed to remain constant over time and uniform across banks.
- **Supervisory buffer rebuilding horizon:** $T = 3$ years.
- **Managerial valuation horizon:** $H = 3$ years.
- **Rebuild expectation:** $e \in [0, \infty)$, subject to regulatory caps on its maximum value.
  The rebuild expectations are a percentage of buffer draw-down (b_u) and can, in theory, range from 0 to ∞. Of these innumerable scenarios, the paper shows results for five i.e. 0%, 50%, 75%, 100%, and 150%.

8.3 Market-based Inputs

The forward-looking approach of the model entails extensive use of expected income and returns data from fundamental analysts, along with current market-implied valuations. The sources for these data and their aggregation is also explained in Subsection 4.2.

- NI_{it}^{FY3}: Expected net income in FY3.
- PO_{it}^{FY3}: Expected payout ratio in FY3 (percent of NI_{it}^{FY3})
  This is set to 50% of NI_{it}^{FY3} to avoid bank-specific payout differences affecting the model results.

- $MCAP_{it}$: Market capitalization.
- A_{it}^{FY3}: Total assets in FY3.
- RWA_{it}^{FY3}: Risk-weighted assets in FY3.
- g_{it}: Expected asset growth rate, net of buffer-induced changes.
  The expected growth rate in assets is set at 0 in line with the static balance sheet assumption that is usual practice in bank stress-testing.
- MDA_{it}^{FY1}: Maximum distributable amount in FY1.
- $T1R_{it}^{FY1}$: Minimum T1 capital requirement in FY1.
- LR_{it}^{FY1}: Minimum T1 leverage ratio requirement in FY1.
- $CET1_{it}^{FY3}$: CET1 capital level in FY3.
- $CET1R_{it}^{FY3}$: CET1 capital ratio in FY3.
- $CET1R_{it}^{FY1}$: CET1 capital ratio in FY1.

8.4 Derived Variables

Management buffer in FY1: $MB_{it}^{FY1} = CET1R_{it}^{FY1} - MDA_{it}^{FY1}$

Price-to-Earnings ratio in FY3: $PER_{it}^{FY3} = \frac{MCAP_{it}}{NI_{it}^{FY3}}$

Risk-weighted asset density in FY3: $RWAD_{it}^{FY3} = \frac{RWA_{it}^{FY3}}{A_{it}^{FY3}}$

Return on assets in FY3: $ROA_{it}^{FY3} = \frac{NI_{it}^{FY3}}{A_{it}^{FY3}}$

Cost of equity, market implied : $CoE_{it}^{MI} = \frac{1}{PER_{it}^{FY3}}$

AT1 bucket: $AT1_{bucket,it} = \max(0.015, T1R_{it}^{FY1} - MDA_{it}^{FY1})$

AT1 coupon: $AT1Cpn_{it} = f(CoE_{it}^{MI})$

8.5 Testing for Hurdles

In this section, we provide the steps involved to obtain the metrics used to test the three hurdles. The hurdles and associated metrics are explained in Section 3. In the following, we provide the complementary calculations needed to estimate these parameters, by the order of the hurdles.

8.5.1 Hurdle 1: Capacity Hurdle

The capacity hurdle ($CapH_{it}$) test a bank's ab-initio ability to use capital buffers without triggering automatic regulatory restrictions.

$$CapH_{it} = \frac{MB_{it}^{FY1}}{b_u}$$

The hurdle is satisfied if:

$$CapH_{it} \geq 1$$

Notably, the type of buffers available also plays a role here. Capacity hurdle is partially or fully satisfied if releasable capital buffers (like the CCyB) are available.

8.5.2 Hurdle 2: Supervisory Hurdle

This hurdle requires banks to replenish their capital shortfall ($\Delta CET1_{it}^{comb}$) generated from the capital draw-down (b_u) within 3 years (defined as T). While this replenishment of capital is assumed to occur organically ($CapGen_{it}$) via annual retained income over T, $\Delta CET1_{it}^{comb}$ varies based on rebuild expectations (e).

Estimating pro-forma values

We start with estimating pro-forma values of key financial metrics post buffer usage, which are based on market expectations on returns and valuations for each bank on a monthly basis. These pro-forma values are used for testing both the supervisory and the management hurdles.

Pro-forma CET1 ratio: $CET1R_{it}^{PF} = CET1R_{it}^{FY3} - b_u$

Pro-forma RWA: $RWA_{it}^{PF} = \frac{CET1_{it}^{FY3}}{CET1R_{it}^{PF}}$

Pro-forma assets: $A_{it}^{PF} = \frac{RWA_{it}^{PF}}{RWAD_{it}^{FY3}}$

Change in assets: $\Delta A_{it} = A_{it}^{PF} - A_{it}^{FY3}$

Change in net income: $\Delta NI_{it} = \Delta A_{it} \cdot ROA_{it}^{FY3}$

Pro-forma net income: $NI_{it}^{PF} = NI_{it}^{FY3} + \Delta NI_{it}$

Pro-forma Return on CET1 (RoCET1): $RoCET1_{it}^{PF} = \frac{NI_{it}^{PF}}{CET1_{it}^{FY3}}$

Capital Rebuild Dynamics

Next, we estimate the capital rebuilt ($CET1R_{it}^{T}$) by the end of the supervisory time horizon (T) via organically generated capital ($CapGen_{it}^{T}$). The superscript T in the formulae below represents the bench-marked supervisory time horizon (assumed at 3 years).

RWA at T: $RWA_{it}^{T} = RWA_{it}^{PF}(1+g_{it})^{T}$

Assets at T: $A_{it}^{T} = A_{it}^{FY3} + \frac{RWA_{ict}^{T} - RWA_{it}^{FY3}}{RWAD_{it}^{FY3}}$

Net income, annual: $NI_{it}^{T} = NI_{it}^{PF} + ROA_{it}^{FY3} \cdot \frac{RWA_{it}^{T} - RWA_{it}^{FY3}}{RWAD_{it}^{FY3}}$

Total payout: $PO_{it}^{T} = PO_{it}^{FY3} \cdot NI_{it}^{T}$

AT1 coupon: $AT1Cpn_{it}^{T} = RWA_{it}^{T} \cdot AT1_{bucket,it} \cdot AT1Cpn_{it}$

Capital generation, annual: $CapGen_{it} = NI_{it}^{T} - PO_{it}^{T} - AT1Cpn_{it}^{T}$

Capital generation, over T: $CapGen_{it}^{T} = T \cdot CapGen_{it}$

CET1 at the end of T: $CET1_{it}^{T} = CET1_{it}^{FY3} + CapGen_{it}^{T}$

CET1 ratio at the end of T: $CET1R_{it}^{T} = \frac{CET1_{it}^{T}}{RWA_{it}^{T}}$

Estimating Capital Shortfalls and Testing for the Supervisory Hurdle

By virtue of defining the target capital for banks ($CET1R_{it}^{target}$), rebuild expectations (e) are instrumental in ascertaining the shortfalls ($\Delta CET1_{it}^{comb}$) that are to be replenished. In the steps below, we derive the estimation of the time taken by banks to replenish the shortfall, $\Delta CET1_{it}^{comb}$, via capital generation, $CapGen_{it}$ given a certain rebuild expectation (e).

Target CET1 ratio: $CET1R_{it}^{target} = CET1R_{it}^{FY3} - b_u(1 - \frac{e}{100})$

CET1 shortfall (CET1R-implied): $\Delta CET1_{it} = (CET1R_{it}^{target} - CET1R_{it}^{T}) \cdot RWA_{it}^{T}$

Target CET1 leverage ratio: $CET1r_{it}^{Lev_req} = LR_{it}^{min} - \frac{AT1_{it}^{T}}{A_{it}^{T}}$

CET1 shortfall (LR-implied): $\Delta CET1_{it}^{Lev} = (CET1r_{it}^{Lev_req} - \frac{CET1_{it}^{T}}{A_{it}^{T}}) \cdot A_{it}^{T}$

Total CET1 shortfall: $\Delta CET1_{it}^{comb} = \max(\Delta CET1_{it}, \Delta CET1_{it}^{Lev})$

The hurdle is satisfied if:

$$\Delta CET1_{it}^{comb} \leq 0 \quad \text{or} \quad \frac{\Delta CET1_{it}^{comb}}{CapGen_{it}} \leq T$$

8.5.3 Hurdle 3: Management Hurdle

For a bank to clear this hurdle, its capital draw-down must accrue more value than in the scenario of not using the buffers, and that should occur over a reasonable investment horizon (H). In the paper, the simulations consider $H = 3\ years$. Hence, buffers are usable only if the bank's fair value multiple after 3 years of buffer usage ($AdjFVM_{it}^{use}$) is larger than the counterfactual fair value multiple ($AdjFVM_{it}^{cf}$), when buffers are not dipped into (b_u^{cf}).

Fair Value Assessment

We start with estimating the fair value of banks under both the use and counterfactual scenarios. As mentioned before, the counterfactual scenario (b_u^{cf}) is simply where capital buffers are not drawn, or $b_u = 0$. Hence, the following calculations, which derive the total (capital-adjusted) net present value of a bank's equity, are conducted in pairs. That is, any level of b_u is paired with the counterfactual b_u^{cf} or $b_u = 0$.

CET1 adjusted for the capital shortfall: $CET1_{it}^{adj} = CET1_{it}^{T} + \Delta CET1_{it}^{comb}$

RoCET1 at T: $RoCET1_{it} = \frac{NI_{it}^{T}}{CET1_{it}^{adj}}$

Fair value multiple at T: $FVMultiple_{it} = \frac{RoCET1_{it}}{CoE_{it}^{MI}}$

Incremental value created by T: $Value_{it} = CET1_{it}^{T} \cdot FVMultiple_{it}$

Discount factor: $DF_{it} = (1 + CoE_{it}^{MI})^{H}$

Net present value of incremental value created by T: $NPValue_{it} = \frac{Value_{it}}{DF_{it}}$

Cumulative payouts over T: $CPO_{it} = PO_{it}^{T} \cdot T$

Present value of the capital shortfall net of payouts T: $TAdjNPV_{it} = \frac{CPO_{it} - \Delta CET1_{it}^{comb}}{DF_{it}}$

Total net present value at T: $TNPValue_{it} = NPValue_{it} + TAdjNPV_{it}$

The fair values so obtained for the **use** and **counterfactual (no use)** scenarios are:

$$TNPValue_{it}^{use}, \quad TNPValue_{it}^{cf}$$

Estimating Fair Value Multiples and Testing for the Management Hurdle

A bank's management would choose to dip into its capital buffers only if the fair value multiple ($AdjFVM_{it}^{use}$) at the end of investment horizon T is larger than the counterfactual multiple $AdjFVM_{it}^{cf}$.

$$AdjFVM_{it}^{use} = \frac{TNPValue_{it}^{use}}{CET1_{it}^{T}}$$

$$AdjFVM_{it}^{cf} = \frac{TNPValue_{it}^{cf}}{CET1_{it}^{T,cf}}$$

The hurdle is satisfied if:

$$AdjFVM_{it}^{use} > AdjFVM_{it}^{cf}$$

8.5.4 Capital Buffer Usability Decision

To sum it up, a bank would be in the position to use buffers when the three hurdles are cleared simultaneously. Notably, access to a releasable buffer would make the capacity hurdle redundant as it would imply an ab-initio capacity, however the next two hurdles will remain pertinent. Below we summarize the conditions under which a bank would be willing to use capital buffers under scenarios of having releasable or non-releasable buffers.

Let $CapH_{it}$, $SupH_{e,it}$, and $MgmtH_{e,it}$ be binary indicators equal to one if the corresponding hurdles are satisfied, and $CapBU_{e,it}$ denote the resulting usability indicator:

- **Non-releasable buffer** ($e = 1$):
  $CapBU_{e,it} = CapH_{it} \wedge SupH_{e,it} \wedge MgmtH_{e,it} = 1$
- **Releasable buffer** ($e \in [0, \infty)$):
  $CapBU_{e,it} = SupH_{e,it} \wedge MgmtH_{e,it} = 1$

9 Annex 2: Calibration of Sensitivity Analysis

This Annex outlines the rationale behind the ranges used in the sensitivity analysis presented in Subsection 5.4. Each of the three dimensions—buffer draw-down (bu), recapitalization horizon (T), and valuation horizon (H)—is anchored in regulatory guidance, supervisory precedent, and observed market practice. The goal is not to pinpoint a single calibration but to simulate across a broad, policy-relevant window of assumptions. In doing so, we aim to assess the robustness of our model and evaluate whether usability outcomes remain qualitatively stable across plausible stress scenarios. What follows provides a short justification for the range selected in each parameter dimension.

Buffer Draw-down

Buffer releases are likely to fall within the 0.5% to 2.5% of RWA range, even if actual releases during COVID were more limited in practice. At the upper bound, 2.5% represents the standard cap for the countercyclical capital buffer (CCyB) under Basel III. Second, this range is broad enough to encompass the entire PN-CCyB activation spectrum, with most jurisdictions setting positive cycle-neutral rates between 0.5% and 2%, precisely to ensure usable capital is available in periods of stress. Third, larger releases (above 2.5%) are rare and generally require exceptional supervisory actions, such as the permanent reduction in P2R adopted in the euro area in 2020. As such, the 0.5–2.5% range reflects a forward-looking, policy-relevant stress window—anchored in regulatory design.

Recapitalization Horizon

Banks facing a need to rebuild their CET1 capital levels are typically expected—by both supervisors and market participants—to do so within a 1 to 3-year window, with 12 to 18 months being the most common benchmark. Regulatory deadlines, such as those tied to Supervisory Review and Evaluation Process (SREP) decisions or Prompt Corrective Action plans, frequently impose binding targets within one year, while macroprudential buffer increases (e.g. CCyB) often allow up to 12–24 months for full implementation. Rating agencies, meanwhile, consistently apply a 12–18 month horizon as the practical deadline for restoring CET1 ratios to target levels, with failure to present a credible rebuild plan within that period regularly cited as grounds for a downgrade or negative outlook. [24]

While longer windows do exist, they are rare and generally involve either structural capital reforms—such as New Zealand's seven-year CET1 phase-in announced in December 2019—or forward guidance around the rebuild of macroprudential buffers previously released, as in the ECB's post-COVID pledge in July 2020. In that case, the ECB explicitly stated that banks would not be required to restore their CBR "any sooner than end-2022," effectively giving banks a 2 and a half-year capital rebuilding grace period since the guidance was issued (July 2020), but almost three years since buffers were released (March 2020).

[24] Based on a comprehensive review of 32 publicly disclosed bank rating actions by Fitch, Moody's, KBRA, and S&P Global Ratings between 2018 and July 2025, each explicitly linking capital rebuild expectations to a defined time window. Across all cases, the expected timeframe ranged from 12 to 18 months, with an average of 15 months.

As such, the one- to three-year range reflects a forward-looking, policy-relevant stress window—anchored in both supervisory guidance and observed market practice.

Valuation Horizon

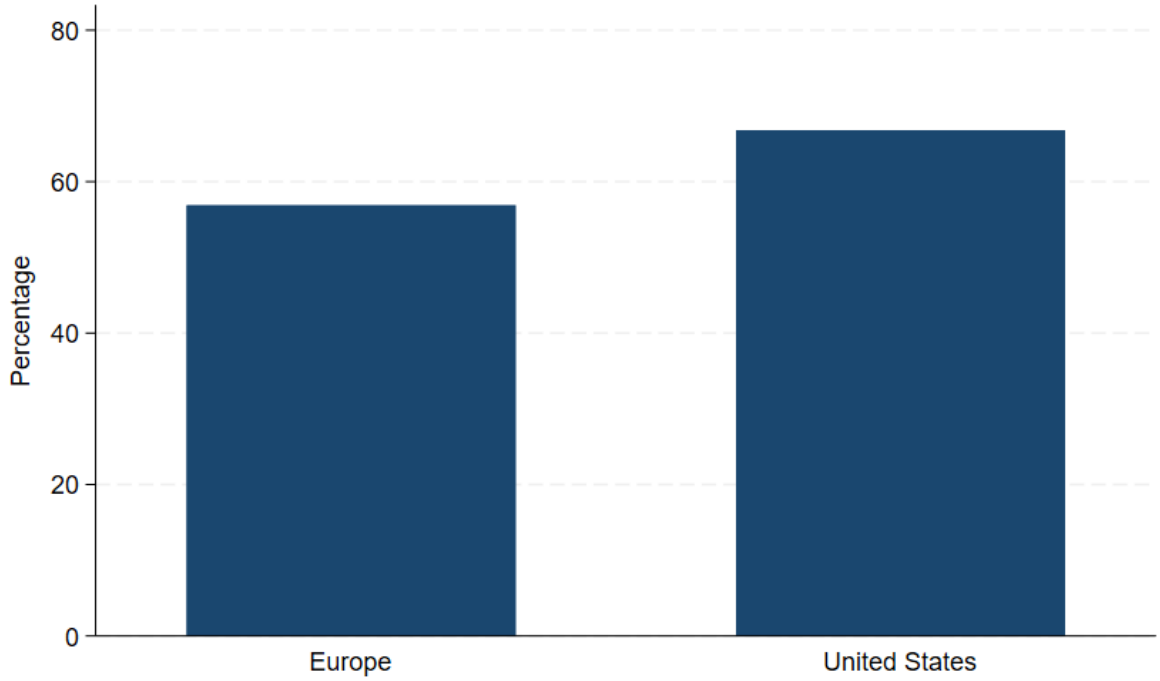
Banks and financial institutions typically target a return on investment (RoI)—whether measured by internal rate of return (IRR) or tangible book value (TBV) earn-back—within three to five years when executing M&A transactions or acquiring loan portfolios in the secondary market. This window reflects market norms shaped by investor expectations, regulatory capital efficiency, analyst forecast horizons, and board incentive structures. Earn-back periods of ≤ 3 years are viewed as best practice and strongly rewarded by the market, while periods > 5 years are often penalized unless backed by compelling strategic rationale or synergy potential. [25]

[25] See, for example, comments and analysis from Mercer Capital (June 2025) , S&P Global (June 2016), or KBW (January 2020).

10 Figures

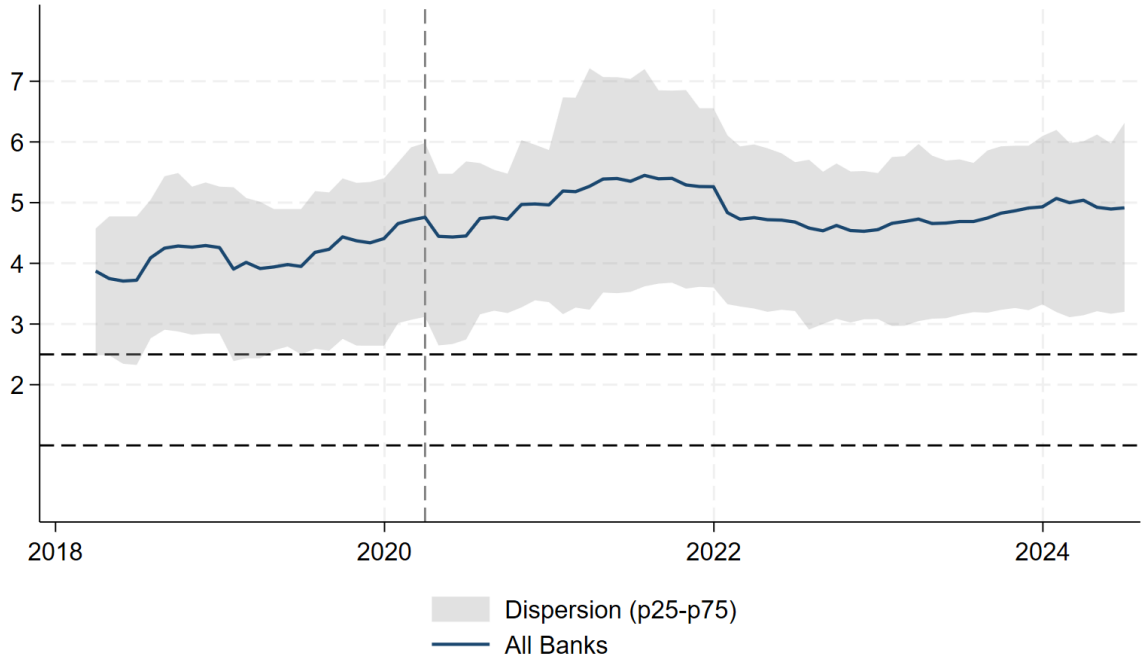
This Annex contains all the figures discussed throughout the paper. The sources are discussed in Subsection 4.2. The vertical dotted grey line across figures represents the month of March 2020, when the World Health Organization declared COVID a pandemic and, importantly, bank capital buffers were released globally.

Figure 1: Share of Total Bank Assets Accounted for by Banks in the Sample (2Q of 2024)



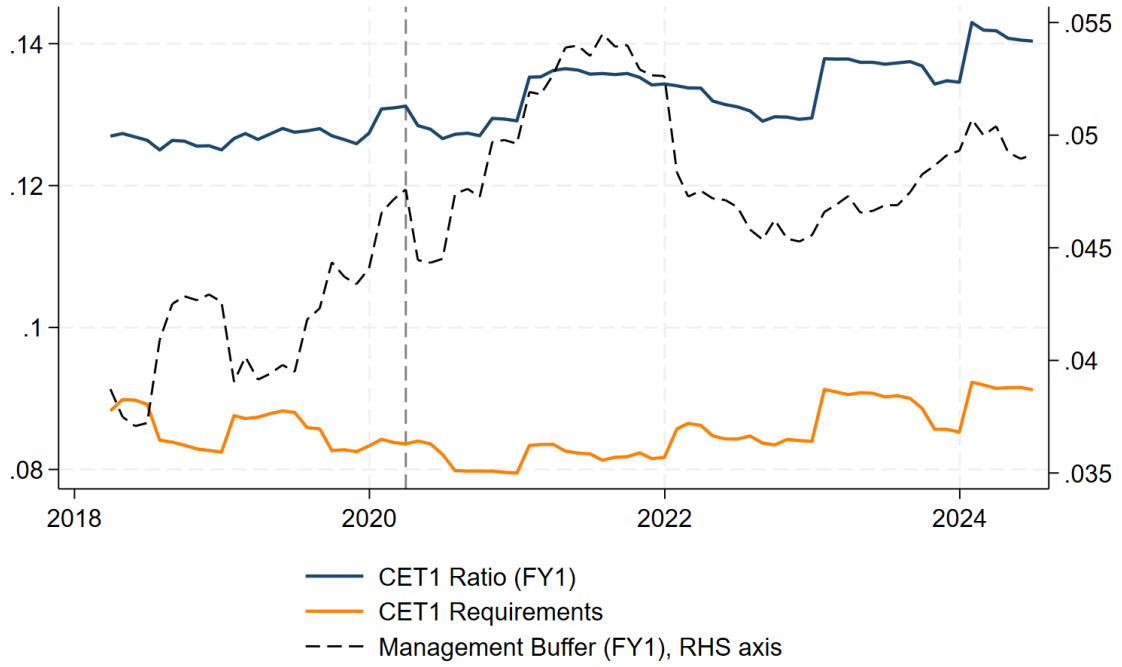
Note: This figure reports the share of total assets from headquartered banks in our sample relative to total assets of deposit-taking institutions in each region. Aggregate assets data for all deposit-taking institutions are obtained from the IMF's Financial Soundness Indicators (FSI) database, expressed in local currencies. Shares are computed using FY1 assets data from Visible Alpha (by S&P) expressed in the same local currency units. The resulting regional shares have remained broadly stable since 2018. These comparisons are presented for illustrative purposes only: methodological differences between the numerator and the denominator—such as differences in consolidation scope, reporting standards, and institutional coverage—mean that the figures should not be interpreted as exact measures of representativeness, but rather as an approximate indication of the relative size and stability of the sample over time. Europe includes euro area, Denmark, Iceland, Norway, Sweden, Switzerland, United Kingdom, and some other EU banks outside the euro area.

Figure 2: Capacity Hurdle: Management Buffer in FY1 (% of RWA)



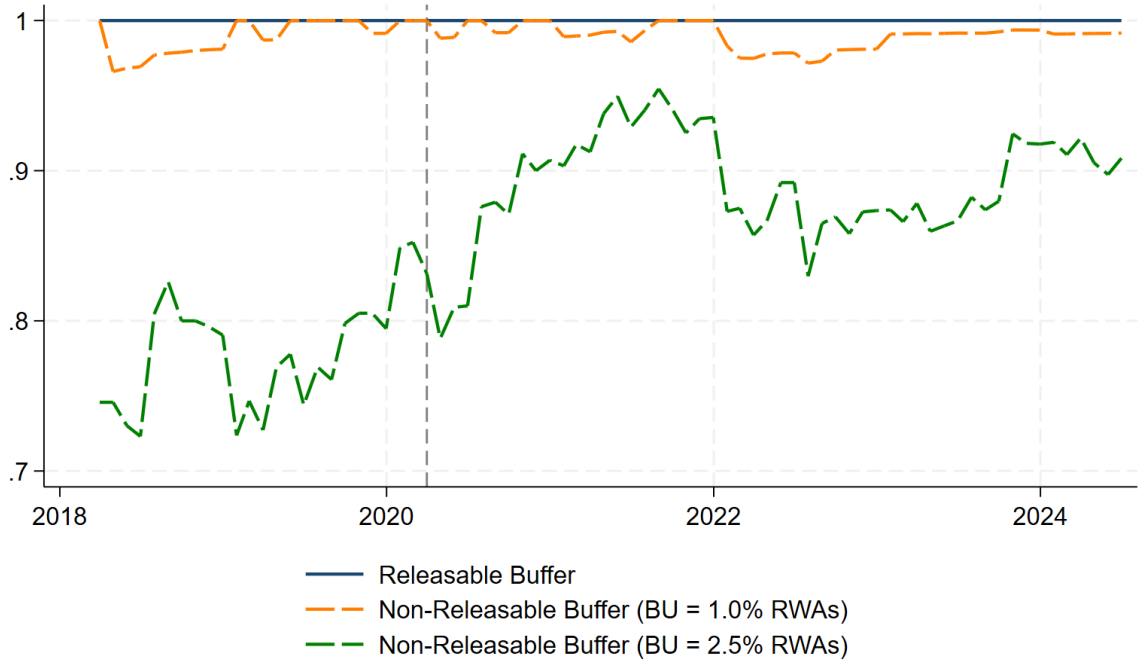
Note: This figure shows the monthly cross-sectional average management buffer—defined as the expected CET1 ratio in FY1 minus the contemporaneous MDA requirement—for 159 listed banks in the U.S. and Europe (March 2018–June 2024). A shaded band marks the inter-quartile range (25th–75th percentiles). The figure also shows two horizontal lines at 1% and 2.5% of RWA, corresponding to standardized buffer drawdown benchmarks used in the simulations.

Figure 3: Mean Management Buffer in FY1: By Component



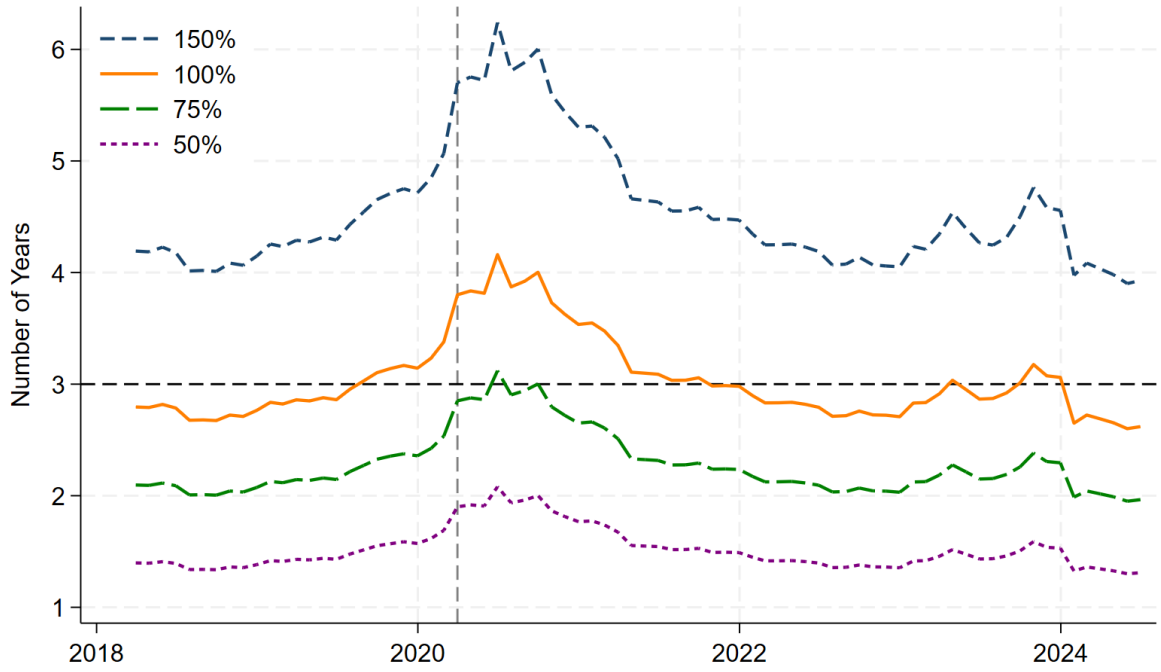
Note: This figure plots three monthly series for the same bank panel and period as in Figure 2: (i) mean expected CET1 ratio in FY1, (ii) mean CET1 requirement, and (iii) the mean management buffer, defined as the difference between the two (secondary axis).

Figure 4: Proportion of Banks clearing the Capacity Hurdle



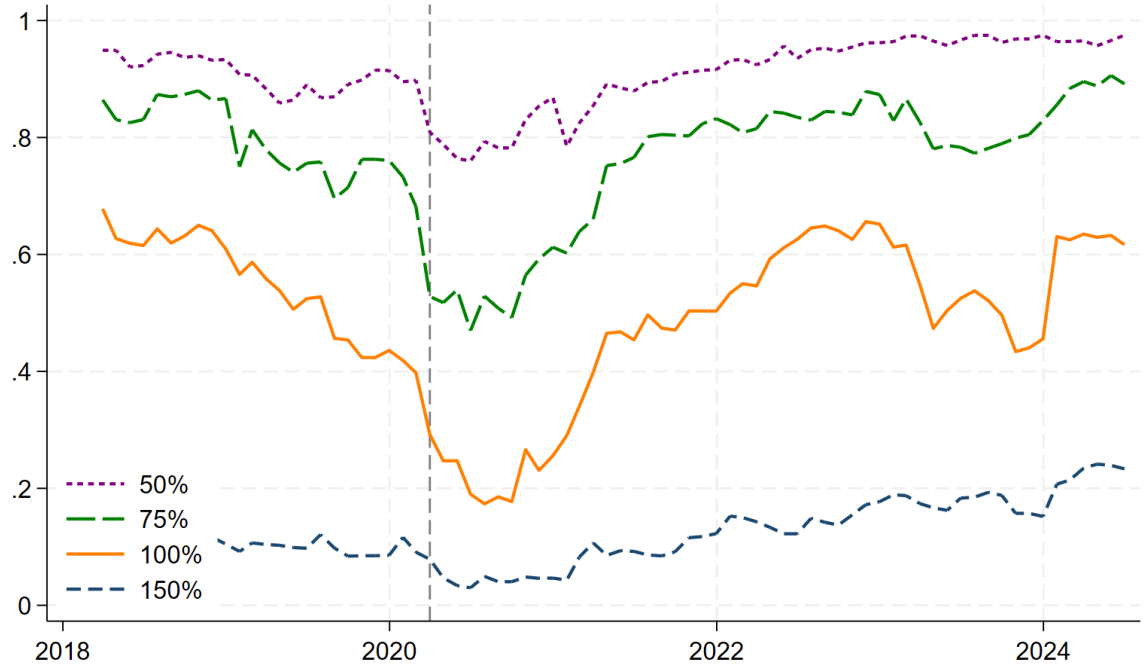
Note: This figure shows the monthly share of banks whose projected FY1 management buffer is greater than or equal to a standardized draw-down of 1.0 or 2.5 pp. of RWA. Two lines correspond to non-releasable buffers at each draw-down size, and one line illustrates releasable buffers, which always clear the hurdle by design since their release lowers the MDA threshold. Sample: 159 U.S. and European banks (March 2018–June 2024).

Figure 5: Supervisory Hurdle: Time to Rebuild Buffers by Rebuild Expectations



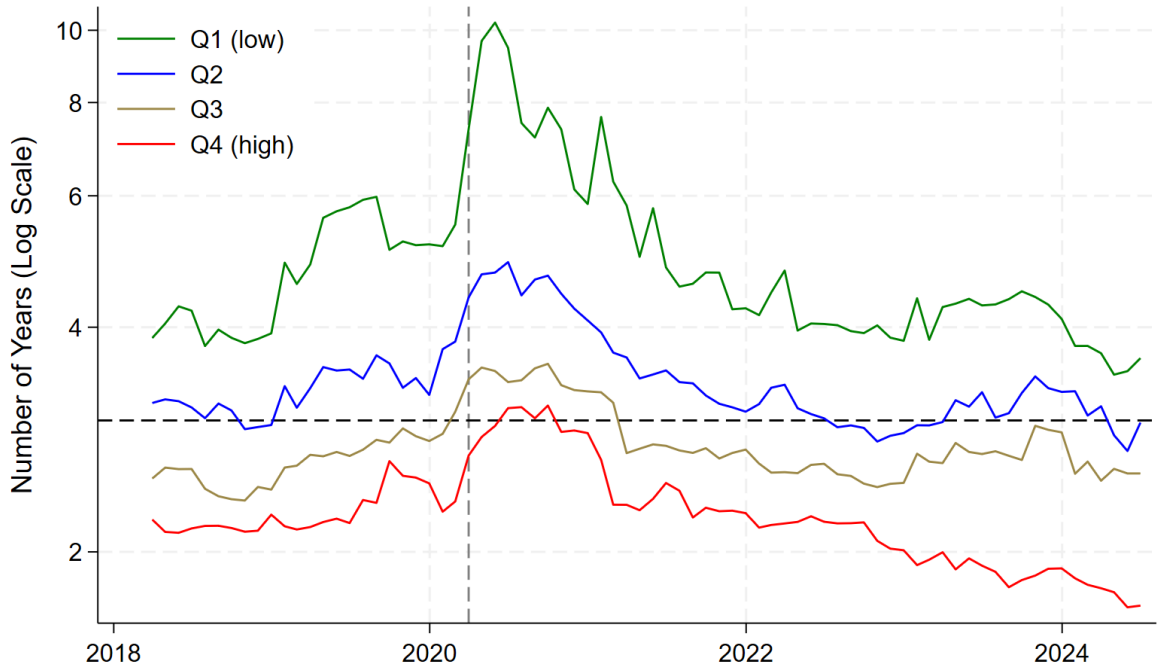
Note: This figure shows the rolling median (in years) of the model-estimated period required to replenish a 2.5 pp. draw-down under four alternative rebuild expectations: 50%, 75%, 100% and 150% of the amount used. A horizontal line marks the 3-year supervisory horizon. Sample: 159 listed banks in the U.S. and Europe (March 2018–June 2024).

Figure 6: Proportion of Banks Clearing the Supervisory Hurdle by Rebuild Expectations



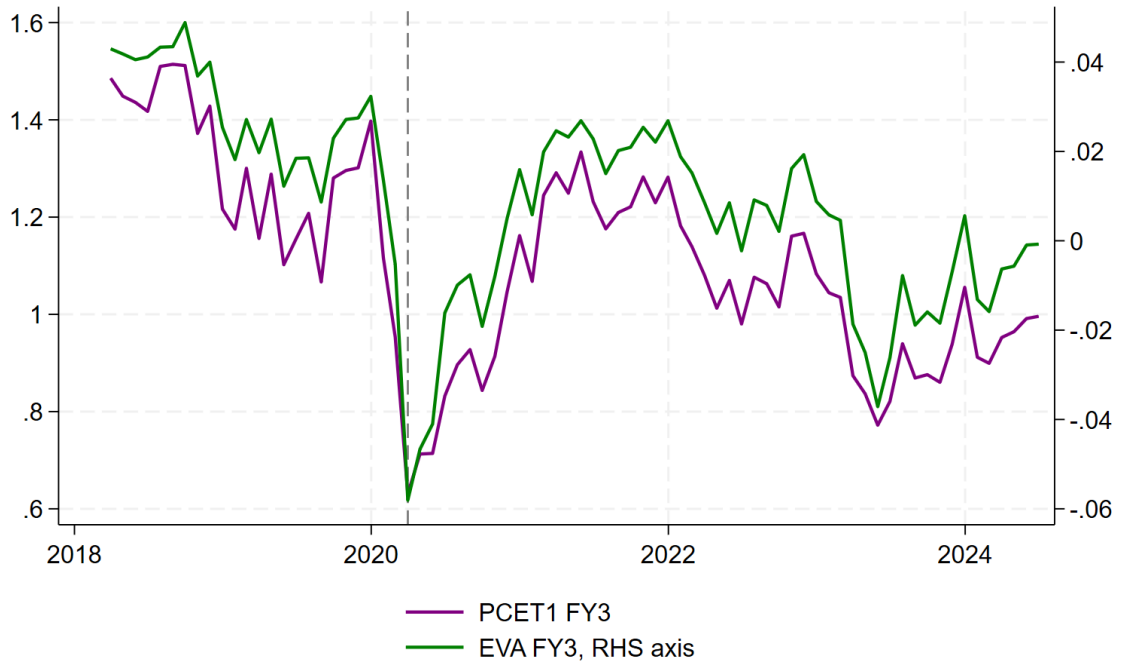
Note: This figure shows the monthly share of banks whose simulated rebuild time for a 2.5 pp. drawdown is no longer than the supervisory horizon (3 years), under rebuild expectations of 50%, 75%, 100% and 150%. Sample: 159 U.S. and European banks (March 2018–June 2024).

Figure 7: Supervisory Hurdle by Return Quartile (100% Rebuild)



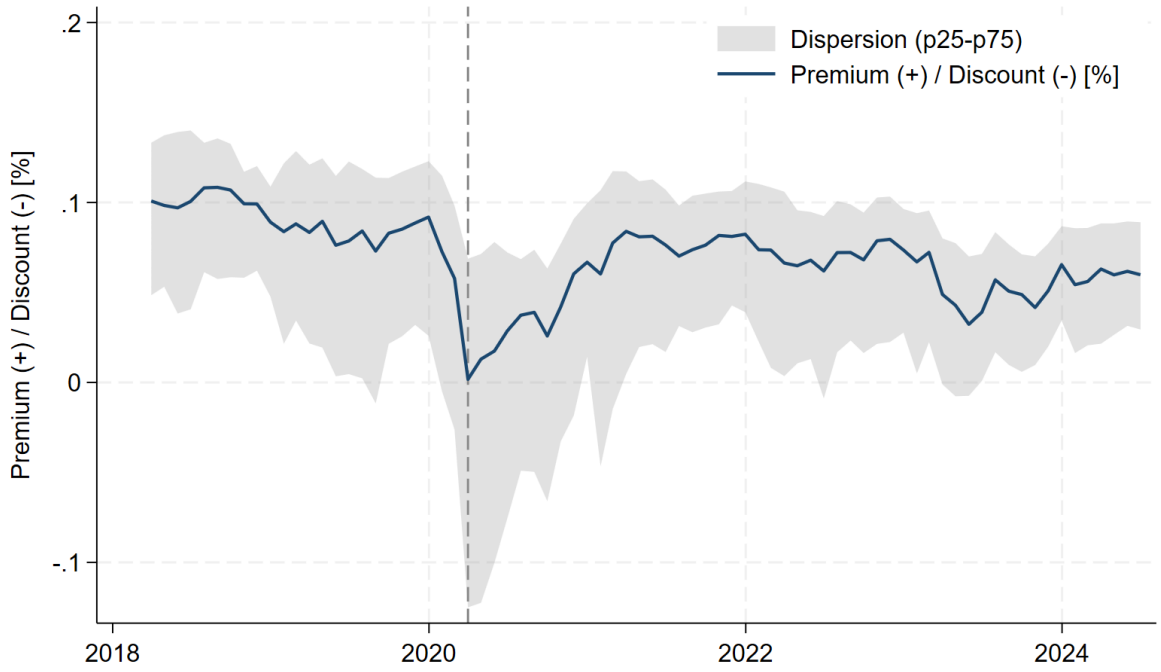
Note: This figure shows the rolling median rebuild time (in years, log scale) under a 100% rebuild expectation, split by quartiles of expected RoCET1 (FY3), recomputed each month. A horizontal line marks the 3-year supervisory horizon. Sample: 159 U.S. and European banks (March 2018–June 2024).

Figure 8: Expected Excess Returns (RoCET1 - CoE) as a Key Driver of Current P/CET1 Multiples



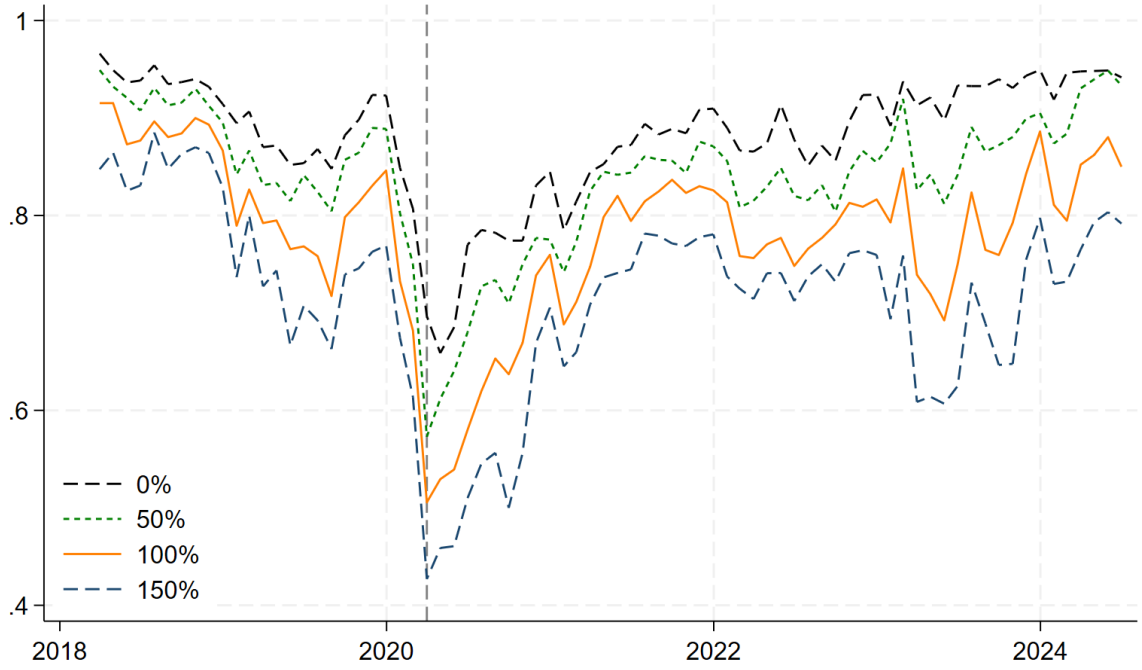
Note: This figure plots the time series of expected excess returns—defined as expected RoCET1 (FY3) minus the market-implied cost of equity (CoE)—together with current P/CET1 multiples. Negative excess returns imply expected profitability falls short of investors' required return and coincide with lower P/CET1 multiples (below unity), while positive excess returns align with higher multiples (above unity). Sample: 159 U.S. and European banks (March 2018–June 2024).

Figure 9: Management Hurdle: Median Value Shortfall (100% Rebuild)



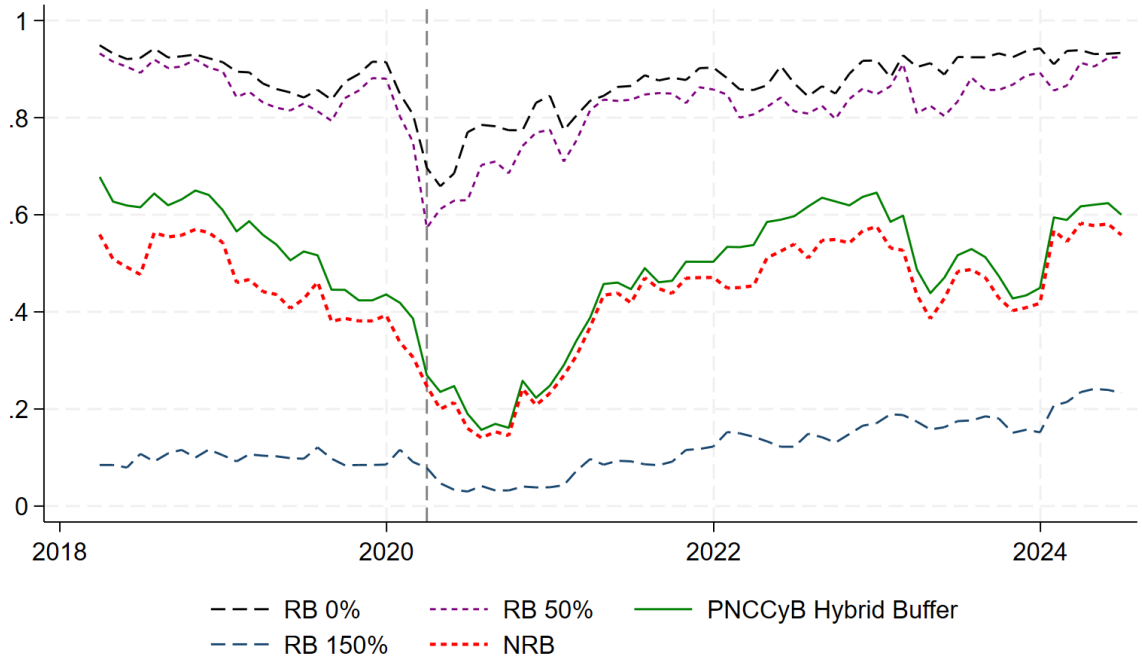
This figure shows the monthly median value shortfall, defined as the difference in fair value (P/CET1 multiple) between the buffer-use and no-use scenarios under a 100% rebuild expectation and a 3-year horizon. A positive value indicates that the bank is better off using the buffer, while a negative value indicates that the bank is worse off relative to preserving capital. The shaded band represents the inter-quartile range. Sample: 159 U.S. and European banks (March 2018–June 2024).

Figure 10: Proportion of Banks Clearing the Management Hurdle



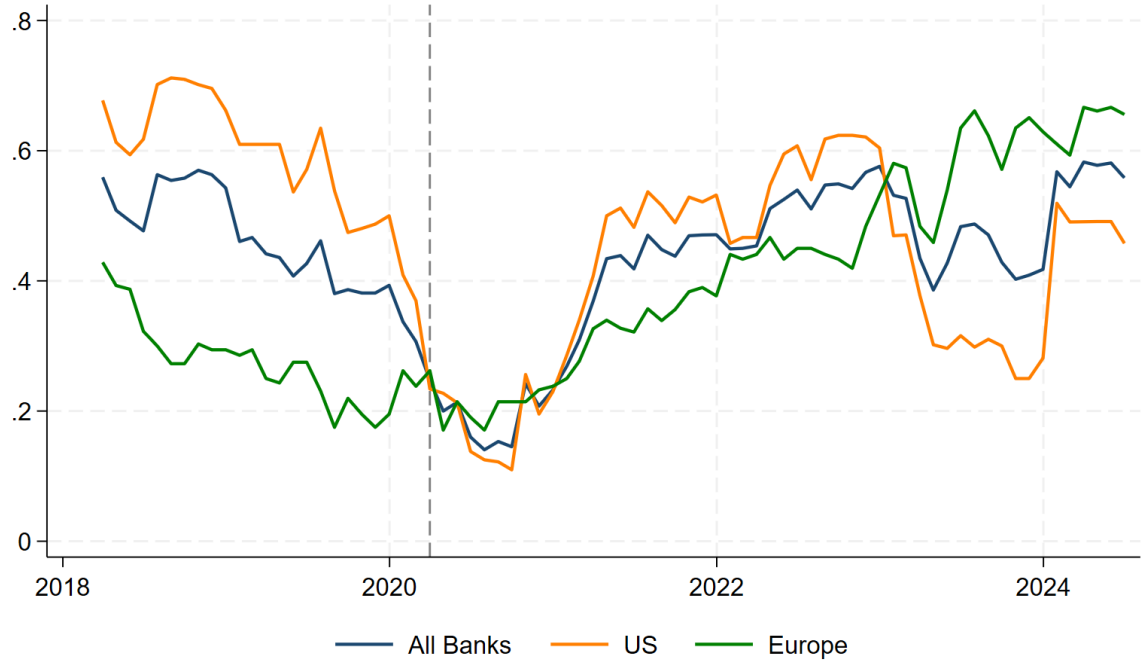
Note: This figure shows the monthly share of banks for which drawing down 2.5 pp. of RWA yields a higher price-to-CET1 fair-value multiple than the no-use scenario, evaluated at rebuild expectations of 0%, 50%, 100% and 150%. Sample: 159 U.S. and European banks (March 2018–June 2024).

Figure 11: Buffer Usability: Results by Buffer Type and Rebuild Expectations



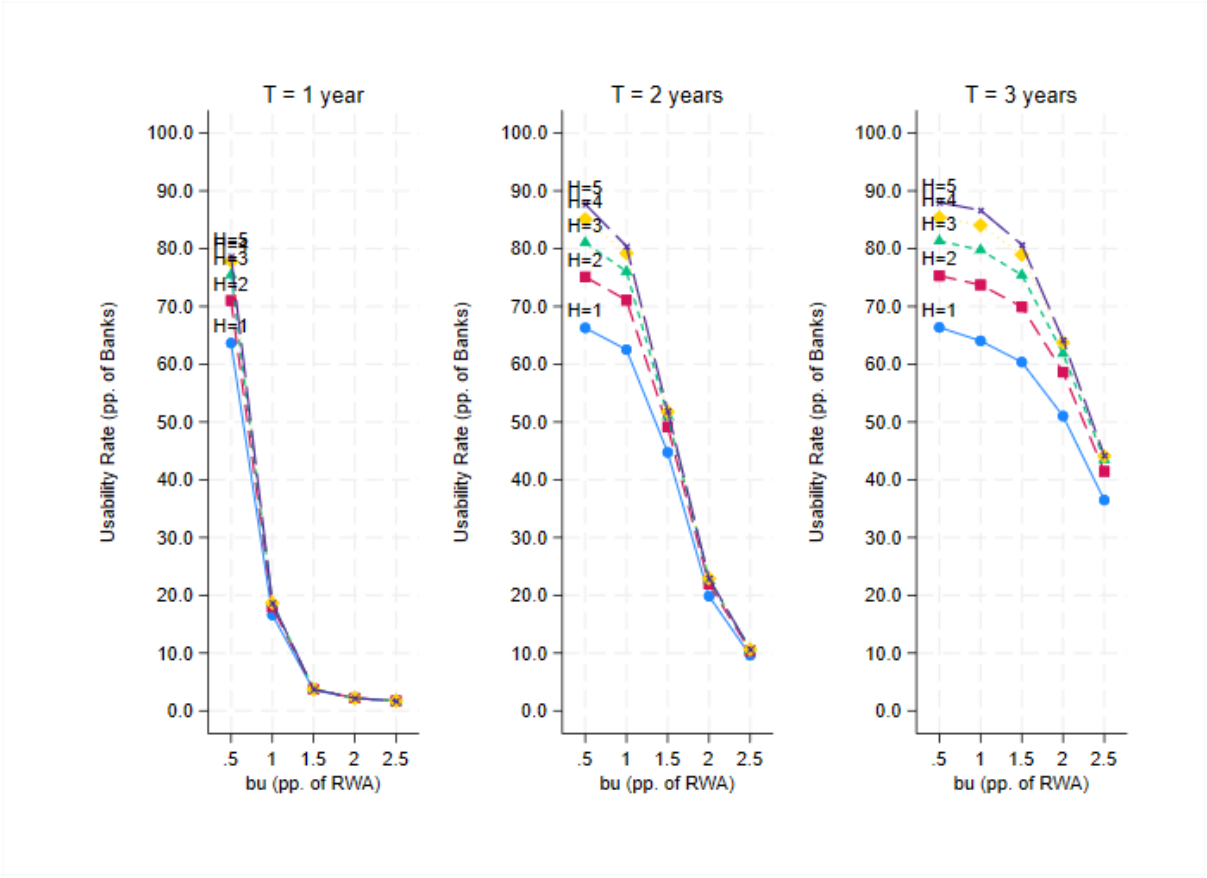
Note: This figure shows the share of banks clearing all three usability hurdles under three buffer designs—releasable (RB), non-releasable (NRB), and PN-CCyB (hybrid)—and rebuild expectations (e) of 0%, 50%, and 100% for RB. For NRB and PN-CCyB, e=100% by design. The standardized drawdown is 2.5 pp. of RWA; supervisory and valuation horizons are 3 years. Sample: 159 listed banks in the U.S. and Europe (Mar 2018–Jun 2024).

Figure 12: Buffer Usability: Results by Region (100% Rebuild)



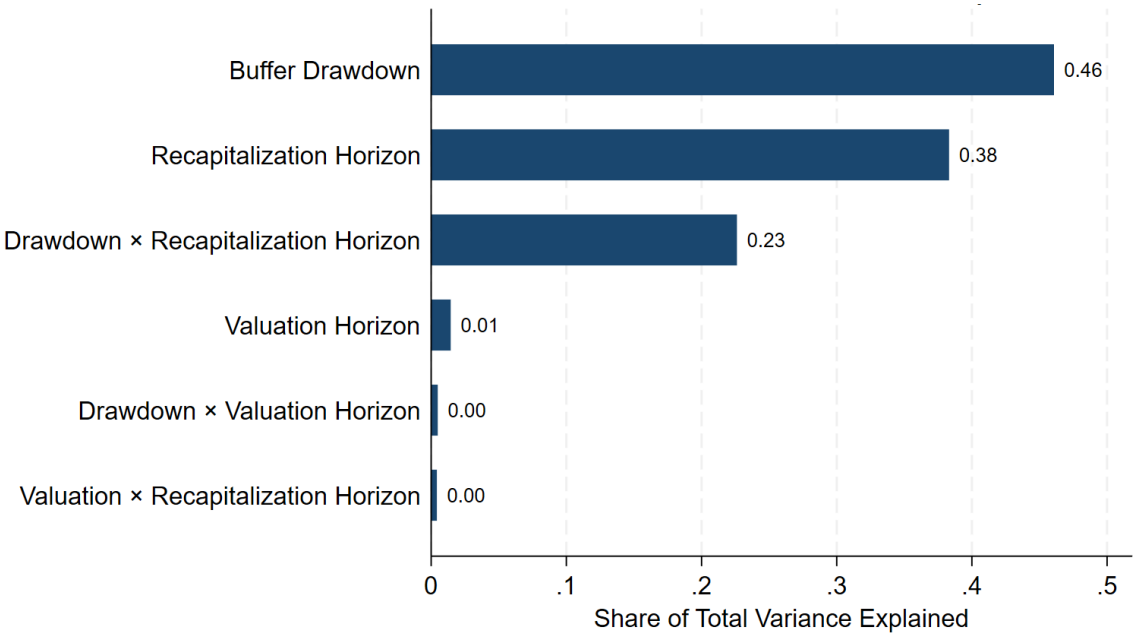
Note: This figure shows the proportion of banks clearing all three hurdles under the non-releasable buffer (100% rebuild) case from Figure 11, split by region (U.S., Europe, and full sample). Sample: 159 U.S. and European banks (March 2018–June 2024).

Figure 13: Buffer Usability: Sensitivity Analysis



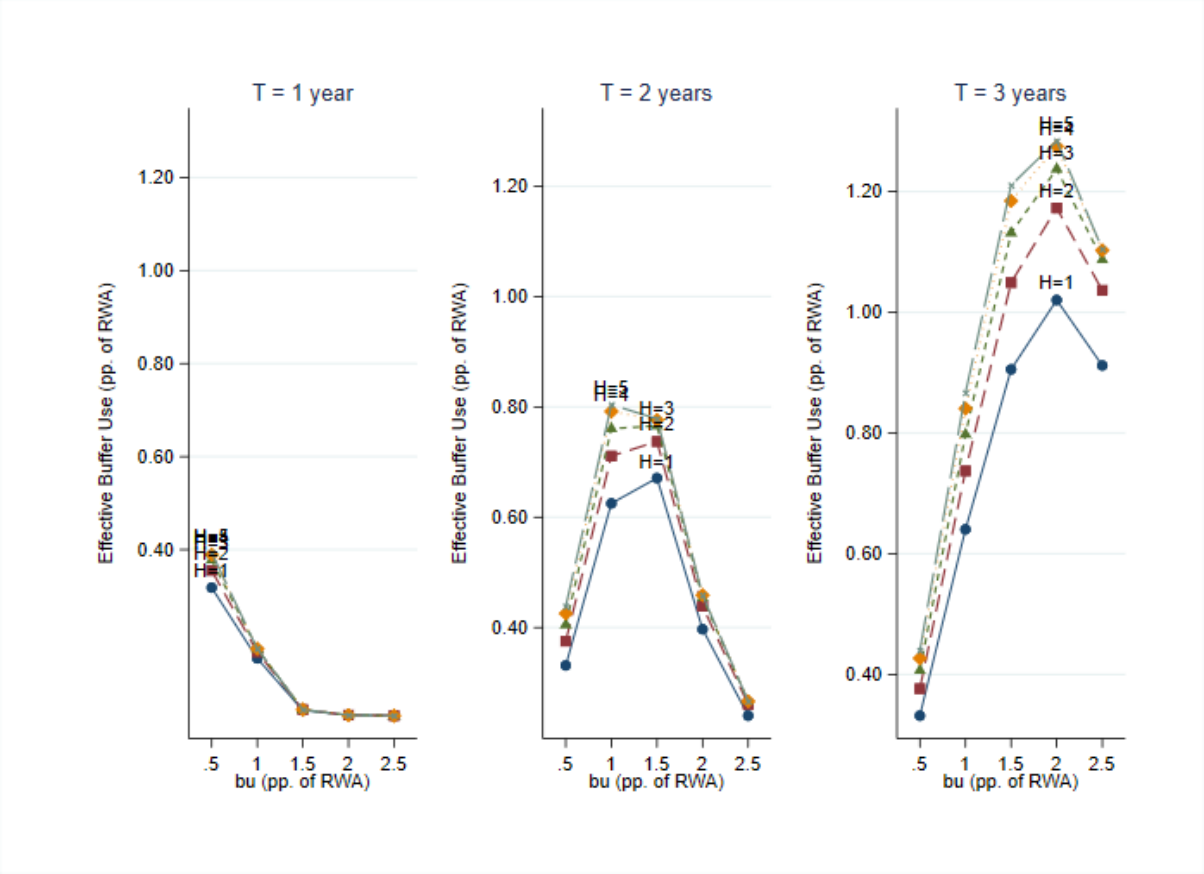
Note: Each panel reports the time-average of monthly cross-sectional shares of banks clearing all three usability hurdles under the non-releasable buffer (100% rebuild) case, varying buffer draw-down (bu at 0.5–2.5% of RWA) and valuation horizon (H at 1–5 years), for fixed recapitalization horizons (T) of 1-3 years.

Figure 14: Variance Decomposition of Buffer Usability Drivers



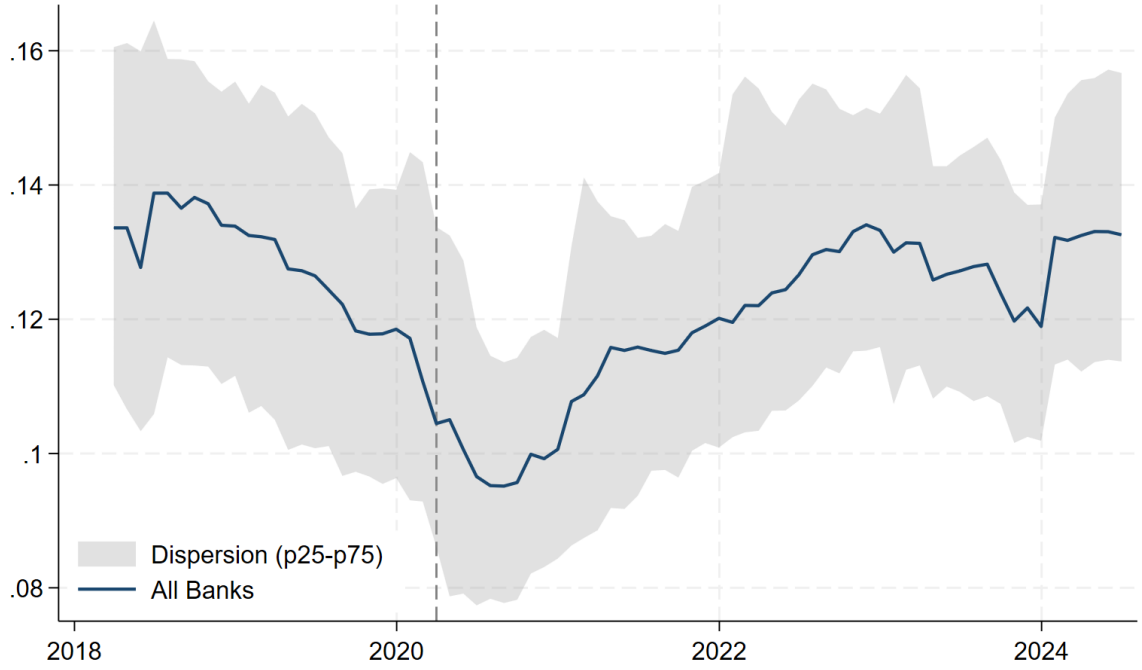
Note: This figure decomposes the variance in simulated buffer usability outcomes (from Figure 13) into contributions of buffer draw-down size (bu), recapitalization horizon (T), valuation horizon (H), and their interactions. Bars show standard eta-squared values, summing to the model's total R^2 (≈ 0.999)

Figure 15: Effective Buffer Usability: Sensitivity Analysis



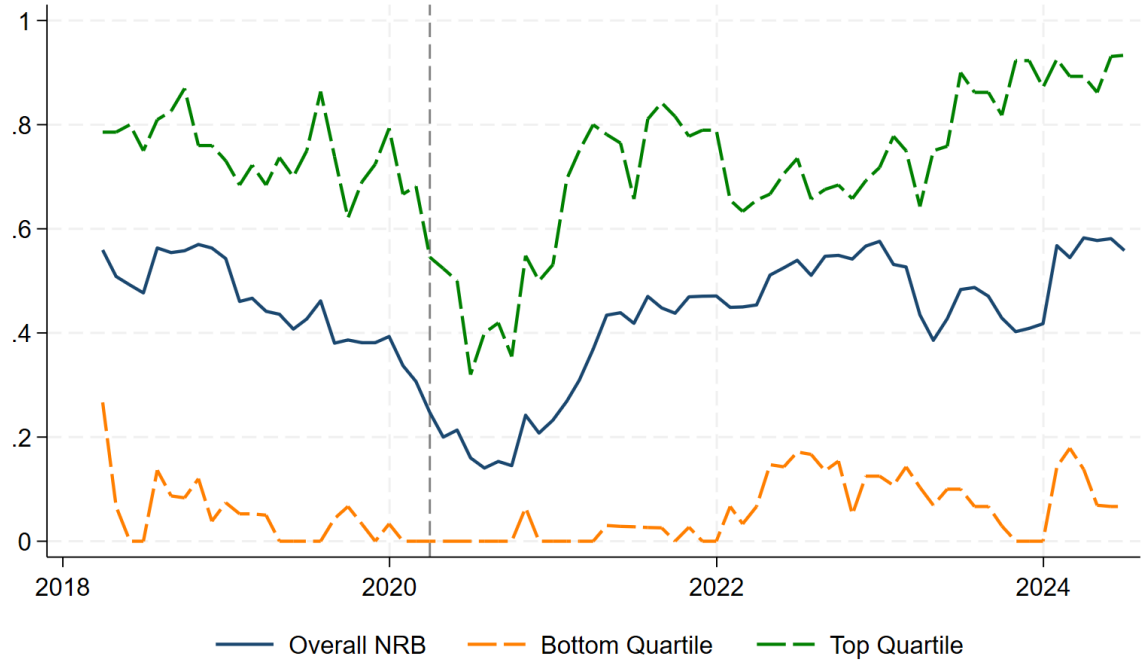
Note: Each panel reports the time-average of monthly cross-sectional effective buffer use, defined as the buffer draw-down (bu, in pp of RWA) multiplied by the share of banks clearing all three usability hurdles under the non-releasable buffer (100% rebuild) case, as reported in Figure 13. The horizontal axis varies the draw-down (bu = 0.5–2.5% of RWA) and the five lines trace alternative valuation horizons (H = 1–5 years), holding the recapitalization horizon (T) fixed at 1, 2, or 3 years across panels.

Figure 16: RoCET1 in FY3 (Median)



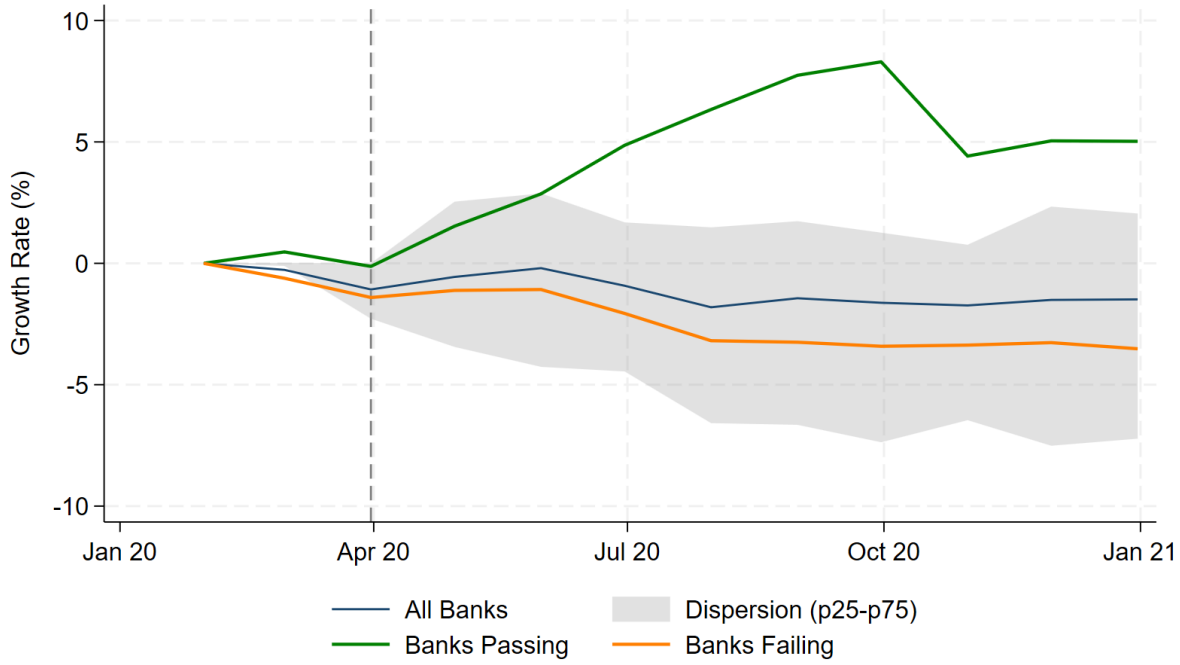
Note: This figure shows the monthly median expected RoCET1 (FY3), with a shaded band for the interquartile range (25th–75th percentiles). Sample: 159 U.S. and European banks (March 2018–June 2024).

Figure 17: Buffer Usability by Return Quartile (100% Rebuild)



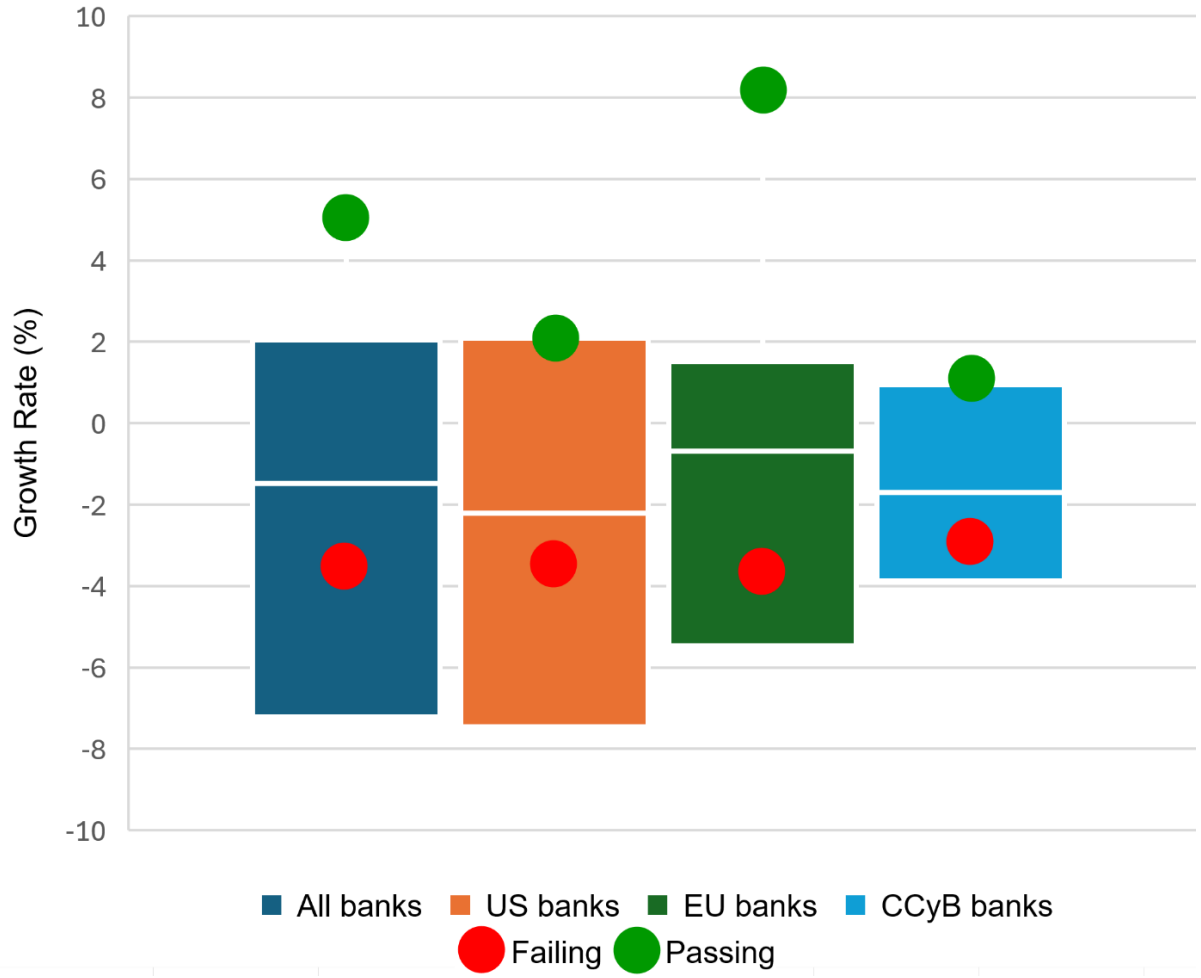
Note: This figure shows the proportion of banks clearing all hurdles under the non-releasable buffer (100% rebuild) case, split by the top and bottom quartiles of expected RoCET1 (FY3), recomputed each month. Sample: 159 U.S. and European banks (March 2018–June 2024).

Figure 18: Mean Growth in FY1 RWA Relative to January 2020 (100% Rebuild)



Note: This figure compares expected RWA growth (FY1, relative to January 2020) during 2020 for banks that clear all hurdles, those that fail, and the overall sample, under the non-releasable buffer (100% rebuild) case. The shaded band shows the inter-quartile range.

Figure 19: Mean Growth in FY1 RWA Relative to January 2020 (100% Rebuild): By Sub-Sample



Note: This figure shows expected RWA growth in FY1 relative to January 2020, using data as of December 2020. Results are presented for four subsamples: the full sample, U.S. banks, European banks, and banks benefiting from CCyB release in 2020. For each subsample, we report the mean growth separately for banks clearing all hurdles (green markers) and those failing to clear (red markers), together with the overall mean and inter-quartile range of all banks in the sample.

11 Tables

Table 1: Not All Buffers Have Been Created Equal

Releasability / **Rebuild expectations**	**Releasable Buffer (RB)**	**Non-Releasable Buffer (NRB)**
Any (from 0% to >100%)	CCyB (ex. PN-CCyB), SyRB	–
100%	PN-CCyB	All other buffers
Implications for our framework	Capacity hurdle is NOT binding	All hurdles are binding

Note: This table classifies buffers along two dimensions: (1) releasability—whether a buffer can be released or not; and (2) rebuild expectations—whether these are fixed at 100 percent or allowed to vary between zero and above 100 percent.

Table 2: Bank-Level Capital Releases

Variable	Observations	Mean	SD	Min	p25	p75	Max
Buffer Release	93	0.0021	0.0055	0	0	0.0010	0.0309
P2R Release	93	0.0024	0.0039	0	0	0.0050	0.0134

Note: This table reports descriptive statistics for two capital relief measures implemented in March 2020, during the COVID period: Buffer Release (covering reductions in CCyB and/or SyRB) and P2R Release (reductions in the CET1 component of P2R). Values are expressed as a share of RWA. The table includes the number of observations, mean, standard deviation, minimum, 25th percentile, 75th percentile, and maximum. The statistics are based on 93 bank-time observations for which capital relief data are available.

Table 3: Bank-Level Variables by Geography

Geography	Variable	Observations	Mean	SD	Min	p25	p75	Max
Europe	Growth.log.RWA	3611	0.0026	0.0286	-0.3315	-0.0036	0.0051	0.5978
	Growth.log.Loans	3443	0.0033	0.0337	-0.6554	-0.0028	0.0058	0.5877
	L.RoCET1.FY3	3611	0.1307	0.0840	0.0005	0.0892	0.1430	0.7340
	L.RoA.FY3	3611	0.0078	0.0065	0.0000	0.0041	0.0096	0.0515
	L.MB.FY1	3611	0.0476	0.0258	-0.0077	0.0314	0.0577	0.1910
	LnAssets.FY1	3611	12.1108	1.7960	7.3124	10.9046	13.7742	15.2759
	L.CoE.MI	3611	0.1634	0.0707	0.0021	0.1206	0.1908	0.8922
	L.MDA	3611	0.1022	0.0203	0.0700	0.0882	0.1100	0.1630
	L.ΔRWAD.FY1	3503	-0.0003	0.0057	-0.1550	0	0	0.1690
United States	Growth.log.RWA	4439	0.0049	0.0427	-0.3538	-0.0019	0.0050	1.2294
	Growth.log.Loans	4399	0.0047	0.0459	-0.6683	-0.0012	0.0021	1.2502
	L.RoCET1.FY3	4439	0.1287	0.0295	0.0375	0.1085	0.1464	0.3008
	L.RoA.FY3	4439	0.0117	0.0027	0.0030	0.0100	0.0134	0.0216
	L.MB.FY1	4439	0.0470	0.0237	-0.0253	0.0302	0.0580	0.1615
	LnAssets.FY1	4439	10.5879	1.4871	8.0918	9.6191	11.1126	15.2152
	L.CoE.MI	4439	0.1050	0.0367	0.0253	0.0812	0.1214	0.6124
	L.MDA	4439	0.0725	0.0087	0.0700	0.0700	0.0700	0.1230
	L.ΔRWAD.FY1	4120	-0.0008	0.0105	-0.2049	0	0	0.2438
Total	Growth.log.RWA	8050	0.0039	0.0371	-0.3538	-0.0027	0.0050	1.2294
	Growth.log.Loans	7842	0.0041	0.0410	-0.6683	-0.0018	0.0036	1.2502
	L.RoCET1.FY3	8050	0.1296	0.0604	0.0005	0.0998	0.1454	0.7340
	L.RoA.FY3	8050	0.0099	0.0051	0.0000	0.0063	0.0127	0.0515
	L.MB.FY1	8050	0.0473	0.0247	-0.0253	0.0307	0.0579	0.1910
	LnAssets.FY1	8050	11.2710	1.7999	7.3124	9.8386	12.4784	15.2759
	L.CoE.MI	8050	0.1312	0.0619	0.0021	0.0916	0.1550	0.8922
	L.MDA	8050	0.0858	0.0211	0.0700	0.0700	0.0971	0.1630
	L.ΔRWAD.FY1	7623	-0.0006	0.0086	-0.2049	0	0	0.2438

Note: This table reports descriptive statistics for key bank-level variables over the full sample period (March 2018 to June 2024), shown separately for European banks, U.S. banks, and the full sample. Expected RWA and loan growth refer to contemporaneous FY1 expectations available at each observation month. All other variables—including expected RoCET1 (FY3), RoA (FY3), management buffer (FY1), log assets (FY1), market-implied cost of equity, MDA requirement, and the change in RWA density (FY1)—are lagged by one period. The table provides mean, standard deviation, minimum, 25th and 75th percentiles, and maximum for each variable and region.

Table 4: Correlation Matrix

	L.RoCET1.FY3	L.MB.FY1	Buffer Rel * COVID	P2R Rel * COVID	L.LnAssets.FY1	L.CoE.MI	L.MDA	L.ΔRWAD.FY1
L.RoCET1.FY3	1.0000							
L.MB.FY1	0.2631	1.0000						
Buffer Rel * COVID	-0.0924	0.0576	1.0000					
P2R Rel * COVID	-0.2300	-0.0151	0.2758	1.0000				
L.LnAssets	-0.1331	-0.3933	0.0746	0.1088	1.0000			
L.CoE.MI	-0.1573	-0.2897	0.0718	0.1590	0.2576	1.0000		
L.MDA	-0.0168	-0.2024	0.1664	0.0554	0.4064	0.3788	1.0000	
L.ΔRWAD.FY1	0.0339	0.0026	-0.0331	-0.0665	0.0145	0.0049	0.0276	1.0000

Note: This table presents the pairwise correlations among the main explanatory variables used in the panel regressions. These include lagged expected profitability (RoCET1, FY3), the lagged management buffer (MB, FY1), and interaction terms for capital relief measures during the COVID period—Buffer Release × COVID and P2R Release × COVID—where the COVID dummy equals one from April to December 2020, zero otherwise. Additional variables include lagged log assets (FY1), lagged market-implied cost of equity (CoE), lagged MDA requirement, and lagged change in RWA density (FY1). The table is used to assess potential multicollinearity among regressors.

Table 5: Main Results

Dependent Variable:	ΔRWA.FY1			
Model:	(1)	(2)	(3)	(4)
L.RoCET1.FY3	0.072***		0.119***	0.167**
	0.000		0.001	0.012
L.MB.FY1	0.182***		0.229***	0.586***
	0.004		0.007	0.001
L.RoCET1.FY3 * L.MB.FY1	-0.602***		-0.835***	-0.953*
	0.001		0.003	0.079
Buffer Release * COVID		-0.037	-0.809	-0.988
		0.948	0.185	0.143
P2R Release * COVID		-0.267	0.487	0.672
		0.647	0.444	0.442
Bank-level controls	Yes	Yes	Yes	Yes
Fixed effects				
Country * Month	Yes	Yes	Yes	Yes
Bank				Yes
Fit Statistics				
Number of banks	153	85	85	84
Observations	7085	5171	5171	5170
R2	0.217	0.199	0.205	0.229
Within R2	0.010	0.006	0.013	0.030

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: This table presents the results of panel regressions analyzing the determinants of expected RWA growth in FY1 over the period March 2018 to June 2024. The dependent variable is the monthly log-difference in expected RWA in FY1. All specifications include lagged expected profitability (RoCET1) in FY3, the lagged management buffer (MB) in FY1, and their interaction. Columns 2–4 additionally include indicators for capital relief measures—Buffer Release × COVID and P2R Release × COVID—which capture the interaction between capital relief variables and a COVID dummy equal to one from April 2020 to December 2020, and zero otherwise. All regressions include the full set of lagged bank-level controls (lagged log assets, lagged market-implied cost of equity, lagged MDA requirement, and lagged change in RWA density). All panel regressions include country-by-month and bank fixed effects. Robust standard errors are clustered at the bank level.

Table 6: Determinants of Expected Profitability and Buffer Size

Dependent Variable:	MB.FY1	RoCET1.FY3
Model	(1)	(2)
L.RoCET1.FY3	-0.102***	
	0.001	
L.MB.FY1		-0.437***
Bank-level controls	Yes	Yes
Fixed effects		
Country * Month	Yes	Yes
Bank	Yes	Yes
Fit Statistics		
Number of banks	150	150
Observations	7082	7082
R2	0.887	0.922
Within R2	0.099	0.069

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: This table presents two auxiliary regressions exploring the determinants of expected profitability and capital headroom, respectively. Column 1 uses the management buffer in FY1 as the dependent variable; Column 2 uses expected RoCET1 in FY3. Both specifications include the full set of lagged bank-level controls: lagged log assets, lagged market-implied cost of equity, lagged MDA requirement, and lagged change in RWA density. Country-by-month and bank fixed effects are included. Robust standard errors are clustered at the bank level.

Table 7: Marginal Effects of RoCET1 across Management Buffer Quintiles

Level	ME	Std. Err.	z-stat	p-value	95% CI
1	0.1468	0.0615	2.39	0.017	[0.0456, 0.2479]
2	0.1360	0.0605	2.25	0.025	[0.0365, 0.2356]
3	0.1275	0.0602	2.12	0.034	[0.0285, 0.2264]
4	0.1155	0.0603	1.92	0.055	[0.0163, 0.2148]
5	0.0855	0.0639	1.34	0.181	[-0.0197, 0.1906]
Average	0.1240	0.0601	2.06	0.039	[0.0251, 0.2229]

Note: This table reports the average marginal effect of lagged expected profitability (RoCET1) (FY3) on expected RWA growth (FY1) at five quintiles of the lagged expected management buffer (MB) (FY1). Each row corresponds to one quintile, from lowest (Q1) to highest (Q5). Marginal effects are computed from the preferred specification (shown in Column 4 of Table 5).

Table 8: Marginal Effects of Management Buffer across RoCET1 Quintiles

Level	ME	Std. Err.	z-stat	p-value	95% CI
1	0.5154	0.1581	3.2600	0.0010	[0.2553, 0.7755]
2	0.4866	0.1552	3.1300	0.0020	[0.2312, 0.7420]
3	0.4705	0.1544	3.0500	0.0020	[0.2166, 0.7244]
4	0.4531	0.1540	2.9400	0.0030	[0.1998, 0.7063]
5	0.3899	0.1578	2.4700	0.0130	[0.1304, 0.6495]
Average	0.4685	0.1543	3.04	0.002	[0.2147, 0.7222]

Note: This table reports the average marginal effect of the lagged expected management buffer (MB) (FY1) on expected RWA growth (FY1) at five quintiles of lagged expected profitability (RoCET1) (FY3). Each row corresponds to one RoCET1 quintile, from lowest (Q1) to highest (Q5). Marginal effects are computed from the preferred specification (shown in Column 4 of Table 5).

Table 9: Heterogeneity by Buffer Activation

Dependent Variable:	ΔRWA.FY1	
Sample:	Full Sample (Main)	Full Sample
Model:	(1)	(2)
L.RoCET1.FY3	0.167**	0.164**
	0.012	0.027
L.MB.FY1	0.586***	0.654***
	0.001	0.001
L.RoCET1.FY3 * L.MB.FY1	-0.953*	-0.909
	0.079	0.239
Buffer release * COVID	-0.988	-0.079
	0.143	0.935
P2R * COVID	0.672	0.510
	0.442	0.582
Activated Buffer * L.RoCET1.FY3		0.021
		0.746
Activated Buffer * L.MB.FY1		-0.444**
		0.014
Activated Buffer * L.RoCET1.FY3*L.MB.FY1		0.620
		0.290
Bank-level controls	Yes	Yes
Fixed effects		
Country * Month	Yes	Yes
Bank	Yes	Yes
Post-Estimation: Activated vs. Non-Activated Buffer		
L.RoCET1.FY3 Effect if Activated (lincom):		0.1851***
L.RoCET1.FY3 Slope Difference (F-stat):		0.7456
L.MB.FY1 Effect if Activated (lincom):		0.2104*
L.MB.FY1 Slope Difference (F-stat):		0.0144
L.RoCET1.FY3 * L.MB.FY1 Effect if Activated (lincom):		-0.2883
L.RoCET1.FY3 * L.MB.FY1 Slope Difference (F-stat):		0.2900
Fit Statistics		
Number of banks	84	84
Observations	5170	5170
R2	0.229	0.231
Within R2	0.030	0.032

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: In this table, Column 2 extends the baseline specification (replicated in Column 1, as originally shown in Column 4 of Table 5) by allowing for heterogeneity in the effects of expected profitability (RoCET1), capital headroom (MB), and their interaction based on buffer activation status. The model includes a lagged indicator for macroprudential buffer activation (CCyB or SyRB) and interacts it with the key explanatory variables. All bank-level controls (lagged log assets, lagged cost of equity, lagged MDA, and lagged change in RWA density) and model structure remain consistent with the preferred specification. Country-by-month and bank fixed effects are included, and robust standard errors are clustered at the bank level. Post-estimation tests compare marginal effects across banks with and without activated buffers.

Table 10: Additional Heterogenity Analysis

Dependent Variable:	ΔRWA.FY1		
Model:	(1)	(2)	(3)
L.RoCET1.FY3	0.167**	0.168**	0.167**
	0.012	0.011	0.017
L.MB.FY1	0.586***	0.587***	0.542***
	0.001	0.001	0.002
L.RoCET1.FY3 * MB.FY1	-0.953*	-0.957*	-0.982*
	0.079	0.073	0.069
Buffer Release * COVID	-0.988	-1.138	-0.634
	0.143	0.167	0.406
P2R Release * COVID	0.672	0.881	2.179*
	0.442	0.511	0.058
Buffer Release * COVID * RoCET1.FY3		1.707	
		0.626	
P2R Release * COVID * RoCET1.FY3		-4.654	
		0.793	
Buffer Release * COVID * MB.FY1.Jan			6.174
			0.216
P2R Release * COVID * MB.FY1.Jan			-37.408
			0.127
Bank-level controls	Yes	Yes	Yes
Fixed effects			
Country * Month	Yes	Yes	Yes
Bank	Yes	Yes	Yes
Fit Statistics			
Number of banks	84	84	70
Observations	5170	5170	4663
R2	0.229	0.229	0.241
Within R2	0.030	0.030	0.031

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: This table extends the baseline specification (replicated in Column 1, as originally shown in Column 4 of Table 5) by testing for heterogeneity in the effects of capital relief measures across two dimensions. Column 2 interacts the capital relief variables (Buffer Release × COVID and P2R Release × COVID) with expected profitability (RoCET1) in FY3. Column 3 interacts the same relief terms with pre-COVID capital headroom, measured as the Management Buffer in FY1 as of January 2020. All bank-level controls (lagged log assets, lagged cost of equity, lagged MDA, and lagged change in RWA density) and model structure remain consistent with the preferred specification. Country-by-month and bank fixed effects are included, and robust standard errors are clustered at the bank level.

Table 11: Regional Segmentation

Dependent Variable:	ΔRWA.FY1			
Sample:	Full (Main)	Full	Europe	U.S.
Model:	(1)	(2)	(3)	(4)
L.RoCET1.FY3	0.167**	0.275**	0.101**	0.255**
	0.012	0.031	0.014	0.035
L.MB.FY1	0.586***	0.859***	0.244**	0.843***
	0.001	0.003	0.034	0.002
L.RoCET1.FY3 * MB.FY1	-0.953*	-2.272*	-0.513	-2.239*
	0.079	0.059	0.284	0.063
Buffer Release * COVID	-0.988	-0.767	-0.396	0.000
	0.143	0.136	0.494	.
P2R Release * COVID	0.672	0.409	-0.373	0.000
	0.442	0.596	0.563	.
Europe * RoCET1.FY3		-0.165		
		0.213		
Europe * MB.FY1		-0.559*		
		0.061		
Europe * RoCET1.FY3 * MB.FY1		1.665		
		0.190		
Bank-level controls	Yes	Yes	Yes	Yes
Fixed effects				
Country * Month	Yes	Yes	Yes	Yes
Bank	Yes	Yes	Yes	Yes
Post-Estimation: Regional RoCET1 Effect				
L.RoCET1.FY3 in Europe (lincom):		0.110***		
Europe vs. USA (F-test, p-value):		0.2134		
L.MB.FY1 Effect in Europe (lincom):		0.299***		
L.MB.FY1 Slope Difference (F-stat):		0.0614		
L.RoCET1.FY3 * L.MB.FY1 Effect in Europe (lincom):		-0.607		
L.RoCET1.FY3 * L.MB.FY1 Slope Difference (F-stat):		0.1904		
Fit Statistics				
Number of banks	84	84	31	53
Observations	5170	5170	2001	3169
R2	0.229	0.231	0.438	0.186
Within R2	0.030	0.031	0.028	0.036

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: This table investigates regional heterogeneity in the determinants of expected RWA growth. Column 1 replicates the baseline specification (as originally shown in Column 4 of Table 5). Column 2 interacts key variables—expected profitability (RoCET1), capital headroom (MB), and their interaction—with a Europe dummy to test for slope differences between European and U.S. banks. Columns 3 and 4 estimate the baseline model separately for the European and U.S. sub-samples. All bank-level controls (lagged log assets, lagged cost of equity, lagged MDA, and lagged change in RWA density) and model structure remain consistent with the preferred specification. Country-by-month and bank fixed effects are included, and robust standard errors are clustered at the bank level. Post-estimation tests assess whether the coefficients differ significantly across regions.

Table 12: Alternative Dependent Variables

Dependent variables:	ΔRWA.FY1 (Main)	ΔLoans.FY1
Model:	(1)	(2)
L.RoCET1.FY3	0.167**	0.116*
	0.012	0.084
L.MB.FY1	0.586***	0.327***
	0.001	0.010
L.RoCET1.FY3 * MB.FY1	-0.953*	-1.698***
	0.079	0.001
Buffer Release * COVID	-0.988	0.006
	0.143	0.992
P2R Release * COVID	0.672	0.201
	0.442	0.810
Bank-level controls	Yes	Yes
Fixed effects		
Country * Month	Yes	Yes
Bank	Yes	Yes
Fit Statistics		
Number of banks	84	84
Observations	5170	5100
R2	0.229	0.238
Within R2	0.030	0.018

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: This table tests the robustness of the baseline results using an alternative dependent variable—expected loan growth—in place of expected RWA growth in FY1. Column 1 reproduces the preferred specification using RWA growth (as originally shown in Column 4 of Table 5). Column 2 replaces the dependent variable with the monthly log-difference in expected total loans. Both specifications include country-by-month and bank fixed effects, as well as the full set of lagged bank-level controls (lagged log assets, lagged cost of equity, lagged MDA, and lagged change in RWA density). Robust standard errors are clustered at the bank level.

Table 13: Alternative Variable of Interest

Dependent Variable:	ΔRWA.FY1	
Variable of Interest:	L.RoCET1.FY3 (Main)	L.RoA.FY3
Model:	(1)	(2)
L.RoCET1.FY3	0.167**	
	0.012	
L.MB.FY1	0.586***	0.581***
	0.001	0.004
L.RoCET1.FY3 * MB.FY1	-0.953*	
	0.079	
Buffer Release * COVID	-0.988	-1.047
	0.143	0.135
P2R Release * COVID	0.672	0.695
	0.442	0.388
L.RoA.FY3		2.063**
		0.046
L.RoA.FY3 * MB.FY1		-17.409
		0.118
Bank-level controls	Yes	Yes
Fixed effects		
Country * Month	Yes	Yes
Bank	Yes	Yes
Fit Statistics		
Number of banks	84	84
Observations	5170	5170
R2	0.229	0.228
Within R2	0.030	0.028

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: This table assesses the robustness of the baseline results to an alternative measure of profitability. Column 1 reproduces the preferred specification using expected return on CET1 (RoCET1) in FY3 as the key profitability variable (as originally shown in Column 4 of Table 5). Column 2 replaces RoCET1 with expected return on assets (RoA) in FY3 and includes its interaction with the management buffer. Both specifications include country by-month and bank fixed effects, as well as the full set of lagged bank-level controls (lagged log assets, lagged cost of equity, lagged MDA, and lagged change in RWA density). Robust standard errors are clustered at the bank level.

Table 14: A Focus on COVID: A Cross-Sectional DiD Approach (2020)

Dependent Variable:	ΔRWA.FY1	ΔLoans.FY1
Model:	(1)	(2)
Post	0.016	0.020
	0.132	0.125
High RoCET1.FY3	0.006	0.006
	0.242	0.353
Post * High RoCET1.FY3	0.038**	0.002
	0.012	0.909
Low MB.Jan.FY1	-0.007	0.003
	0.201	0.492
Post * Low MB.Jan.FY1	-0.013	-0.008
	0.215	0.517
High RoCET1.FY3 * Low MB.Jan.FY1	0.002	-0.003
	0.743	0.623
Post * High RoCET1.FY3 * Low MB.Jan.FY1	-0.030*	-0.004
	0.094	0.870
Post * Buffer Release	-0.282	-0.392
	0.614	0.579
Post * P2R Release	-1.580	-2.069
	0.208	0.132
Bank-level controls	No	No
Fixed effects		
Country * Month	No	No
Bank	No	No
Post-Estimation Statistics		
Post * High RoCET1.FY3 (lincom)	0.045***	0.009
Post * High RoCET1.FY3 * Low MB.Jan-FY1 (lincom)	0.015	0.005
Post * High RoCET1.FY3 * Low MB.Jan-FY1 (F-stat)	2.87*	0.03
Post * Buffer Release (lincom)	-0.51	-0.39
Post * P2R Release (lincom)	-1.75	-2.16
Fit Statistics		
Number of banks	77	75
Observations	152	148
R2	0.217	0.071

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: This table presents cross-sectional difference-in-differences (DiD) estimates using 2020 data to assess heterogeneity in banks' balance sheet responses to the COVID shock. The dependent variables are cumulative growth in expected RWA (Column 1) and gross loan volumes (Column 2) over FY1, measured between January–March (pre-COVID) and April–December (post-COVID). Regressions include continuous treatment variables for macroprudential buffer releases (CCyB + SyRB) and P2R relief, each interacted with the post dummy. Cross-sectional heterogeneity is introduced via two binary indicators: high expected profitability (top third of RoCET1, FY3) and low management buffers (bottom third of MB, FY1 as of January 2020). Fixed effects and time-varying controls are excluded to preserve identification in the collapsed bank–period structure. Post-estimation rows 1–2 report slope differences (lincom): the net post-COVID effect for high-RoCET1 banks and for the joint group of high-RoCET1 & low-MB banks. Row 3 reports the incremental effect of low management buffers on the high-RoCET1 difference (triple interaction, F-test). Rows 4–5 show DiD contrasts (post–pre slopes) for buffer releases and P2R relief. Robust standard errors are clustered at the bank level.

Table 15: Robustness to Estimator Choice

Dependent Variable:	ΔRWA.FY1			
Estimator:	Two-way FE (Main)	Two-Step System GMM	LPM	Logit
Model:	(1)	(2)	(3)	(4)
L.RoCET1.FY3	0.167**	0.074***	1.308***	7.649***
	0.012	0.006	0.001	0.000
L.MB.FY1	0.586***	0.114**	4.866***	28.266***
	0.001	0.012	0.000	0.000
L.RoCET1.FY3 * MB.FY1	-0.953*	-0.544***	-13.916***	-86.048***
	0.079	0.006	0.001	0.000
Buffer Release * COVID	-0.988	-0.071	13.158	100.839
	0.143	0.447	0.264	0.285
P2R Release * COVID	0.672	-0.054	3.347	30.820
	0.442	0.797	0.712	0.543
L.ΔRWA.FY1		-0.088		
		0.712		
Bank-level controls	Yes	Yes	Yes	Yes
Fixed effects				
Month		Yes		
Country * Month	Yes		Yes	Yes
Bank	Yes		Yes	Yes
Fit Statistics				
Number of banks:	84	92	84	84
Observations	5170	5708	5170	4567
R2	0.229		0.280	
Within R2	0.030		0.006	
GMM Statistics				
Number of instruments:		87		
AR(1) p-value:		0.061		
AR(2) p-value:		0.574		
Hansen p-value:		0.445		
Difference-in-Hansen p-value:		0.943		
Logit Statistics (Marginal effects)				
L.RoCET1.FY3				0.7495
L.MB.FY1				3.4767
Buffer Release * COVID				20.026
P2R Release * COVID				6.1207

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: This table compares the baseline fixed-effects estimator (Column 1, as originally shown in Column 4 of Table 5) with alternative estimation methods. Column 2 reports results from a two-step system GMM estimator, using second to fourth lags, collapsed, as instruments. Columns 3 and 4 estimate linear probability and logit models, respectively, using a binary dependent variable that equals one when expected RWA growth in FY1 is positive, zero otherwise. All specifications include the full set of lagged bank-level controls (lagged log assets, lagged cost of equity, lagged MDA, and lagged change in RWA density). Fixed effects vary by model and are noted in the table. Robust standard errors are clustered at the bank level. GMM-specific post-estimation diagnostics are reported. For the logit model, marginal effects are also reported to facilitate interpretation of coefficient magnitudes.

Table 16: Peaks of Effective Buffer Use by Rebuild Horizon T

Panel A: Peak Effective Buffer Use (pp. of RWA)

T	Concavity	Peak (pp.)	95% CI low	95% CI high	Discrete argmax
1	Convex***	0.364	0.342	0.386	0.367
2	Concave***	0.719	0.660	0.777	0.746
3	Concave***	1.167	1.113	1.222	1.198

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Panel B: Nominal Release (pp. of RWA) at Peak Effective Buffer Use

T	Concavity	Release (pp.)	95% CI low	95% CI high	Discrete argmax
1	Convex***	0.500	–	–	0.500
2	Concave***	1.354	1.296	1.412	1.500
3	Concave***	1.973	1.923	2.023	2.000

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Panel C: Usability: Peak Effective Buffer Use (% of Nominal Release)

T	Concavity	Usability (%)	95% CI low	95% CI high	Discrete argmax
1	Convex***	69.1	62.4	75.8	73.3
2	Concave***	54.8	50.3	59.3	49.7
3	Concave***	60.9	57.9	63.9	59.9

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: Panel A reports the *maximum* effective buffer use (pp. of RWA) for each recapitalization horizon T. Panel B reports the *nominal release* at which that maximum occurs. For T=1, the quadratic fit is convex ($b_2 > 0$); hence there is no interior maximum and the peak occurs at the boundary of the simulation grid (0.5 pp.), which is therefore shown. Panel C reports the *usability at the peak*—the share of released capital that is usable system-wide at the point where Panel A is attained. The small gap between the quadratic and discrete usability rates for T=1 reflects the limited precision of the quadratic approximation at the grid edge, where the fit smooths over a steep nonlinearity. The last column in each panel shows the non-parametric discrete argmax from the simulation grid.

Table 17: Peaks of Effective Buffer Use (POST Apr–Dec 2020)

Panel A: Pooled Sample (Total Relief = Buffers + P2R)

Specification	Peak Release (pp.)	Peak Use (pp.)	Usability (%)
Fixed knots (1.0 / 1.5 / 2.0)	1.000*	0.509**	50.87**
Quantile knots (25 / 50 / 75)	1.010**	0.550**	54.47*

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Panel B: Profitability Heterogeneity (High RoE)

Group	Peak Release (pp.)	Peak Use (pp.)	Usability (%)
High RoE = 0 (base)	1.500**	0.390	26.03
High RoE = 1	1.400***	0.895	63.95

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Panel C: Capital Headroom Heterogeneity (Low MB)

Group	Peak Release (pp.)	Peak Use (pp.)	Usability (%)
Low MB = 0 (base)	0.999	0.501	50.12
Low MB = 1	1.000***	0.540	54.02

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Note: Panel A reports pooled estimates for total capital relief (buffers + P2R) using both fixed and data-driven spline specifications. Panels B and C split the sample by profitability (High RoE = top tercile of Jan–2020 $RoCET1^{FY3}$) and capital headroom (Low MB = bottom tercile of Jan–2020 management buffer). All regressions include bank and month fixed effects and 500 cluster bootstraps by bank. Reported coefficients correspond to the estimated peak release (pp. of RWA), the associated effective use (pp.), and the implied usability rate ($100 \times y^*/x^*$). For the quantile-knot specification, the data-driven knot locations are $k_1 = 0.700$ (p25), $k_2 = 1.010$ (p50), and $k_3 = 1.368$ (p75), measured in pp. of RWA and computed over POST banks with positive relief. Because most 2020 releases were below 1 pp. of RWA, the right-hand side of the curve is only weakly identified; the estimated profiles should therefore be interpreted as consistent with—but not a full mapping of—the concave relationship predicted by the model.

Table 18: Spline Slopes and Quadratic Tests (Total Relief; POST Apr–Dec 2020)

Panel A: Pooled Sample

Specification	m_1	m_2	m_3	m_4	**Wald** p
Quantile knots (25 / 50 / 75)	0.430	1.234	0.273	0.362	0.781

Curvature test	**Coef.**	**[95% CI]**	p
Quadratic (POST, month FE)	0.073**	[0.011, 0.135]	0.021
DiD: POST×tr^2 (two-way FE)	-0.072	[-0.207, 0.063]	0.290

Panel B: Profitability Heterogeneity (High RoE)

Group	m_1	m_2	m_3	m_4	**Wald** p
High RoE = 0 (base)	-0.042	2.050	1.504	1.540	0.663
High RoE = 1	0.316	1.765***	1.765***	—	0.000

Curvature test	**Coef.**	**[95% CI]**	p
High RoE = 0 (POST, month FE)	0.082**	[0.020, 0.145]	0.011
High RoE = 1 (POST, month FE)	-4.476***	[-6.062, -2.891]	0.000

Panel C: Capital Headroom Heterogeneity (Low MB)

Group	m_1	m_2	m_3	m_4	**Wald** p
Low MB = 0 (base)	0.079	1.814*	0.187	0.345	0.517
Low MB = 1	1.003**	-3.684***	1.311**	-21.862***	0.000

Curvature test	**Coef.**	**[95% CI]**	p
Low MB = 0 (POST, month FE)	0.059	[-0.020, 0.137]	0.142
Low MB = 1 (POST, month FE)	0.369	[-0.476, 1.213]	0.376

Note: This table reports POST marginal slopes by spline segment (m_1 lowest–relief) and curvature tests. Slopes come from a linear–spline panel with bank and month fixed effects; knots are data-driven (p25/p50/p75) on POST observations with $tr_{pp} > 0$. "Wald p" tests $H_0 : m_1 = m_2 = m_3 = m_4$. "Quadratic (POST, month FE)" is the coefficient on tr_{pp}^2 in POST-only regressions with month FE (identified from cross-bank variation); "DiD: POST×tr^2" is the coefficient on $1\{\text{POST}\} \times tr_{pp}^2$ in a two-way FE model (bank and month). Standard errors are clustered by bank; stars denote two-sided p-values (* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$). Segments may be omitted where POST support is thin; when a segment is omitted, cumulative slopes can coincide (e.g., $m_2 = m_3$).