OESTERREICHISCHE NATIONALBANK
EUROSYSTEM

Working Paper 269

From Official Guidelines to Practice:
Decoding Europe's Countercyclical Capital Buffer Decisions

Zsofia Döme, Michael Sigmund

OESTERREICHISCHE NATIONALBANK
EUROSYSTEM

OeNB Working Paper 269 | Oct. 2025
42 pages

From official guidelines to practice: decoding Europe's countercyclical capital buffer decisions

In this study, we analyze how European regulators set the countercyclical capital buffer (CCyB). We find that they do not strictly follow international rules. Instead, decisions are often made using a positive, cycle-neutral buffer. If these rules had existed before the 2007–2008 global financial crisis, banks would have had enough capital to avoid government help.

Authors

Zsofia Döme
Liechtensteinstein Financial Market Authority, Macroprudential Supervision, Financial Stability Division
sophia.doeme@fma-li.li

Michael Sigmund
Oesterreichische Nationalbank, Economic Analysis and Research Department
michael.sigmund@oenb.at

JEL classification
E32, E58, E61, G21, G28

Keywords
countercyclical capital buffer, macroprudential policies, financial cycles

Improving bank resilience

If regulators had applied the CCyB methodology before the 2007–2008 crisis, banks would have built up €289bn in extra capital. This amount would have exceeded the €240bn governments spent to stabilize financial institutions across the EU afterward.

Drivers of CCyB rates

CCyB rates are mainly influenced by supervisory funding structures and whether authorities apply a positive, cycle-neutral buffer, meaning banks hold a small, permanent capital cushion even in normal times.

About the study

The study uses linear and non-linear models with BIS, ECB and World Bank data to analyse how CCyB rates are set in Europe. It also highlights future research on the costs and benefits of positive cycle-neutral buffers and on harmonizing frameworks to improve policy effectiveness.

From Official Guidelines to Practice: Decoding Europe's Countercyclical Capital Buffer Decisions

Zsofia Döme[1], Michael Sigmund[2]

Abstract

Since 2014, several countries have implemented the Basel III countercyclical capital buffer (CCyB) to enhance the banking sector's resilience against risks arising from excessive credit growth. We analyze the CCyB decision-making process of macroprudential authorities across Europe. Our findings indicate that macroprudential authorities neither follow the Basel Committee on Banking Supervision (BCBS) guide, based on the credit-to-GDP gap, nor do they rely on the variables recommended by the European Systemic Risk Board when setting the CCyB rate. However, we demonstrate that had the BCBS CCyB guide been applied prior to the global financial crisis of 2007–2008, capital reserves within the European banking sector would have been sufficient to cover the 240 billion euros in government support used to stabilize financial institutions. Our results show that CCyB decision rates are predominantly influenced by a positive cycle-neutral CCyB approach and the funding structure of banking supervision.

Keywords: Countercyclical capital buffer; Macroprudential policies; Financial cycles
JEL Classification: E32; E58; E61; G21; G28

Email addresses: sophia.doeme@fma-li.li (Zsofia Döme), michael.sigmund@oenb.at (Michael Sigmund)

[1]Financial Market Authority Liechtenstein, Landstrasse 109, 9490 Vaduz, Liechtenstein.

[2]Oesterreichische Nationalbank (OeNB), Otto-Wagner-Platz 3, A-1090 Vienna, Austria. The views expressed in this paper are those of the authors and do not necessarily reflect those of the Eurosystem, the OeNB and the Liechtenstein FMA.

Non-Technical summary

The countercyclical capital buffer (CCyB) is a key capital-based macroprudential instrument which was designed by the Basel Committee on Banking Supervision (BCBS) in 2010 (BIS, 2010a). The instrument was set up as a response to the global financial crisis of 2007–2008, as part of the Basel III framework. It was legally introduced in 2014 to increase the resilience of the banking sector to cyclical risks. The main objective of the CCyB is to raise banks' Common Equity Tier 1 (CET1) capital requirement when risks in the financial system build up, i.e., when credit has grown to excessive levels.

The BCBS provided guidance to macroprudential authorities for setting the CCyB rate, following the principle of "guided discretion" (BIS, 2010d). This rules-based assessment includes the so-called "credit-to-GDP gap" and a piecewise linear function to translate the credit-to-GDP gap into a CCyB rate. The BCBS guideline highlights that while the credit-to-GDP gap is a useful starting point in guiding decisions on the CCyB rates, its performance can differ across countries and over time as it sometimes gives misleading signals. Given the heterogeneity and the dynamic nature of financial systems, macroprudential authorities should therefore not only rely on a strict rules-based regime related to the credit-to-GDP gap, but also consider discretionary powers by taking into account other indicators when assessing credit growth before setting the CCyB (ESRB, 2014).

In this paper, we first examine whether the additional capital build-up by strictly following the rules-based BCBS CCyB guidance would have been sufficient to cover the losses related to the global financial crisis of 2007–2008 if the measure had been available for macroprudential authorities. Second, we explore the primary determinants of CCyB rates in light of the different CCyB approaches and characteristics as well as the macroprudential stance of the macroprudential regulator. We ask whether authorities follow the BCBS CCyB guidance, the ESRB recommendation (ESRB, 2014), or the positive cycle-neutral CCyB approach, under which a positive "default" CCyB rate is set in normal times unrelated to the credit cycle.

First, we find that if macroprudential authorities had followed the rules-based BCBS CCyB methodology, sufficient additional capital would have been built up in the banking sector in many countries before the global financial crisis of 2007–2008. Approximately 289 billion euros would have been available in 2006 to cover the losses of the global financial crisis of 2007–2008, when summing up the additional capital requirement that banks would have built up if the BCBS CCyB guidance had been in place. The total costs for governments to support financial institutions in the aftermath of the global financial crisis of 2007–2008 in the European Union were estimated to be around 240 billion euros between 2007 and 2017, as reported by Eurostat (2015, 2018).

Second, we find that the CCyB decision is neither driven by the BCBS CCyB guidance nor by the variables listed in the ESRB recommendation. Instead, the CCyB decision is driven by the supervisory funding structure and, even more importantly, whether macroprudential authorities apply the positive cycle-neutral CCyB rate approach in normal times.

1. Introduction

The countercyclical capital buffer (CCyB) is a key capital-based macroprudential instrument which was designed by the Basel Committee on Banking Supervision (BCBS) in 2010 (BIS, 2010a). The instrument was set up as a response to the global financial crisis of 2007–2008, as part of the Basel III framework. It was legally introduced in 2014 to increase the resilience of the banking sector to cyclical risks. The main objective of the CCyB is to raise banks' Common Equity Tier 1 (CET1) capital requirement for domestic exposures, when risks in the financial system build up, i.e., when credit has grown to excessive levels. The purpose of the buffer is to prevent negative effects on the real economy by protecting the banking sector from periods of excessive credit growth, which were often followed by costly financial crises (Laeven and Valencia, 2012). In this case, the CCyB should be released, which ensures that banks have the capacity to absorb losses by using the released capital. The aim of the CCyB is to continue maintaining the flow of credit to the economy without being constrained by regulatory capital requirements (BIS, 2010a,d).

The BCBS provides guidance for macroprudential authorities on setting the CCyB rate, emphasizing the principle of "guided discretion" (BIS, 2010d). Under this approach, macroprudential authorities monitor overall credit growth in their countries and assess whether it has grown to excessive levels, using the "credit-to-GDP gap" as a key indicator to determine the CCyB rate. The BCBS guideline highlights that while the credit-to-GDP gap is a useful starting point in guiding decisions on the CCyB rates, its performance can differ across countries and over time, as it sometimes gives misleading signals. Given the heterogeneity and the dynamic nature of financial systems, macroprudential authorities should therefore not only rely on a strict rules-based regime related to the credit-to-GDP gap, but also consider discretionary powers by taking into account other indicators when assessing credit growth before setting the CCyB, as also introduced by the recommendation of the European Systemic Risk Board (ESRB, 2014) for European Economic Area countries.

Using this discretion, a "positive cycle-neutral CCyB approach" to setting the CCyB has gained momentum across the EU and beyond in recent years, motivated by the COVID-19 pandemic and other shocks that can disrupt the financial cycle at any point. This approach allows for the voluntary introduction of a positive CCyB when cyclical risks are assessed to be neither subdued nor elevated. Unlike structural buffers, which remain fixed throughout the cycle, releasable buffers like the CCyB could provide crucial flexibility to support the economy during crises. However, the limited build-up of these buffers before the pandemic reduced their effectiveness and the potential for macroprudential relief. As a result, many macroprudential authorities have opted for a positive cycle-neutral CCyB in recent years, even without observing excessive credit growth (BIS, 2022, 2024).

Given the ongoing debate surrounding the introduction of macroprudential capital buffers, our first research question examines the effectiveness of the BCBS CCyB guide in generating sufficient additional capital to cover banking sector losses during the global financial crisis of 2007–2008. Since the credit-to-GDP gap has been widely recognized in the literature as a reliable indicator of financial crises (Drehmann and Borio, 2010; Jordà et al., 2011; Schularick and Taylor, 2012; Aikman et al., 2014; BIS, 2010a,b,c,d; Jokivuolle et al., 2015), we investigate whether following this

guide would have led to an adequate buildup of capital to offset the costs incurred by government support and, ultimately, by taxpayers.

Our second research question aims to explore the primary determinants of CCyB rates in light of the different CCyB approaches. We study whether authorities follow the BCBS CCyB guide or whether the variables listed in the ESRB recommendation (ESRB, 2014), which are intended to be considered to determine excessive credit growth in addition to the BCBS CCyB guide for European Economic Area countries, are applied when setting CCyB rates. Moreover, we examine the impact of the supervisory funding structure on CCyB decisions and investigate the role of a positive cycle-neutral CCyB approach during normal times not related to the credit cycle.

Our contribution to the literature is two-fold. To our knowledge, we are the first to quantify whether the additional capital build-up by strictly adhering to the rules-based BCBS CCyB guide would have been sufficient to cover the losses related to the global financial crisis of 2007–2008 if it had been available for macroprudential authorities. We estimate how much additional capital European banks would have built up according to the standard BCBS CCyB methodology. We investigate these effects of additional capital requirements in Europe in terms of risk-weighted assets. Second, we conduct an empirical analysis to determine the extent to which European countries adhere to the BCBS guidelines and the ESRB CCyB recommendation, as well as whether they adopt a positive cycle-neutral CCyB approach for their CCyB decisions since 2014, when the CCyB framework was legally implemented.

To conduct our empirical analysis, we compile a panel dataset from the BIS, the European Central Bank (ECB), and ESRB, allowing us to examine CCyB decisions. We focus on countries within the European Union, Norway, and Iceland when analyzing the determinants of CCyB decision rates, due to the availability of detailed and comprehensive data from 2014Q4 to 2023Q4.[3]

First, we find that if macroprudential authorities had followed the rules-based BCBS CCyB methodology, sufficient additional capital would have been built up in the banking sector of many countries before the global financial crisis of 2007–2008. Approximately 287 billion euros would have been available in 2006 to cover the losses of the global financial crisis of 2007–2008 in Europe, when summing up the additional capital requirement that banks would have built up if the BCBS CCyB guide had been in place. The total costs for governments to support financial institutions in the aftermath of the global financial crisis of 2007–2008 in the European Union were estimated to be around 240 billion euros between 2007 and 2017, as reported by Eurostat (2015, 2018).

Second, we find that the CCyB decision is neither driven by the BCBS CCyB guide nor by the variables listed in the ESRB recommendation. Instead, the CCyB decision is driven by the supervisory funding structure and, even more importantly, whether macroprudential authorities apply the positive cycle-neutral CCyB rate approach in normal times.

The paper is organized as follows: In Section 2, we review the relevant literature, including the pos-

[3]As a robustness check, we estimate some of our CCyB decision models with data only until 2020Q1, since all macroprudential authorities in Europe either decreased or fully released their CCyB in March 2020 as a response to the anticipated negative economic shock implied by the COVID-19 pandemic (Dursun-de Neef et al., 2023).

itive cycle-neutral CCyB approach. Section 3 outlines the BCBS guide. In Section 4, we present the dataset used for the empirical CCyB decision models. Section 5 describes the econometric methodology employed. In Section 6, we report our findings. Finally, Section 7 discusses the implications of the results and offers recommendations for improving the macroprudential buffer framework.

2. Related literature

Before introducing the macroprudential buffer framework in 2014, a large body of literature has explored topics related to the CCyB. First, the impact of higher capital buffers on the credit cycle and the financial system's resilience are two crucial issues frequently discussed in the context of the CCyB. On the one hand, banks, authorities and the literature often claim that higher regulatory capital requirements would reduce lending to the real economy (Cappelletti et al., 2019; Fang et al., 2022) and thus the profitability of banks, which in turn ultimately would decrease the stability of the financial system. On the other hand, Admati and Hellwig (2014) and Barth et al. (2014) strongly criticize these arguments, since higher capital buffers increase the loss-absorbing capacity of banks.

Second, several empirical papers studied whether the credit-to-GDP gap is a good measure to detect excessive credit growth (Drehmann and Borio, 2010; Jordà et al., 2011; Schularick and Taylor, 2012; Aikman et al., 2014; BIS, 2010a,b,c,d; Jokivuolle et al., 2015). In this context, the use of the Hodrick-Prescott (HP) filter to derive the gap has been widely criticized by Hamilton (2018). He finds that the HP filter has several limitations, including spurious dynamics not found in the underlying data, inconsistencies at data endpoints, and the frequent use of an excessively high smoothing parameter. Instead, he suggests the use of linear projections as an alternative to derive deviations from trends, which, however, were disproved to be a better alternative (Drehmann and Yetman, 2018). Some have also criticized the use of GDP to normalize the level of credit in the economy, as credit-to-GDP gaps tend to be negatively correlated with output and therefore its use could exacerbate the procyclicality of macroprudential policies (Repullo and Saurina, 2011).

There is also a large literature on the prediction of financial crises based on the credit-to-GDP gap (Kaminsky and Reinhart, 1999; Babecky et al., 2014; Laeven and Valencia, 2013; Lo Duca et al., 2017; Laeven and Valencia, 2018). A few papers also analyze the CCyB policy frameworks, such as Edge and Liang (2022) that evaluate how a country's governance structure for macroprudential policy affects the CCyB. They find that stronger governance and credit growth increase the likelihood that a country increases its CCyB, while the credit-to-GDP gap does not. Herz and Keller (2023) find similar results that the credit-to-GDP gap and the BCBS guide do not contribute significantly to the CCyB rate. Their results are based on a random-effects logit model, which does not allow for a correlation between the unobserved country effects and other explanatory variables. Moreover, in their estimations, they select a sample of countries that have already activated the CCyB rate at some point in time and find that only the 5-year cumulative house price growth and the non-performing loan ratio have a statistically significant effect on the CCyB decision rate.

In addition, Arbatli-Saxegaard and Muneer (2020) give a comprehensive overview of CCyB frame-

works and how they evolve over time. Their analysis shows significant variation in how countries communicate about their CCyB frameworks, with countries using the CCyB more actively offering more detailed disclosures. Although there is a broad consensus on CCyB objectives and the use of diverse indicators, most frameworks emphasize discretion and judgment over strict rules, and buffer decisions in practice rely heavily on these flexible approaches. Moreover, Pekanov and Dierick (2016) analyze CCyB frameworks in the European Union before 2016, and find that different approaches based on a variety of additional indicators are used to activate or increase the CCyB. These articles emphasize the limitations of relying solely on the rules-based CCyB guide from the BCBS and underscore the importance of taking into account additional indicators to identify excessive credit growth.

In recent years, the new "positive cycle-neutral CCyB approach" has sparked debate about its costs and benefits. Between 2015 and 2019, many countries had a negative credit-to-GDP gap, which, under the rules-based BCBS CCyB guide, limited the setting of positive CCyB rates. However, alternative indicators also showed no signs of excessive credit growth. As a result, CCyB rates remained low, restricting the amount of releasable buffers available for unpredictable external shocks. Many macroprudential authorities find such releasable buffers valuable in crises, particularly for shocks unrelated to the credit cycle, such as the COVID-19 pandemic (Behn et al., 2023).

The cycle-neutral approach seeks to address this by ensuring that buffers are available when needed without stigmatizing banks with weaker capitalization. Empirical evidence suggests that banks are more willing to maintain lending during severe shocks when buffer requirements are explicitly released by macroprudential authorities rather than when they risk falling below regulatory thresholds. A key concern in past crises has been that banks hesitate to draw down capital buffers due to uncertainty about supervisory responses and potential market stigma. The positive cycle-neutral CCyB approach mitigates this by providing a more predictable framework for buffer usability and reducing the risk of under-calibration or delays in buffer accumulation (BIS, 2024).

International organizations, such as the ECB and BCBS, have acknowledged the benefits of a more proactive approach to CCyB accumulation, particularly as banks may be reluctant to use buffers due to concerns about breaching capital requirements. By ensuring that macroprudential buffers are pre-accumulated and explicitly releasable, the positive cycle-neutral CCyB approach aims to enhance bank resilience while maintaining credit supply during economic downturns. However, ongoing discussions continue regarding releasable buffers as well as the appropriate level of the CCyB in normal times, ensuring it balances financial stability concerns with the need to avoid excessive constraints on credit growth (BIS, 2022; Herrera et al., 2024; Behn et al., 2023; O'Brien et al., 2018; Hájek et al., 2016; Arbatli-Saxegaard and Muneer, 2020).

3. The BCBS CCyB guide

As a starting point for determining the CCyB, macroprudential authorities should use the BCBS CCyB guide (BIS, 2010a; ESRB, 2014). This common reference guide is based on the aggregate private sector credit-to-GDP gap. The credit-to-GDP gap is calculated as the difference between

the credit-to-GDP ratio and its long-run trend.[4]

The trend is computed using the one-sided Hodrick-Prescott (HP) filter (Hodrick and Prescott, 1997).[5] The gap is then used to determine the rate of the CCyB, as it indicates whether credit is at excessive levels compared to its long-run trend. If the gap is below a certain threshold (in the Basel III framework set at 2%), the buffer rate is zero. The buffer increases linearly with the gap until the buffer reaches its maximum level of 2.5%, when the gap exceeds another upper threshold set at 10%. If the gap is greater than 10, the CCyB rate stays at 2.5%:

$$\begin{aligned} f(x) &= 0\% && \text{if} \quad x < 2\% \,, \\ f(x) &= -0.625 + 0.3125x && \text{if} \quad x \in [2\%, 10\%] \,, \\ f(x) &= 2.5\% && \text{if} \quad x > 10\% \,, \end{aligned} \tag{1}$$

where x is the credit-to-GDP gap measures in percent according to BIS (2010d) and $f(x)$ the CCyB rate. The buffer rate has to be between 0% and 2.5% and calibrated in steps of 0.25 percentage points or multiples of 0.25 percentage points.[6]

The credit-to-GDP gap represents the difference between the credit-to-GDP trend and the credit-to-GDP ratio. The credit-to-GDP ratio measures the credit volume relative to nominal GDP. Formally, it is assumed that the credit-to-GDP ratio (y_t) has two components, namely a general trend (g_t) and a cyclical component (c_t):

$$y_t = g_t + c_t \,. \tag{2}$$

Hodrick and Prescott (1997) suggest interpreting the trend component g_t as a smooth series that does not differ too much from the observed y_t. It is calculated as follows:

$$\min_{\{g\}_{t=-1}^{T}} \sum_{t=1}^{T} (y_t - g_t)^2 + \lambda \sum_{t=1}^{T} [(g_t - g_{t-1}) - (g_{t-1} - g_{t-2})]^2 \,, \tag{3}$$

where λ determines the outcome of the filter. If $\lambda = 0$, then the optimal solution is given by $y_t = g_t$, which means that there is no cyclical component. If $\lambda \to \infty$, then the HP filter produces a linear time trend (only the second term in Eq. (3) matters, and a linear time trend produces a constant

[4]The CCyB guide uses a broad definition of credit that considers all sources of debt funds to the private sector (including funds raised abroad).

[5]The smoothing parameter for the credit-to-GDP ratio, referred to as lambda, is set to 400,000 to capture the long-run trend.

[6]National authorities can implement a CCyB buffer in excess of 2.5%, if it is deemed appropriate in their national perspective, as highlighted in Article 126 of the Capital Requirements Directive (CRD V, 2019) for European Economic Area (EEA) countries. The CCyB applies to domestic banks, including subsidiaries of foreign banks, but international reciprocity provisions do not extend to buffers above 2.5% of risk-weighted assets (BIS, 2010d). In our dataset, no country in the EEA has set a buffer in excess of 2.5% until 2023Q4.

slope).

The state space formulation of Eq. (3) can be described as follows:

$$\begin{aligned} y_t &= g_t + c_t \,, \\ g_t &= 2g_{t-1} - g_{t-2} + v_t \,. \end{aligned} \tag{4}$$

Hamilton (2018) shows that if c_t and v_t are white noise and not correlated, then $\lambda = \sigma_c^2/\sigma_v^2$.

4. Data

Our empirical analysis is based on publicly available datasets from the Bank for International Settlements (BIS), the ECB, the ESRB and the World Bank.[7] In the first step, to determine whether the BCBS CCyB guide would have been an efficient macroprudential capital buffer before the global financial crisis of 2007–2008, we use an unbalanced panel dataset, which includes all countries that report their private sector credit data to the BIS.

To study the determinants of the CCyB decision models, we again use an unbalanced panel dataset from the ECB from 2015Q1 to 2023Q4 and focus on data from European Union (EU) countries, Norway and Iceland. This restriction is necessary because we want to compare CCyB decision models derived from the BCBS CCyB guide and the ESRB recommendation with roughly the same number of observations and countries. Many variables recommended by the ESRB (ESRB, 2014) are only available for European Union countries, Norway and Iceland with the same frequency and quality.

We set the positive CCyB dummy to 1 for those countries that introduce a positive cycle-neutral CCyB approach and 0 otherwise. It takes the value of 1 for the Czech Republic, Iceland, Sweden, and Norway for the whole sample period. For Lithuania, the positive CCyB dummy is added from 2017Q4, followed by Denmark in 2018Q1, Ireland in 2018Q3, Estonia in 2022Q4, and the Netherlands in 2023Q2.

4.1. BIS data

We use the credit-to-GDP gap, calculated following the methodology outlined in Section 3, as provided by the BIS.[8] We also collect the credit-to-GDP ratio and the CCyB decision rate from the BIS. The CCyB decision rate refers to the rate determined by macroprudential authorities. Given the possibility of a phase-in period of up to 12 months before the CCyB rate applies, some CCyB

[7] We upload our most recent codes to reproduce all our results to www.github.com.

[8] The data can be downloaded online from the BIS website: https://www.bis.org/statistics/dataportal/credit.htm?m=224 and https://www.bis.org/statistics/totcredit/totcredit.xlsx.

decision rates may not become legally binding because a subsequent CCyB decision rate could be overruled by a previous one.[9]

The BIS data include over 40 countries, covering a time period of more than 45 years on average. One significant advantage of this dataset, in addition to its high quality, is that it includes both advanced and emerging economies. This allows us to compare CCyB rates on an international level.

4.2. ECB: SDW and ESRB data

We enhance the BIS data set with quarterly ECB data from the ESRB "Risk Dashboard", which are available from the ECB's statistical data warehouse (SDW). The ESRB data contain a collection of systemic risk indicators for the financial systems of European Union countries, Norway, and Iceland, and provide information on macroeconomic, credit, and structural risks. We use these data to analyze the CCyB decisions taken by macroprudential authorities. More specifically, we use the variables listed in the ESRB recommendation (ESRB, 2014) as explanatory variables, which are described in Table 1.

To account for the macroeconomic environment, we include the unemployment rate, the annualized yearly nominal GDP growth rate, and the current account as a percentage of GDP.

To account for credit risk, we use several variables: First, we calculate the RPP-to-GDP gap, which is the residential property price index (RPP) to nominal GDP minus the RPP-to-GDP trend. To calculate the RPP-to-GDP ratio, we normalized both variables to 100 in 2015Q2. We then use the one-sided HP-filter to calculate the RPP-to-GDP trend with the same parameters as the credit-to-GDP trend. Second, we utilize lending margins for private households and non-financial corporations (NFCs), which are calculated as the difference between the interest rates received on loans and those paid on deposits for each sector. Third, we add the two-year growth rate of household and NFC loans in banks' balance sheets to measure the overall credit developments.

To measure structural risks in the banking sector, we add the leverage ratio and the common equity Tier 1 (CET1) ratio of the banking sector.[10] Furthermore, we add the return on assets (ROA), the non-performing loan (NPL) ratio, and the combined buffer requirements (CBR) in terms of risk-weighted assets. These variables measure the solvency and performance of the banking sector. We also include the euro area *Composite Indicator of Systemic Stress* (euro area CISS) in our dataset (Hollo et al., 2012) since it is a useful indicator for signaling stress in the financial markets, which is relevant for the CCyB release phase.

In addition, we use data on the CCyB decision rates, which are directly reported by the macro-prudential authorities to the ESRB for all European Union countries, Norway and Iceland.[11] This

[9] A good example for the different CCyB decision rate and the CCyB effective rate is Germany. The German macroprudential authority decided to set the CCyB rate to 0.25% in 2019Q2 but released the buffer in March 2020 due to the COVID-19 pandemic. Hence, the effective CCyB rate remained at 0% for the entire period of time.

[10] The leverage ratio is defined as Tier 1 capital divided by total assets.

[11] The data is available on the ESRB website: https://www.esrb.europa.eu/national_policy/ccb/html/

dataset contains information on the timing of the CCyB decision based on the reference date, announcement date, and the date on which the CCyB applies in the corresponding country. For calculating hypothetical CCyB rates and to determine which indicators influence the CCyB decisions in Europe, we use the date of announcement of the CCyB rate (i.e. the relevant "CCyB decision" date) as the dependent variable, since the implementation of the CCyB rate may be delayed by up to 12 months given the phase-in period of the CCyB.

4.3. World Bank: Supervisory quality data

To measure the quality and independence of banking supervision and macroprudential supervision, we use data from the most recent "Bank Regulation and Supervision Survey (BRSS)" from 2019 (Anginer et al., 2019) conducted by the World Bank. This dataset provides information on how banks are regulated and supervised across countries worldwide.[12]

For the empirical analysis, we construct the following five categorical variables for supervisory funding: government, banks, government and banks, other, banks and other. While "other" means that neither the supervised banks nor the government finance banking supervision, "banks and other" refers to funding by banks and other sources.[13] Given that only Sweden is funded by the government, we introduce the variable "funding no banks", which addresses this issue by taking a value of one when banking supervision is entirely funded without contributions from banks.

In addition, we also construct a categorical "macroprudential supervision index" ranging from 0 to 4, based on Anginer et al. (2019) that judge the quality of macroprudential supervision. This index includes four components: (1) whether the country has an integrated financial supervisory agency overseeing all significant financial institutions; (2) whether the country measures individual banks' contributions to systemic risk; (3) whether different resolution processes are in place for systemically important financial institutions (SIFIs) versus other financial institutions; and (4) whether the country monitors interconnectedness among banks and non-bank intermediaries (e.g. hedge funds, money market mutual funds, or shadow banking entities). Each "yes" response adds one point to the index, reflecting the extent to which bank supervisors address systemic risks, a crucial factor in managing the risks associated with excessive credit growth.

The World Bank collected this data around 2016, aligning well with the timing of initial CCyB decisions across many European Union countries. Given that these supervisory variables are country-specific and relatively static over time, we use this index instead of country fixed effects to avoid multicollinearity.

`index.en.html`.

[12] The most recent survey was conducted by the World Bank between 2017 and 2019 and provides consistent information on how banks are regulated and supervised across 160 countries worldwide. This survey covers the period from 2011 to 2016 (`https://www.worldbank.org/en/research/brief/BRSS`).

[13] In the following countries, banking supervision is funded by banks and the government: AT and NO. In BG, CZ, GR, IT, PT, and RO the funding is provided by "other" sources. Only in SE, the government funds banking supervision alone. Supervision in DE, ES, LT, MT, SI, and SK are funded by banks and other sources. In the remaining countries, banking supervision is funded by banks.

Table 1: Summary statistics of included variables

	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.	Data Cov.	Source
Dependent variables								
CCyB decision	0.00	0.00	0.00	0.30	0.02	2.50	76.93	BIS/ESRB
CCyB decision (0,1)	0.00	0.00	0.00	0.12	0.01	1.00	76.93	BIS/ESRB
BCBS variables								
BCBS CCyB guide	0.00	0.00	0.00	0.16	0.00	2.50	88.22	BIS
Positive CCyB dummy	0.00	0.00	0.00	0.21	0.00	1.00	100.00	NCB/ESRB
Credit-to-GDP ratio	25.00	65.75	91.00	91.98	108.08	359.00	88.22	BIS/ESRB
Credit-to-GDP gap	-104.30	-33.00	-16.75	-20.61	-5.40	65.80	88.22	BIS/ESRB
Supervisory funding variables								
Supervisory funding: Banks	0.00	0.00	0.00	0.47	1.00	1.00	96.43	World Bank
Supervisory funding: Banks, other	0.00	0.00	0.00	0.19	0.00	1.00	96.43	World Bank
Supervisory funding: Government	0.00	0.00	0.00	0.05	0.00	1.00	96.43	World Bank
Supervisory funding: Government, Banks	0.00	0.00	0.00	0.08	0.00	1.00	96.43	World Bank
Supervisory funding: Other	0.00	0.00	0.00	0.21	0.00	1.00	96.43	World Bank
Supervisory funding: No banks	0.00	0.00	0.00	0.25	1.00	1.00	96.43	World Bank
Mapru supervision index	0.00	2.00	3.00	2.62	3.00	4.00	100.00	World Bank
ESRB variables								
RPP-to-GDP ratio	86.36	101.49	110.87	115.29	123.38	195.66	80.12	ECB
RPP-to-GDP gap	-17.78	-0.36	2.91	4.95	10.88	36.43	80.12	ECB
Lending margins to HH	-2.93	1.37	1.81	1.92	2.49	4.78	80.89	ECB
Lending margins to NFC	-4.18	1.27	1.63	1.82	2.30	4.93	80.89	ECB
Current account (% of GDP)	-0.34	-0.01	0.01	0.01	0.04	0.15	76.93	ECB
Unemployment rate	2.00	4.79	6.42	7.32	8.40	25.95	86.20	ECB
Leverage ratio	4.83	6.83	8.53	8.86	10.52	15.14	86.20	ECB
Two-year HH loan growth	-27.19	1.34	7.20	6.79	11.94	39.21	78.86	ECB
Two-year NFC loan growth	-28.76	0.98	6.79	7.49	12.22	59.96	77.99	ECB
CET1 ratio	10.86	15.49	16.85	17.27	18.79	34.79	80.12	ECB
CBR (% of RWA)	0.00	2.18	3.16	3.20	4.24	9.91	60.04	ECB
NPL ratio	0.73	1.79	3.46	6.23	6.95	42.07	85.04	ECB
ROA	-2.61	0.38	0.63	0.61	0.84	2.30	86.20	ECB
Euro area CISS	0.04	0.07	0.11	0.13	0.18	0.40	86.20	ECB

Data source: BIS, ESRB, ECB SDW, World Bank, NCB (national central banks).
The table shows the minimum (Min.), the first quantile (1st Qu.), the median (Median), the mean (Mean), the third quantile (3rd Qu.), the maximum (Max.) and the data coverage (Data Cov.) for the variables used in this paper. Data Cov. refers to the percentage of available observations if the data was a balanced panel. The column "Source" states the source of the data.
The data include the European Union countries, Norway and Iceland for the period 2015Q1 to 2023Q4.
CCyB decision rate is the buffer level at the date of announcement and is between 0% and 2.5%. The CCyB decision rate data are taken from the ESRB and if not available from the BIS.
The credit-to-GDP gap and the resulting BCBS CCyB guide are calculated based on ESRB and BIS data. If both datasets report the credit-to-GDP gap for a specific country and a specific time period, then the ESRB data are used. The BCBS CCyB guide takes the credit-to-GDP gap as an input and is calculated as described in Eq. (1). The credit-to-GDP ratio is defined as all sources of debt funds to households and other non-financial private corporations divided by nominal GDP. The positive CCyB dummy takes the value of 1 for those countries which communicated their intention to introduce a positive cycle-neutral CCyB framework and 0 otherwise.
Supervisory funding variables are taken from the World Bank (Anginer et al., 2019). Banking supervision is either funded by banks, by banks and other sources, by the government alone, by the government and banks or by other sources. Supervisory funding by no banks is a dummy, that is 1 if banks are not involved in the funding of banking supervision.
Mapru supervisory index is a categorical variable that takes values between 0 and 4 as described in Section 4.3.
HH stands for private households. NFC stands for non-financial corporations. Two-year HH loan growth and two-year NFC loan growth are the respective two-year loan growth rates.
The RPP-to-GDP ratio represents the residential property price (RPP) index relative to nominal GDP, with both variables normalized to 100 in 2015Q2 for consistency. The RPP-to-GDP gap is calculated as the difference between the RPP-to-GDP ratio and its trend. The trend is derived using a one-sided HP filter, applying the same smoothing parameters as those used in the calculation of the credit-to-GDP trend.
The lending margin to HH (NFC) is the lending rate minus the deposit rate for households (non-financial corporates).
Leverage ratio is defined as Tier 1 capital divided by total assets. CET1 ratio is the Common Equity Tier 1 ratio calculated as the sum of the CET1 capital divided by the sum of the banking sector's risk-weighted assets.
CBR (% of RWA) stands for combined buffer requirement (the sum of the countercyclical capital buffer, the O-SII, the G-SII buffer and the systemic risk buffer) in the country's banking sector in percent of the sum of risk-weighted assets (RWA).
ROA refers to the return on assets. NPL ratio refers to the non-performing loan ratio (non-performing loans divided by total gross loans).
Euro area CISS refers to the euro area Composite Indicator of Systemic Stress (Hollo et al., 2012).

5. Empirical approach

We employ two distinct econometric approaches to model CCyB decision rates using panel data in Section 5.1. To control for country-specific effects, we use a linear fixed effects model as our first approach, which is robust but does not account for the boundedness of CCyB rate between $[0, 2.5\%]$. To address this issue, we also apply the fractional response model with and without correlated random effects. These models serve as a robustness check and are presented in the Appendix C.

Both econometric approaches allow for correlations between the explanatory variables and the unobserved country effects. Our estimation sample for each model is based on data availability, rather than selecting countries that have previously implemented a positive CCyB decision, in contrast to Herz and Keller (2023). In Section 5.2, we outline the models we estimate to approximate the regulator's CCyB decision rate.

5.1. Econometric approach

First, we utilize standard fixed effects models to estimate a linear decision rule, a widely-used method for empirical applications in economics and finance for panel datasets. As noted in previous studies, such as Dawes and Corrigan (1974) and Gigerenzer and Gaissmaier (2011), linear decision rules are commonly employed to make decisions based on multiple codeable inputs. Even if regulators use heuristics to make their CCyB decisions based on the BCBS CCyB guide or the indicators mentioned in the ESRB recommendation, linear regression models should approximate these heuristics well, as described by Hogarth and Karelaia (2006); Baucells et al. (2008); Martignon and Hoffrage (2002); Katsikopoulos (2011) among many others.

The BCBS CCyB guide, presented in Eq. (1), is characterized by a piecewise linear structure and relies on a single codeable input, namely the credit-to-GDP gap, as a common reference point to determine CCyB decisions. The ESRB also recommends using a set of codeable inputs. Therefore, we specify the following linear fixed effects model:

$$y_{i,t} = \alpha_i + X_{i,t}^{\intercal} \beta + \epsilon_{i,t} \, . \tag{5}$$

$y_{i,t}$ refers to the CCyB rate for country i at time t. α_i captures potential country fixed effects. $X_{i,t}$ refers to a set of explanatory variables that are expected to influence the CCyB decision.

Second, we apply the extension of the fractional response model of Papke and Wooldridge (1996) by the correlated random effects model for fractional response panel data (Papke and Wooldridge, 2008). A fractional response model accounts for the fact that the CCyB is defined to be in the interval $[0\%, 2.5\%]$. The fractional response model does not take advantage of the panel structure of the data, and therefore does not account for time-invariant individual-specific effects. However, the correlated random effects model for fractional response panel data is able to account for these effects.

Papke and Wooldridge (1996) suggest the following model for a fractional response dependent variable,

$$E[y_i|x_i] = G(X_i^\intercal \beta) \, , \tag{6}$$

where $G(\cdot)$ is a known function satisfying $0 < G(z) < 1$ for all $z \in \mathbf{R}$. For $G(\cdot)$, we choose the probit function as suggested by Papke and Wooldridge (1996), which ensure that the predicted values of y lie in the interval $(0, 1)$. To ensure that the CCyB rates are between $(0, 1)$, we divided all CCyB rates by 2.5. The quasi-log-likelihood function reads as follows:

$$\mathcal{L}(\beta) = \sum_{i=1}^{N} y_i \; log[G(X_i^\intercal \beta)] + (1 - y_i) \; log[1 - G(X_i^\intercal \beta)] \, . \tag{7}$$

This quasi-log-likelihood function allows y being 0 and 1, thus y can lie in the interval $[0, 1]$. The first-order conditions resulting from Eq. (7) are non-linear and analytically not solvable. Therefore, we rely on numerical optimization such as the Newton-Raphson method to find the optimal set of parameters.

In the correlated random effects model of Papke and Wooldridge (2008), it is possible to include (time-invariant) country-specific heterogeneity without running into the incidental parameter problem (Neyman et al., 1948).

$$E[y_{i,t}|x_{i,t}, c_i] = \Phi(X_{i,t}^\intercal \, \beta + c_i), \qquad \text{t = 1,...,T} \, . \tag{8}$$

$\Phi(\cdot)$ could be the standard normal cumulative distribution or the logistic distribution. $X_{i,t}$ is a vector of explanatory variables and $y_{i,t}$ denotes the endogenous variable. Most importantly, c_i denotes the fixed effect. Papke and Wooldridge (2008) suggest restricting the distribution of c_i given X_i to a conditional normal distribution, as in Chamberlain (1980):

$$c_i|(X_{i,1}, X_{i,2}, .., X_{i,T}) \sim N(\psi + \bar{X}_i^\intercal \zeta, \sigma_c^2) \, , \tag{9}$$

where $\bar{X}_i$ is a vector of k explanatory variables and, for each k, $\bar{x}_{i,k} = 1/T_i \sum_{t=1}^{T_i} x_{i,t,k}$ is the time average of the explanatory variable k for an individual i. Papke and Wooldridge (2008) suggest estimating the following model:

$$E[y_{i,t}|X_{i,t}, \bar{X}_i] = \Phi(X_{i,t}^\intercal \, \beta + \psi + \bar{X}_i \zeta) \, . \tag{10}$$

For $\Phi(\cdot)$, we choose the probit function as suggested by Papke and Wooldridge (1996), which ensures that the predicted values of y lie in the interval $(0, 1)$. The quasi-log-likelihood function

reads as follows:[14]

$$\mathcal{L}(\beta) = \sum_{i=1}^{N} \sum_{t=1}^{T_i} y_{i,t} \; log[\Phi(X_{i,t}^{\intercal}\beta + \bar{X}_i\zeta)] + (1 - y_{i,t}) \; log[1 - \Phi(X_{i,t}^{\intercal}\beta + \bar{X}_i\zeta)] \; . \tag{11}$$

Similar to Eq. (7), the first order conditions arising from Eq. (11) are non-linear and analytically not solvable. Again, we rely on numerical optimization such as the Newton-Raphson method to find the optimal set of parameters.

In these non-linear models, it is also interesting to calculate the partial effects that can be obtained by differentiating Eq. (8) with respect to $x_{i,t,k}$ (Papke and Wooldridge, 2008).

$$\frac{\partial E[y_{i,t}|X_{i,t}, \bar{X}_i]}{\partial x_{i,t,k}} = \beta_k \Phi(X_{i,t}^{\intercal}\beta + c_i) \; . \tag{12}$$

Following the discussion in Papke and Wooldridge (2008), a more popular measure of the importance of the observed covariates is to average the partial effects across the distribution of c. For the average of the partial effect (APE_k) of k, we obtain the following expression:

$$APE_k = \beta_k E_c[\Phi(X_{i,t}^{\intercal}\beta + c)] \; . \tag{13}$$

To identify APE_k, we make the same assumptions as in Papke and Wooldridge (2008), namely strict exogeneity of $X_{i,t}$ and the conditional normal assumption of c_i given $X_{i,t}$, as stated in Eq. (9).

5.2. Empirical decision models

We estimate seven *BCBS models* and six *ESRB models*. The *BCBS models*, detailed in Section 3, utilize the data from Section 4.1, while the *ESRB models*, based on the data in Section 4.2, examine the variables that influence CCyB rates.

The *BCBS model* specifications are shown in Table 2. For Model 1, we estimate the CCyB rates as decided by the macroprudential authorities as a function of the lagged BCBS CCyB guide, as described in Eq. (1). The lag length is two quarters. In general, we use lagged explanatory variables, since CCyB decisions are based on past observations, given that the relevant (credit and GDP) data are usually available with a lag often up to 6 to 12 months. In Model 2, we regress the CCyB decision to the BCBS CCyB guide with a four quarter lag. In both models, we would expect a positive coefficient of close to 1 if the BCBS CCyB guide was taken into account by the macroprudential authorities for their CCyB decision rates.

[14] As a robustness check, we also estimate all model with the logit link function. The results are very similar.

In Model 3 and Model 4, we test if the credit-to-GDP gap and/or the credit-to-GDP ratio lagged by two and four quarters were relevant for the country's CCyB rates. Again, we would expect a positive sign if the macroprudential authorities took these (early warning) indicators into account, while not exactly following the translation of the credit-to-GDP gap into a CCyB rate as given by Eq. (1). In Model 5 and Model 6, we add two explanatory variables from the World Bank supervisory quality dataset (Anginer et al., 2019), as explained in Section 4.3. In Model 7, we include the so-called *positive CCyB dummy* variable, which considers a positive cycle-neutral CCyB rate.

Table 2: Model specifications: BCBS CCyB guide

Model Names	Dependent variable	Independent variables	Expected sign
BCBS Model 1	CCyB rate	(1) BCBS CCyB guide (-2)	+
BCBS Model 2	CCyB rate	(1) BCBS CCyB guide (-4)	+
BCBS Model 3	CCyB rate	(1) Credit-to-GDP gap (-2) (2) Credit-to-GDP ratio (-2)	+ +
BCBS Model 4	CCyB rate	(1) Credit-to-GDP gap (-4) (2) Credit-to-GDP ratio (-4)	+ +
BCBS Model 5	CCyB rate	(1) BCBS CCyB guide (-2) (2) Supervisory funding (3) Mapru supervision index	+ ~ ~
BCBS Model 6	CCyB rate	(1) BCBS CCyB guide (-2) (2) Supervisory funding without banks (3) Mapru supervision index	+ ~ ~
BCBS Model 7	CCyB rate	(1) BCBS CCyB guide (-2) (2) positive CCyB dummy	+ +

The models to be estimated in Section 6.2 and Appendix C aim to test whether the BCBS CCyB guide is applied in setting the CCyB.
The CCyB rate is the dependent variable. It is the buffer rate at the date of announcement.
BCBS CCyB guide refers to the Basel CCyB framework, as given in Eq. (1). The credit-to-GDP gap is defined as total credit to the non-financial sector divided by nominal GDP.
Supervisory funding is a categorical variable with multiple levels. Supervisory funding can either be provided by banks, by the government, by banks and the government, by banks and other sources, or only by other sources, as explained in Section 4.3.
Supervisory funding without banks is a dummy variable that takes the value of one if the supervisory funding is not provided by banks.
The macroprudential supervision index takes values $0, 1, 2, 3$ and 4 depending on the quality of macroprudential supervision, as explained in Section 4.3.
Positive CCyB dummy is set to 1 for the current and the following time periods when the responsible regulatory authority in a country communicates the adoption of a positive cycle-neutral CCyB rate in equilibrium and 0 otherwise.

The *ESRB model* specifications are shown in Table 3 for the time period 2015Q1 to 2023Q4. The explanatory variables are selected based on the ESRB recommendation (ESRB, 2014).

In Model 1, we include besides the credit-to-GDP gap and the credit-to-GDP ratio also the two-year household loan growth, the two-year non-financial corporations loan growth as measures of credit development, the residential property price (RPP)-to-GDP gap as a measure of property price overvaluations, the current account divided by GDP for external imbalances and the leverage ratio of banks to account for the strength of bank balance sheets for each country. These variables are added as it has been found in empirical models that they may complement the credit-to-GDP gap for signaling the build-up of system-wide risks related to excessive growth. Combining such variables with the credit-to-GDP gap has been found to improve signaling performance (ESRB,

2014). Moreover, we include the two-year lending margin for household and NFC loans, which can offer insights into the profitability and risk-taking behavior of banks, even though this relationship may be nuanced. High margins could reflect strong demand for credit or indicate that banks are charging a premium for riskier borrowers, potentially contributing to the buildup of systemic risks. Conversely, higher margins might also suggest that banks are exercising caution or pricing loans higher to compensate for perceived risks. Therefore, these indicators must be considered in context and cannot alone justify adjustments to the CCyB. In addition, all variables are lagged by two quarters to account for potential delays in data availability, as well as to reflect the time required for economic adjustments and the authorities' decision-making processes.

In Model 2, we incorporate the unemployment rate and year-on-year GDP growth as additional explanatory variables to better capture the macroeconomic environment and its potential impact on the CCyB decision-making process.

In Model 3, we add the combined buffer requirements (CBR) as a percentage of risk-weighted assets (CBR % of RWA) which is the sum of the (macroprudential) capital buffers in a country. We lag this variable by one quarter to mitigate potential multicollinearity issues. This variable should consider the risk-bearing capacity of the respective banking sector and give an indication of the macroprudential authorities' stance. We also include indicators of banking sector conditions, which were suggested by the BCBS and the ESRB for the release phase. In this context, we add the return on assets (ROA), as a proxy for profitability, and the non-performing loans ratio. These indicators were researched by the BCBS to judge whether they perform well in the release phase. In addition, we include the composite indicator of systemic stress (CISS) for the euro area. We again lag all variables, except for the CISS, which is available on a daily basis, by two quarters.

In Model 4 and Model 5, we again add the two supervisory quality variables, while in Model 6 the positive cycle-neutral CCyB dummy is included.

Table 3: Model specifications: CCyB decision according to ESRB recommendation

Models	Dependent variable	Independent variables	Expected sign
ESRB Model 1	CCyB decision	(1) Credit-to-GDP gap (-2)	+
		(2) Credit-to-GDP ratio (-2)	+
		(3) Two-year HH loan growth (-2)	+
		(4) Two-year NFC loan growth (-2)	+
		(5) RPP-to-GDP gap (-2)	+
		(6) Two-year lending margin to NFC (-2)	~
		(7) Two-year lending margin to HH (-2)	~
		(8) Current account (% of GDP) (-2)	+
		(9) Leverage ratio (-2)	~
ESRB Model 2	CCyB decision	(1)-(9) as ESRB Model 1	
		(10) Unemployment rate (-2)	-
		(11) y-o-y GDP growth (-2)	+
ESRB Model 3	CCyB decision	(1)-(11) as ESRB Model 2	
		(12) CBR (% of RWA) (-1)	~
		(13) Euro area CISS	-
		(14) NPL ratio (-2)	~
		(15) ROA (-2)	~
ESRB Model 4	CCyB decision	(1)-(15) as ESRB Model 3	
		(16) Supervisory funding	~
		(17) Mapru supervision index	~
ESRB Model 5	CCyB decision	(1)-(15) as ESRB Model 3	
		(18) Supervisory funding without banks	~
		(17) Mapru supervision index	~
ESRB Model 6	CCyB decision	(1)-(15) as ESRB Model 3	
		(20) positive CCyB dummy	+

The models to be estimated in Section 6.3 and Appendix C aim to test whether the variables outlined in the ESRB recommendation are used in setting the CCyB. HH stands for private households. NFC stands for non-financial corporations.
The CCyB decision is the dependent variable. It is the buffer rate at the date of announcement.
Two-year HH loan growth refers to the two-year growth rate of household loans. Two-year NFC loan growth refers to the two-year growth rate of non-financial corporations loans.
The RPP-to-GDP gap is the difference between the residential property price (RPP) to nominal GDP ratio and the RPP-to-GDP trend, which is calculated using a one-sided HP filter to determine the trend for the RPP-to-GDP ratio.
Lending margin to HH (NFC) is defined as the difference of interest rate received on loans and the interest rate paid on deposits for households (non-financial corporations).
Leverage ratio is defined as Tier 1 capital divided by total assets. CET1 ratio is the Common Equity Tier 1 ratio calculated as the sum of the CET1 capital divided by the sum of the banking sector's risk-weighted assets.
CBR (% of RWA) stands for combined buffer requirement (the sum of the capital conservation buffer, the countercyclical capital buffer, the systemically important institutions buffer and the systemic risk buffer) in the country's banking sector in percent of the sum of risk-weighted assets (RWA) in the country's banking sector.
ROA refers to return on assets. NPL ratio refers to the non-performing loan ratio (non-performing loans divided by total gross loans). Euro area CISS refers to the Euro area Composite Indicator of Systemic Stress (Hollo et al., 2012).
Supervisory funding variables are taken from the World Bank (Anginer et al., 2019), as explained in Section 4.3. Banking supervision is either funded by the bank, by banks and other sources, by the government, by the government and banks or by other sources. Supervisory funding without banks is a dummy variable that takes the value of 1 if banks do not provide the supervisory funding.
Mapru supervisory index is a categorical variable that takes values between 0 and 4, as described in Section 4.3.
Positive CCyB dummy is set to 1 for the current and the following periods when the responsible regulatory authority in a country communicates the adoption of a positive cycle-neutral CCyB rate in equilibrium and 0 otherwise.

6. Results

This section contains our main results. In Section 6.1, we calculate country-specific credit-to-GDP gaps for all countries in the BIS dataset and identify those countries that would have had a positive CCyB rate had the BCBS CCyB guide been in place before the global financial crisis of 2007–2008. In Section 6.2, we present the estimation results of BCBS CCyB decision models for the European Union, Norway, and Iceland. Finally, in Section 6.3, we analyze the extent to which the variables outlined in the ESRB recommendation influence the CCyB decision rates across these countries.

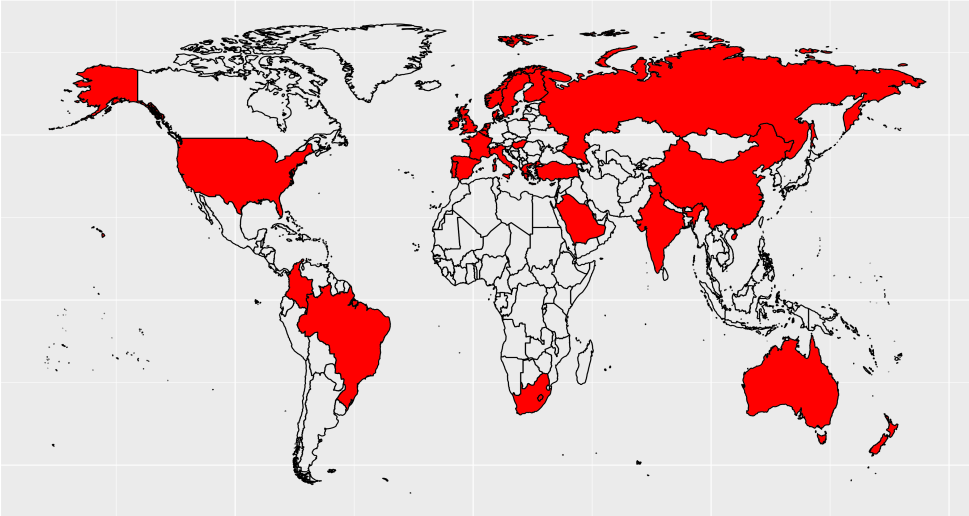
Additionally, we provide many robustness checks in the appendices. In Appendix B, we estimate our main models without the COVID-19 period. In Appendix C, we provide the estimation results for the fractional response models. In Appendix D, we estimate our main models without including countries that follow the positive cycle-neutral CCyB approach. In Appendix E, we explore regulatory capture by introducing interaction terms for different models.[15]

6.1. Hypothetical CCyB rates before the global financial crisis of 2007–2008

In a first step, we calculate hypothetical CCyB rates based on the BCBS guide (i.e., the credit-to-GDP gap following Eq. (1)) for all countries included in the BIS data sample for the years 2005 and 2006. We focus on the period prior to the global financial crisis of 2007–2008, as the CCyB is intended to be built up before crises, particularly to cover potential losses in the banking sector during and after a crisis.

[15] In the online appendix, we provide additional robustness checks by estimating our main models only for large and small countries. Next, we estimate our main models with a COVID-19 dummy. Finally, we exclude the period 2015Q1-2016Q4, since macroprudential regulators might need a learning period to settle into their steady-state CCyB decisions.

Figure 1: Countries with hypothetical CCyB rates in 2005 and 2006



Note: In this figure, all countries highlighted in red would have had a positive CCyB rate according to the BCBS guide in 2005 and 2006, one to two years prior to the global financial crisis of 2007–2008. A more detailed overview of all countries with a positive CCyB rate before the crisis is provided in Table A.7.

In Figure 1, we highlight in red all countries that experienced excessive credit growth with a credit-to-GDP gap exceeding 2%. According to Eq. (1) and based on the BCBS guide, such conditions would have warranted a positive CCyB rate. Drawing from various banking crisis databases (Babecky et al., 2014; Romer and Romer, 2017; Laeven and Valencia, 2013, 2018), almost all of the highlighted countries were also severely hit by the global financial crisis of 2007–2008.[16] In each of these countries, at least one of the referenced databases identifies a financial or banking crisis period between 2007 and 2009.

To determine the amount of additional capital that would have been required in the banking sectors if these hypothetical positive CCyB rates had been implemented before 2007, we utilize data on risk-weighted assets from the ECB's SDW to calculate the corresponding increase in CET1 capital that would have been necessary. Given that the ECB database only covers European countries, we only perform this calculation for the European Union countries. Due to the lack of data on risk-weighted assets before 2007, we additionally proxy the country-specific risk-weighted assets for 2004, 2005, and 2006 by considering the "risk density", defined as the ratio of risk-weighted assets to total assets, in 2007. As the risk density should not change significantly from year to year, this proxy should not distort the conclusions of the exercise.

In this analysis, we estimate the upper bound of additional capital requirements due to the assumption of binding CCyB rates. This assumption implies that banks do not hold sufficient excess capital beyond the minimum requirement or aim to maintain a constant level of their management

[16]These countries include Australia, Belgium, the Czech Republic, Denmark, Spain, Finland, France, the United Kingdom, Greece, Hungary, Ireland, India, Italy, the Netherlands, Norway, New Zealand, Portugal, Sweden, the USA, and South Africa.

buffer. Furthermore, introducing additional CCyB requirements may dampen lending growth in subsequent periods, potentially resulting in lower CCyB requirements for the loan portfolio going forward.

We show the results of this exercise – i.e., the positive CCyB rates calculated using Eq. (1) based on the BCBS guide – in Table 4. By the end of 2006, the CCyB would have facilitated the accumulation of almost 290 billion euros in additional capital across European Union countries, which could have been released to cover the losses of the global financial crisis of 2007–2008 had the measure been in place. We compare the built-up capital to the costs paid by governments to support financial institutions, which are estimated by Eurostat (2015) and Eurostat (2018) at around 240 billion euros. This comparison shows that the additional capital required by the positive CCyB rates could have potentially saved taxpayers' money and at least offset some of the expenses borne by governments.

Table 4: Additional capital requirements

Date	Additional CET1 requirements (in thousand EUR)
2004Q1	165,764,896.70
2004Q2	172,803,618.98
2004Q3	177,927,378.62
2004Q4	187,773,670.62
2005Q1	193,436,035.10
2005Q2	206,154,878.40
2005Q3	215,899,005.42
2005Q4	235,388,229.33
2006Q1	243,957,739.94
2006Q2	266,978,569.20
2006Q3	274,825,846.47
2006Q4	287,492,638.96

Source: BIS. ECB SDW. Own calculations.
Additional CET1 requirements for all European Union countries, assuming that the hypothetical CCyB rates in Table A.7 are binding.
Country details on the components of the sums are given in Table A.8.

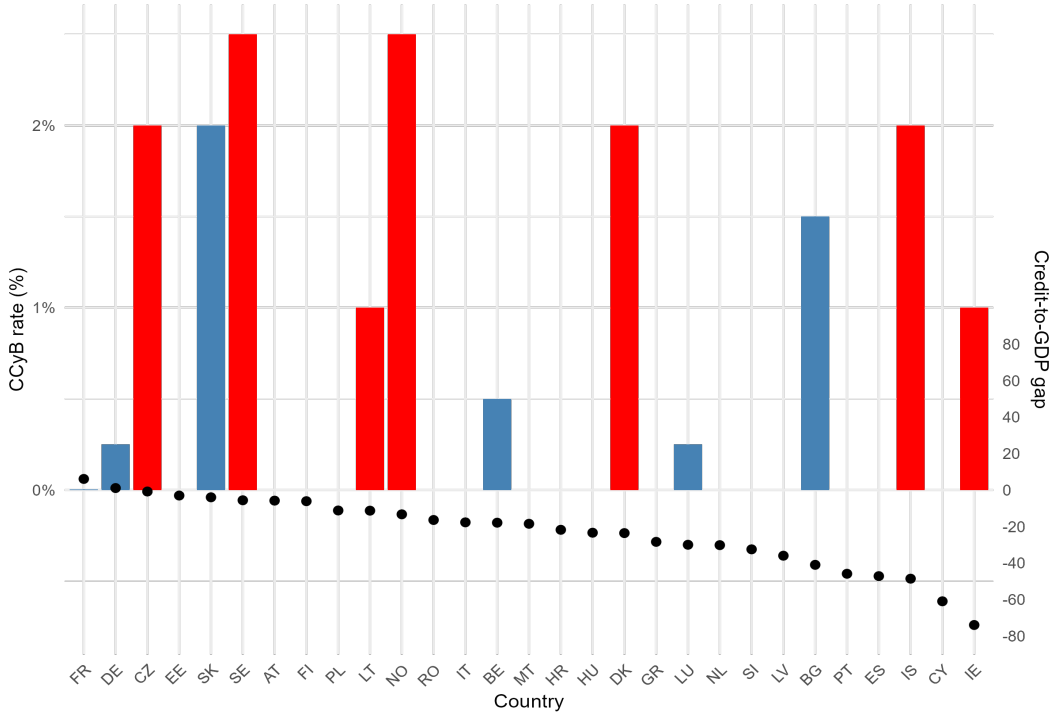
6.2. BCBS CCyB decision results

This section examines the CCyB decision-making process used by European Union countries, Norway, and Iceland. We present the results in Table 5 using the model specifications outlined in Table 2.

Given the strong hypothetical performance of the BCBS CCyB guide as an indicator for building up the CCyB prior to the global financial crisis of 2007–2008, surprisingly, the coefficient of the BCBS CCyB guide (in models BCBS 1 and BCBS 2) does not have a statistically significant

positive coefficient that is close to 1 in our models. On the contrary, the estimation output shows that the coefficients of the BCBS CCyB guide lagged by two and four periods are negative and statistically insignificant. This indicates that macroprudential authorities tend to adopt an approach that diverges from the BCBS CCyB guide, as presented in Eq. (1). These findings are consistent with those presented in Figure 2, which depicts the limited positive correlation between credit-to-GDP gaps and country-specific CCyB decision rates.[17] Although the credit-to-GDP gap seemed to be a reliable indicator for signaling excessive credit growth prior to the global financial crisis of 2007–2008, prompting the increase of the buffer, our findings indicate that regulatory authorities have not followed the rules-based BCBS CCyB guide upon its legal availability in 2014 when setting their CCyB rates.

Figure 2: CCyB rates vs. credit-to-GDP gap



This figure shows the credit-to-GDP gap and the corresponding CCyB rates as of 2019Q4 for all European countries in our dataset that report these variables before the COVID-19 pandemic. The countries are ranked in descending order of their credit-to-GDP gap, represented by the black dots below the bars. The values of the credit-to-GDP gap are displayed on the right y-axis. The CCyB rates are presented as bars on the left y-axis, with countries having no bars indicating a CCyB rate of 0%. Countries whose macroprudential authorities have adopted a positive cycle-neutral CCyB prior to the COVID-19 pandemic are marked with red bars, while those that did not are marked with blue bars.

Although the BCBS CCyB guide shows no statistically significant effect on CCyB rates in Europe, we control for the credit-to-GDP gap and credit-to-GDP ratio in BCBS 3 and BCBS 4, as both are expected to positively influence CCyB rates. However, both lagged credit-to-GDP gap variables

[17]For robustness, we also estimate Model 1 with different lags and also the current value of the BCBS CCyB guide and find similar results.

(two and four quarters) are statistically insignificant. Interestingly, the two-quarter lag suggests that countries with a higher gap tend to set lower buffer rates, aligning with the findings of previous models. Despite the credit-to-GDP gap indicating excessive credit growth, macroprudential authorities do not appear to set positive CCyB rates based on this indicator.[18] The rules-based CCyB approach only explains about 5% of buffer rate variation. In the next subsection, we therefore explore alternative variables to assess excessive credit growth, as suggested by the ESRB and the BCBS, to better understand the factors affecting CCyB rates in Europe.

Next, we examine how the sophistication of macroprudential supervision and the funding structure of banking supervision affect CCyB rates. While we observe a positive correlation between CCyB rates and macroprudential supervision sophistication, ideally, the funding structure should not impact CCyB decisions. However, our findings show that it does. In Model 5, with bank funding as the reference category, the coefficients for all other funding sources are positive, though not (always) statistically significant. Notably, when the government is the sole funding source, the effect is statistically significant, indicating that government-funded supervision leads to higher CCyB rates. However, since only Sweden has fully government-funded supervision, these results should be interpreted cautiously, especially given Sweden's high macroprudential capital buffers. To explore this further, we add a dummy variable in Model 6, indicating whether banks are involved in supervisory funding. The positive, statistically significant coefficient suggests that, on average, CCyB rates are higher when no banks are involved in funding supervision.

These findings raise interesting questions about the implications of supervisory funding structures and the potential risks of regulatory capture. For instance, if banks finance their own supervision, they may exert undue influence over supervisory decisions. Additionally, reliance on bank funding may lead to insufficient resources for effective supervision. By controlling for the supervisory funding structure, the explanatory power of the models improves to over 20%. These results are in line with the findings of Edge and Liang (2022), indicating that governments influence the CCyB decision process. Similar patterns have been observed in relation to other macroprudential capital buffers, such as those for other systemically important institutions (Sigmund, 2022).

Building on these insights, we expand the analysis in Model 7 by incorporating a dummy variable for countries that have committed to maintaining a positive CCyB rate during normal times, even when cyclical systemic risks are neither subdued nor elevated. As anticipated, the results show a significant coefficient of approximately 1, indicating that countries following this approach set CCyB rates about 1.02 percentage points higher than others. This variable also significantly enhances the model's explanatory power, increasing it to around 45%, underscoring the importance of this factor in determining CCyB rates.

[18] Given that Eq. (1) is piece-wise linear, the CCyB rate cannot take negative values and is bounded between 0% and 2.5%, we also estimate a fractional response model with correlated random effects in Appendix C. The results are shown in Table C.11 and Table C.12. The results are in line with those in Table 5 and Table 6. This means that the linear decision model is a good proxy for the piecewise linear and bounded CCyB decision model.

Table 5: Linear BCBS CCyB Models

	BCBS 1	BCBS 2	BCBS 3	BCBS 4	BCBS 5	BCBS 6	BCBS 7
Intercept					−0.2429	−0.2475	0.0826*
					(0.2478)	(0.2750)	(0.0451)
BCBS CCyB guide (-2)	−0.0303				0.0720	0.1267	0.0115
	(0.0826)				(0.0775)	(0.1337)	(0.0677)
BCBS CCyB guide (-4)		−0.0040					
		(0.1153)					
Credit-to-GDP gap (-2)			−0.0005				
			(0.0041)				
Credit-to-GDP ratio (-2)			0.0007				
			(0.0020)				
Credit-to-GDP gap (-4)				0.0010			
				(0.0045)			
Credit-to-GDP ratio (-4)				−0.0012			
				(0.0021)			
Funding banks, other					0.1009		
					(0.1577)		
Funding gov					1.0958***		
					(0.0721)		
Funding gov, banks					0.6841		
					(0.5021)		
Funding other					0.3254		
					(0.2135)		
Funding no banks						0.4141*	
						(0.2211)	
Mapru supervision index					0.1278	0.1613*	
					(0.0913)	(0.0864)	
positive CCyB dummy							1.0230***
							(0.0793)
Country fixed effects	*yes*	*yes*	*yes*	*yes*	*no*	*no*	*no*
Within R-Squared	0.00	0.00	0.00	0.00			
Between R-Squared	0.04	0.05	0.09	0.09			
Overall R-Squared	0.01	0.01	0.05	0.05	0.23	0.09	0.44
Nof Obs	709	725	709	725	689	689	709
Nof Groups	29	29	29	29	29	28	29
Avg. Obs. per Group	24.45	25	24.45	25	23.76	24.61	24.45
Min Obs. per Group	12	13	12	13	7	12	12
Max Obs. per Group	39	39	39	39	39	36	36

Source: Own calculations. BIS. SDW.
$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$. We use cluster robust standard errors with clustering at the country level.
The dependent variable is the CCyB decision rate. The observation period is from 2015Q1 to 2023Q4.
In BCBS Model 1, the explanatory variable is the BCBS CCyB guide lagged by two quarters. In the BCBS Model 2, the explanatory variable is the BCBS CCyB guide lagged by four quarters.
In BCBS Model 3, the explanatory variables are the credit-to-GDP gap and the credit-to-GDP ratio lagged by two quarters.
In BCBS Model 4, the explanatory variables are the credit-to-GDP gap and the credit-to-GDP ratio lagged by four quarters.
In BCBS Model 5, the explanatory variables are the BCBS CCyB guide lagged by two quarters, the supervisory funding source with the reference category "banks" and the index for the macroprudential supervision, which takes values between 0 and 4, depending on the sophistication of a country's macroprudential supervision.
In BCBS Model 6, the explanatory variables are the BCBS CCyB guide lagged by two quarters, the supervisory funding dummy without banks' participation (funding no banks), and the index for the macroprudential supervision.
In BCBS Model 7, the explanatory variables are the BCBS CCyB guide lagged by two quarters and the positive CCyB dummy, which takes the value of 1 if the observation is from one of the following countries after they implemented the positive cycle-neutral CCyB: Czech Republic, Denmark, Estonia, Ireland, Iceland, Lithuania, Netherlands, Sweden, or Norway.
Because of multicollinearity, we do not add country fixed effects to the models BCBS 5, BCBS 6, and BCBS 7.

In Appendix E, we explore regulatory capture by introducing an interaction term between the supervisory funding structure (Funding no banks) and the BCBS CCyB guide. Our results show

that when supervision is not funded by banks (e.g., funded by governments or other sources) and the BCBS guide recommends a 1% buffer, the actual CCyB rate decreases by about 0.49 percentage points. This suggests a misalignment with the BCBS guide, as adherence would produce a coefficient closer to 1. Instead, the observed coefficient of -0.49 indicates that CCyB decisions under non-bank-funded supervision often counter BCBS recommendations or the credit-to-GDP gap. In contrast, in countries where supervision is partially funded by banks, authorities appear more likely to align with the BCBS guide, potentially reflecting the banking sector's influence on policy decisions.

Additionally, our findings reveal that supervisory authorities not funded by banks are more inclined to adopt a positive cycle-neutral CCyB approach.[19] This divergence likely reflects different priorities, which could be influenced by the funding structure of supervisory activities.

6.3. ESRB CCyB decision results

Although the credit-to-GDP gap is considered a useful common reference point for determining CCyB decision rates, this subsection also incorporates other variables proposed by the BCBS and the ESRB as additional indicators to measure excessive credit growth. A broad set of variables for taking buffer decisions could ensure that the risk of misleading signals both for the build-up and the release phase is reduced.

Model 1 in Table 6 presents the explanatory variables recommended by the BCBS and the ESRB for determining the build-up of the CCyB. As observed in the previous subsection, the credit-to-GDP gap never has a significant positive effect on CCyB decision rates. While all indicators for assessing excessive credit growth are insignificant, many coefficients, such as the credit-to-GDP ratio, household and NFC loan growth, the current account and the residential property price (RRP)-to-GDP gap exhibit the expected positive signs. The remaining alternative indicators for assessing excessive credit growth in ESRB Model 1 are not only insignificant, but also fail to exhibit the anticipated relationships.

In Model 2, we add common macroeconomic control variables, such as GDP growth and the unemployment rate, to account for the general economic environment. The results indicate that higher unemployment rates are associated with lower CCyB decision rates, aligning with expectations since elevated unemployment typically reflects increased system-wide risk. Conversely, the positive coefficient for GDP growth suggests that CCyB rates tend to rise during economic expansions, in line with our expectations.

In Model 3, we also control for variables, which are recommended for the release phase, such as the non-performing loans (NPL) ratio, the return on assets (ROA) as well as the euro area CISS, which do not seem to play a significant role. Only the combined buffer requirement (CBR), which we use as a proxy for the macroprudential authorities' stance, has a significantly positive effect

[19] A separate regression confirms this, showing that supervisory funding without bank involvement increases the probability of a positive cycle-neutral CCyB approach by about 20%. Results are provided in the supplementary material.

on the CCyB decision rate, as expected. This finding suggests that authorities maintaining higher overall capital buffers are more inclined to implement higher CCyB rates, reflecting a proactive approach to strengthening financial system resilience.

In line with our previous results, the supervisory funding structure significantly impacts CCyB rates, as shown in ESRB Model 4 and Model 5. By incorporating this indicator, we enhance the model's explanatory power to around 60%. Notably, when banking supervision is funded by governments or other non-bank sources, the CCyB rate is, on average, significantly higher by approximately 39 to 76 basis points, respectively. Furthermore, when we account for cases where supervision funding excludes banks, the corresponding coefficient remains positive and statistically significant, with a similar magnitude.

While alternative variables, macroeconomic indicators, and funding structure significantly impact the CCyB decision-making process, a considerable portion of it remains unexplained. One possible explanation might be that there are factors that cannot be accounted for with quantitative indicators, but can be traced back to country-specific factors. Thus, in ESRB Model 6, we again control for whether countries are following a positive cycle-neutral CCyB approach. The statistically and economically significant positive coefficient of the positive CCyB dummy confirms the findings from the previous subsection. The positive CCyB dummy is an important driver of the CCyB decision rate. We find that countries that follow a positive CCyB rate in normal times have on average a CCyB decision rate that is 0.9 percentage points higher than that of other countries.

Further regressions conducted in Appendix C in Table C.13, in which we present the estimation results of the fractional response (correlated random effects) models described in Section 5.1, do not change these findings. In Appendix B in Table B.10, we also estimate the same models as in Table 6 but with data until 2019Q4, to account only for the build-up phase of the CCyB, given that in March 2020 almost all countries either fully or partially decreased their CCyB rates. The results are similar. The main difference is the coefficient of the positive CCyB dummy, which is higher at around 1.25 (instead of 0.9). This gap can be explained by the decrease of CCyB rates as a response to the COVID-19 pandemic.

To sum up, in accordance with our previous results, the positive CCyB dummy and the funding of banking supervision are the most relevant indicators explaining CCyB decision rates in Europe.

Table 6: Linear ESRB Models

	ESRB Model 1	ESRB Model 2	ESRB Model 3	ESRB Model 4	ESRB Model 5	ESRB Model 6
Intercept				−1.9213***	−1.9049***	−0.7046**
				(0.5414)	(0.5565)	(0.3287)
Credit-to-GDP gap (-2)	−0.0086	−0.0079	−0.0109**	0.0050	0.0036	−0.0007
	(0.0054)	(0.0049)	(0.0053)	(0.0044)	(0.0042)	(0.0034)
Credit-to-GDP ratio (-2)	0.0011	0.0070	0.0147*	0.0085***	0.0073***	0.0020*
	(0.0037)	(0.0055)	(0.0078)	(0.0018)	(0.0016)	(0.0011)
Two-year HH loan growth (-2)	0.0136	0.0104	0.0166	0.0326**	0.0397***	0.0250***
	(0.0084)	(0.0073)	(0.0108)	(0.0142)	(0.0088)	(0.0056)
Two-year NFC loan growth (-2)	0.0001	0.0005	0.0025	−0.0081	−0.0100	0.0031
	(0.0037)	(0.0034)	(0.0040)	(0.0082)	(0.0083)	(0.0029)
RPP to GDP gap (-2)	0.0004	−0.0078	−0.0233**	0.0045	0.0087	0.0044
	(0.0070)	(0.0073)	(0.0116)	(0.0121)	(0.0094)	(0.0050)
Lending margins to HH (-2)	−0.0585	−0.0367	0.1908	0.3172**	0.2064*	−0.0035
	(0.1213)	(0.1097)	(0.1857)	(0.1431)	(0.1133)	(0.0879)
Lending margins to NFC (-2)	−0.1206	−0.0803	−0.2907	−0.2266	−0.1560	−0.1899*
	(0.1454)	(0.1345)	(0.2090)	(0.1421)	(0.1243)	(0.1142)
Leverage ratio (-2)	−0.0080	−0.0120	−0.0682**	0.0025	0.0099	0.0265
	(0.0298)	(0.0269)	(0.0343)	(0.0307)	(0.0326)	(0.0357)
Current account (% of GDP) (-2)	0.0743	0.1951	0.3507	−2.7998	−2.2526	−1.5031
	(1.4571)	(1.4378)	(1.5835)	(1.7832)	(1.7112)	(1.5503)
Unemployment rate (-2)		−0.0713*	−0.0145	0.0085	0.0238	0.0196***
		(0.0371)	(0.0686)	(0.0198)	(0.0148)	(0.0068)
y-o-y GDP growth (-2)		0.0045	0.0095	0.0079	0.0072	0.0080
		(0.0037)	(0.0069)	(0.0083)	(0.0086)	(0.0065)
CBR (% of RWA) (-1)			0.1469**	0.1831**	0.1644***	0.1058*
			(0.0726)	(0.0709)	(0.0600)	(0.0568)
ROA (-2)			0.0609	−0.0903	−0.0343	0.0381
			(0.0636)	(0.1355)	(0.1470)	(0.0975)
NPL ratio (-2)			−0.0238	−0.0005	−0.0005	0.0127
			(0.0162)	(0.0113)	(0.0096)	(0.0080)
Euro area CISS			−0.9421*	−0.8365	−0.8379	−0.7033
			(0.5389)	(0.5281)	(0.5403)	(0.5121)
Funding banks, other				0.3973***		
				(0.1362)		
Funding gov				0.5352***		
				(0.1903)		
Funding gov, banks				0.1864		
				(0.2047)		
Funding other				0.7566***		
				(0.1993)		
Mapru supervision index				0.0976	0.1276	
				(0.1112)	(0.0936)	
Funding no banks					0.5565***	
					(0.1450)	
positive CCyB Dummy						0.8954***
						(0.1123)
Country fixed effects	*yes*	*yes*	*yes*	*no*	*no*	*no*
Within R-Squared	0.0734	0.1066	0.2322			
Between R-Squared	0.3343	0.3481	0.8764			
Overall R-Squared	0.20	0.20	0.42	0.60	0.58	0.61
Nof Obs	495	495	333	314	314	333
Nof Groups	29	29	27	19	19	20
Avg. Obs. per Group	17.07	17.07	12.33	16.53	16.53	16.65
Min Obs. per Group	1	1	2	3	3	3
Max Obs. per Group	30	30	26	26	26	26

Source: ECB SDW. BIS. Own Calculations.
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. We use cluster-robust standard errors with clustering at the country level.
The dependent variable is the CCyB decision. The observation period is from 2015Q1 to 2023Q4.
In ESRB Model 1, the explanatory variables are the two-year household loan growth, the two-year NFC loan growth, the RPP-to-GDP gap lagged by two quarters, two-year lending margin to NFC and households lagged by two quarters, current account (% of GDP) and the leverage ratio (Tier 1 capital divided by total assets). In ESRB Model 2, we add the unemployment rate and the year-on-year nominal GDP growth to the list of explanatory variables of ESRB Model 1. In ESRB Model 3, we add the combined buffer requirements expressed in percentage of risk-weighted assets lagged by one quarter to the list of explanatory variables of ESRB Model 2. In ESRB Model 4, we add the supervisory funding source with the reference category banks and the macroprudential supervision index, which takes values between 0 and 4, depending on the sophistication of a country's macroprudential supervision, to the list of explanatory variables of ESRB Model 3. In ESRB Model 5, we add the supervisory funding dummy without banks' participation (funding no banks) instead of all categories of supervisory funding.
In ESRB Model 6, we add the positive CCyB dummy to the list of explanatory variables of ESRB Model 3, which takes the value of 1 if the observation is from one of the following countries after they implemented the positive cycle-neutral CCyB: Czech Republic, Denmark, Estonia, Ireland, Iceland, Lithuania, Netherlands, Sweden, or Norway. To avoid any multicollinearity, we do not add country fixed effects to ESRB Model 4, ESRB Model 5, and ESRB Model 6.

7. Conclusion and policy recommendations

We analyze how authorities are setting CCyB rates, using datasets from the BIS, the ESRB, and the ECB and linear and non-linear decision models. First, we examine whether the BCBS credit-to-GDP gap and the related BCBS rules-based CCyB guide would have been sufficient in the build-up to the global financial crisis of 2007–2008 to absorb the related losses of the banking sector. Second, we ask whether macroprudential authorities follow the BCBS CCyB guide (i.e., the credit-to-GDP gap). Third, we evaluate the determinants of CCyB decision rates in the European Union, Norway, and Iceland.

First, we show that the required CET1 capital under the hypothetical CCyB rates derived from the rules-based BCBS CCyB guide in 2005 and 2006 would have been sufficient to absorb the losses incurred by the banking sectors in various European countries during the global financial crisis of 2007–2008. This suggests that, had the CCyB been in place prior to the crisis, the reliance on government support or taxpayer funds could have been significantly reduced. Our findings contribute to clarifying the common perception among policymakers and regulators that the credit-to-GDP gap responds too slowly or insufficiently in the build-up phase of the buffer before financial crises, at least in the context of the global financial crisis of 2007–2008.

Second, our analysis reveals that countries frequently deviate from the BCBS CCyB guide when setting their CCyB rates. Our empirical findings suggest that macroprudential authorities do not consistently adhere to the rules-based BCBS guide and, in some cases, implement CCyB rates that directly contradicts the rules-based BCBS guide. This highlights the guide's limited influence on actual buffer-setting decisions since its legal implementation.

Third, our results indicate that additional indicators as suggested by the BCBS and the ESRB, particularly those related to the build-up of cyclical risk, including credit-related variables, do not appear to have a significant impact on CCyB decision rates in the European Union. This further supports the empirical evidence that most European countries do not strictly rely on the variables mentioned in the ESRB recommendation for setting their CCyB rates. This inconsistency suggests that, despite the theoretical benefits of the BCBS guide and additional ESRB-related variables in calibrating the CCyB, various practical, political, and institutional constraints hinder their full and harmonized implementation.

Finally, we demonstrate that the major determinants for CCyB rates in the European Union are the positive cycle-neutral CCyB approach and, to a lesser extent, the funding structure of banking supervision. If banks are not involved in funding their banking supervision, then CCyB rates are up to around 0.5 percentage point higher. A positive cycle-neutral CCyB approach, although differing from the original concept of the CCyB framework, also appears to be an attractive option for several macroprudential authorities. This approach can offer additional macroprudential flexibility, enabling authorities to better respond to unforeseen external shocks, which was first observed during the COVID-19 pandemic, when almost all macroprudential authorities in Europe either fully or partially released or cancelled upcoming increases in their CCyB rate (ESRB, 2021), in case a buffer was built up before the pandemic.

One of our key findings is the significant variation in national approaches to CCyB accumulation (and release), driven by country-specific preferences, economic conditions, and macroprudential policy considerations. To enhance the effectiveness of this buffer, we propose greater harmonization of CCyB frameworks across jurisdictions. A more coordinated approach could help reduce disparities, ensure a level playing field, and strengthen financial system resilience by facilitating a more uniform response to cyclical risks. For instance, discrepancies in CCyB rates may incentivize banks to shift new business to countries with lower requirements, potentially undermining the intended stabilizing effects. Greater alignment in CCyB implementation could hence mitigate such spillover effects, enhancing financial stability, reducing crisis risks, and minimizing unnecessary social costs.

Our findings also suggest that funding sources for banking supervision have an effect on CCyB decision rates. We therefore propose that policymakers explore more stable and centralized funding models for banking supervision, ensuring that supervisory authorities have the necessary resources to monitor systemic risks and to enforce the CCyB effectively.

Building on our findings, we propose several areas for future research. First, future studies could perform textual analysis of official CCyB decision announcements from macroprudential authorities to gain deeper insights into the decision-making process. This approach could systematically examine policy justifications, risk assessments, and the indicators referenced in these announcements, offering a clearer understanding of the rationale behind CCyB adjustments, the economic considerations guiding these decisions, and any emerging shifts in policy focus over time. Such research would contribute to a more nuanced understanding of the priorities and mechanisms underlying CCyB decisions.

Second, while the CCyB has been increasingly utilized in recent years, further work is also needed to evaluate the costs and benefits of adopting a positive cycle-neutral CCyB. This analysis could also seek to identify commonalities and differences across international CCyB frameworks. From the perspective of fostering an international level playing field, greater harmonization of buffer levels, as well as alignment in the design and implementation of CCyB frameworks – including their build-up and release phases – would be highly beneficial. These steps could improve the coherence of macroprudential policies and enhance their effectiveness across different jurisdictions.

In conclusion, to strengthen the CCyB's role in mitigating systemic risk, harmonization of CCyB frameworks at the international level, improvement of funding mechanisms for supervisory authorities, and targeted research into the institutional and operational barriers to policy implementation are crucial. By addressing these challenges, policymakers can ensure that macroprudential tools like the CCyB become more effective in contributing to reducing the costs of financial crises, ultimately contributing to the stability of the global financial system.

References

Admati, A. and Hellwig, M. (2014). *The Bankers' New Clothes: What's Wrong with Banking and What to Do about It - Updated Edition*. Princeton University Press.

Aikman, D., Haldane, A. G., and Nelson, B. D. (2014). Curbing the credit cycle. *The Economic Journal*, 125(585):1072–1109.

Anginer, D., Bertay, A. C., Cull, R., Demirgüç-Kunt, A., and Mare, D. S. (2019). Bank regulation and supervision ten years after the global financial crisis. *World Bank Policy Research Working Paper*, (9044).

Arbatli-Saxegaard, E. and Muneer, M. (2020). The countercyclical capital buffer: A cross-country overview of policy frameworks. Staff Memo No. 6/2020, Norges Bank.

Babecky, J., Havranek, J., Rusnak, M., Smdkova, K., and Vasicek, B. (2014). Banking, debt, and currency crises in developed countries: Stylized facts and early warning indicators. *Journal of Financial Stability*, 15:1–17.

Barth, J., Caprio Jr, G., and Levine, R. (2014). *Guardians of Finance: Making Regulators Work for us*. MIT Press.

Baucells, M., Carrasco, J. A., and Hogarth, R. M. (2008). Cumulative dominance and heuristic performance in binary multiattribute choice. *Operations Research*, 56(5):1289–1304.

Behn, M., Pereira, A., Pirovano, M., and Testa, A. (2023). A positive neutral rate for the countercyclical capital buffer – state of play in the banking union. ECB Macroprudential Bulletin 21.

BIS (2010a). Basel III: A global regulatory framework for more resilient banks and banking systems. https://www.bis.org/publ/bcbs189.pdf.

BIS (2010b). Countercyclical capital buffer proposal. https://www.bis.org/publ/bcbs172.pdf.

BIS (2010c). Countercyclical capital buffers: exploring options. https://www.bis.org/publ/work317.pdf.

BIS (2010d). Guidance for national authorities operating the countercyclical capital buffer. https://www.bis.org/publ/bcbs187.pdf.

BIS (2022). Newsletter on positive cycle-neutral countercyclical capital buffer rates. https://www.bis.org/publ/bcbs_nl30.htm.

BIS (2024). Range of practices in implementing the countercyclical capital buffer policy. https://www.bis.org/bcbs/publ/d585.pdf.

Cappelletti, G., Ponte Marques, A., Varraso, P., Budrys, V., and Peeters, J. (2019). Impact of higher capital buffers on banks' lending and risk-taking: evidence from the euro area experiments. ECB Working Paper Series No. 2292.

Chamberlain, G. (1980). Analysis of covariance with qualitative data. *The Review of Economic Studies*, 47(1):225–238.

CRD V (2019). Directive 2013/36/EU of the European Parliament and of the Council of 26 June 2013 on access to the activity of credit institutions and the prudential supervision of credit institutions and investment firms, amending Directive 2002/87/EC and repealing Directives 2006/48/EC and 2006/49/EC Text with EEA relevance.

Dawes, R. M. and Corrigan, B. (1974). Linear models in decision making. *Psychological Bulletin*, 81(2):95–106.

Drehmann, M. and Borio, C. (2010). Countercyclical Capital Buffers: Exploring Options. BIS Working Papers No 317.

Drehmann, M. and Yetman, J. (2018). Why you should use the Hodrick-Prescott filter - at least to generate credit gaps. BIS Working Papers No 744.

Dursun-de Neef, H. Ö., Schandlbauer, A., and Wittig, C. (2023). Countercyclical capital buffers and credit supply: Evidence from the COVID-19 crisis. *Journal of Banking and Finance*, 154:106930.

Edge, R. and Liang, J. (2022). Financial Stability Committees and the Basel III Countercyclical Capital Buffer. *International Journal of Central Banking*, 76:247–299.

ESRB (2014). Recommendation of the European Systemic Risk Board of 18 June 2014 on guidance for setting countercyclical buffer rates (ESRB/2014/1). https://www.esrb.europa.eu/pub/pdf/recommendations/140630_ESRB_Recommendation.en.pdf.

ESRB (2021). A Review of Macroprudential Policy in the EU in 2020. Technical Report July 2021, ESRB.

Eurostat (2015). Eurostat Supplementary Table for the Financial Crisis. Background note, Eurostat.

Eurostat (2018). Eurostat Supplementary Table for Reporting Government Interventions to Support financial Institutions. Background note, Eurostat.

Fang, X., Jutrsa, D., Peria, S. M., Presbitero, A. F., and Ratnovski, L. (2022). Bank capital requirements and lending in emerging markets: The role of bank characteristics and economic conditions. *Journal of Banking and Finance*, 135:105806.

Gigerenzer, G. and Gaissmaier, W. (2011). Heuristic Decision Making. *Annual Review of Psychology*, 62(1):451–482.

Hájek, J., Frait, J., and Plašil, M. (2016). The countercyclical capital buffer in the Czech Republic. *Financial Stability Report*, 2017:106–114.

Hamilton, J. D. (2018). Why You Should Never Use the Hodrick-Prescott Filter. *Review of Economics and Statistics*, 100(5):831–843.

Herrera, L., Scalone, V., and Pirovano, M. (2024). The importance of being positive: costs and benefits of a positive neutral rate for the countercyclical capital buffer. ECB Macroprudential Bulletin June 2024.

Herz, B. and Keller, J. (2023). How do regulators set the countercyclical capital buffer? *International Journal of Central Banking*, 19(3):99–137.

Hodrick, R. J. and Prescott, E. C. (1997). Postwar us business cycles: an empirical investigation. *Journal of Money, Credit, and Banking*, 29(1):1–16.

Hogarth, R. M. and Karelaia, N. (2006). "take-the-best" and other simple strategies: why and when they work "well" with binary cues. *Theory and Decision*, 61(3):205–249.

Hollo, D., Kremer, M., and Lo Duca, M. (2012). CISS-a Composite Indicator of Systemic stress in the Financial System. ECB Working Paper Series No. 1426.

Jokivuolle, E., Pesola, J., and Viren, M. (2015). Why is credit-to-gdp a good measure for setting countercyclical capital buffers? *Journal of Financial Stability*, 18:117–126.

Jordà, Ò., Schularick, M., and Taylor, A. M. (2011). Financial crises, credit booms, and external imbalances: 140 years of lessons. *IMF Economic Review*, 59(2):340–378.

Kaminsky, G. L. and Reinhart, C. M. (1999). The twin crises: the causes of banking and balance-of-payments problems. *American Economic Review*, 89(3):473–500.

Katsikopoulos, K. (2011). Psychological heuristics for making inferences: Definition, performance, and the emerging theory and practice. *Decision Analysis*, 8(1):10–29.

Laeven, L. and Valencia, F. (2012). Systemic Banking Crises Database: An Update. IMF Working Paper No. 12/163, IMF.

Laeven, L. and Valencia, F. (2013). Systemic banking crises database. *IMF Economic Review*, 61(2):225–270.

Laeven, L. and Valencia, F. (2018). Systemic banking crises: A new database. IMF Working Paper WP/18/206.

Lo Duca, M., Koban, A., Basten, M., Bengtsson, E., Klaus, B., Kusmierczyk, P., Lang, J. H., Detken, C., and Peltonen, T. A. (2017). A new database for financial crises in european countries: Ecb/esrb eu crises database.

Martignon, L. and Hoffrage, U. (2002). Fast, frugal, and fit: Simple heuristics for paired comparison. *Theory and Decision*, 52(1):29–71.

Neyman, J., Scott, E. L., et al. (1948). Consistent estimates based on partially consistent observations. *Econometrica*, 16(1):1–32.

O'Brien, E., O'Brien, M., and Velasco, S. (2018). Measuring and mitigating cyclical systemic risk in Ireland: The application of the countercyclical capital buffer. Financial Stability Notes 4/FS/18, Central Bank of Ireland.

Papke, L. and Wooldridge, J. (1996). Econometric methods for fractional response variables with an application to 401 (k) plan participation rates. *Journal of Applied Econometrics*, 11(6):619–632.

Papke, L. E. and Wooldridge, J. M. (2008). Panel data methods for fractional response variables with an application to test pass rates. *Journal of Econometrics*, 145(1-2):121–133.

Pekanov, A. and Dierick, F. (2016). Implementation of the countercyclical capital buffer regime in the European Union. ESRB Macroprudential Commentaries 8, European Systemic Risk Board.

Repullo, R. and Saurina, J. (2011). The countercyclical capital buffers of Basel III: A critical asessment. *CEMFI Working Paper 1102*.

Romer, C. D. and Romer, D. H. (2017). New evidence on the aftermath of financial crises in advanced countries. *American Economic Review*, 107(10):3072–3118.

Schularick, M. and Taylor, A. M. (2012). Credit booms gone bust: Monetary policy, leverage cycles, and financial crises, 1870-2008. *American Economic Review*, 102(2):1029–61.

Sigmund, M. (2022). The capital buffer calibration for other systemically important institutions - Is the country heterogeneity in the EU caused by regulatory capture? *Scottish Journal of Political Economy*, 69(5):533–563.

Appendix A. European Hypothetical CCyB before the global financial crisis of 2007-2008

Table A.7: Hypothetical CCyB rates before the global financial crisis of 2007–2008

Country	2004Q1	2004Q2	2004Q3	2004Q4	2005Q1	2005Q2	2005Q3	2005Q4	2006Q1	2006Q2	2006Q3	2006Q4
AU	1.91	2.19	2.16	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
BE	2.22	1.88	1.62	1.53	0.91	0.50	0.00	0.00	0.00	0.00	0.00	0.00
CN	2.50	2.34	1.31	0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CZ	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.28	0.94	1.31	1.31	1.84
DK	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
ES	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
FI	0.00	0.00	0.00	0.00	0.00	0.62	0.53	0.88	1.81	2.50	2.50	1.88
FR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.09	0.25
GB	1.28	1.03	1.38	1.19	0.97	1.66	1.78	1.75	1.56	1.81	2.34	1.84
GR	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
HU	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
IE	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
IN	1.66	1.34	1.31	2.38	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
IT	1.94	2.22	2.06	2.47	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
NL	0.50	0.00	0.00	0.00	0.00	0.53	0.44	0.00	0.00	0.00	0.00	0.00
NO	2.50	2.50	2.50	2.09	1.75	1.59	0.88	0.97	0.59	0.50	0.75	0.62
NZ	0.00	0.00	0.00	0.00	0.28	0.59	1.00	2.12	2.25	2.50	2.50	2.50
PT	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50	2.50
SA	0.00	0.00	0.00	0.03	0.00	0.34	0.38	0.31	0.00	0.00	0.00	0.00
SE	0.00	0.00	0.00	0.00	0.00	0.44	0.47	1.03	0.75	1.12	0.91	1.25
TR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.91	2.12	1.81	1.72
US	1.66	1.62	1.62	1.88	1.59	1.81	1.88	2.00	2.16	2.41	2.44	2.50
ZA	0.00	0.00	0.00	0.00	0.00	0.28	0.59	0.94	1.62	1.84	2.50	2.50

This table shows the hypothetical CCyB rates for different countries by assuming that the BCBS CCyB guide would have already been in place before the global financial crisis of 2007–2008.
The numbers are presented for all countries that report their credit-to-GDP ratio to the BIS between 2004 and 2006. The column "Country" refers to the ISO 3166-1 alpha-2 codes.

Table A.8: Breakdown for additional CET1 requirements for European Union countries

Country	Date	Hypothetical CCyB	Risk density 2007	Bank credit to private sector	Additional CCyB requirements
Belgium	200412	1.53	35.14	182,589,000	982,465
Czech Republic	200512	0.28	31.64	953,815,000	848,840
Czech Republic	200612	1.84	31.64	1,188,769,000	6,935,356
Denmark	200412	2.50	36.66	2,153,438,000	19,733,635
Denmark	200512	2.50	36.66	2,465,889,000	22,596,868
Denmark	200612	2.50	36.66	2,810,471,000	25,754,542
Spain	200412	2.50	60.89	937,027,000	14,264,887
Spain	200512	2.50	60.89	1,194,951,000	18,191,409
Spain	200612	2.50	60.89	1,497,390,000	22,795,607
Finland	200512	0.88	45.07	112,780,000	444,781
Finland	200612	1.88	45.07	125,660,000	1,061,951
France	200612	0.25	35.74	1,479,118,000	1,321,511
Greece	200412	2.50	65.13	121,748,000	1,982,405
Greece	200512	2.50	65.13	147,309,000	2,398,611
Greece	200612	2.50	65.13	175,777,000	2,862,152
Hungary	200412	2.50	64.49	8,032,960,000	129,506,269
Hungary	200512	2.50	64.49	9,550,290,000	153,968,453
Hungary	200612	2.50	64.49	11,299,430,000	182,167,846
Ireland	200412	2.50	70.27	162,329,000	2,851,697
Ireland	200512	2.50	70.27	211,315,000	3,712,253
Ireland	200612	2.50	70.27	266,548,000	4,682,553
Italy	200412	2.47	64.38	963,200,000	15,309,663
Italy	200512	2.50	64.38	1,035,475,000	16,666,778
Italy	200612	2.50	64.38	1,153,246,000	18,562,395
Portugal	200412	2.50	71.20	176,565,000	3,142,650
Portugal	200512	2.50	71.20	191,536,000	3,409,116
Portugal	200612	2.50	71.20	214,645,000	3,820,429
Sweden	200512	1.03	44.52	2,864,190,000	13,151,120
Sweden	200612	1.25	44.52	3,149,436,000	17,528,298

Source: BIS. ECB SDW. Own calculations.
This table presents European Union countries that would have set a positive CCyB according to the BCBS CCyB guide and have reported the necessary data to the BIS.
The hypothetical CCyB refers to the BCBS guide to calculate the CCyB based on the credit-to-GDP gap as defined in Eq. (1). Risk density is defined as risk-weighted assets divided by total assets. These ratios are already provided by the ECB SDW.
Bank credit to the private sector refers to the aggregate credit to the private sector, including households and non-financial corporations, for each country. The numbers are in thousand EUR.
Additional CET1 requirements per country and selected periods are shown. These numbers are in thousand euros. We do not show all quarters with a positive hypothetical CCyB for each country but only selected quarters around the build-up to the global financial crisis of 2007–2008.
Since risk-weighted assets data are unavailable prior to 2007, we use data on risk density from 2007, along with available total banking assets data, to approximate the risk-weighted assets for each period and country. We assume that the CCyB would have been binding during this time.

Appendix B. CCyB models without the COVID-19 period

In this section, we estimate our main linear model (Table 5 and Table 6) but with data until 2019Q4, to account only for the build-up phase of the CCyB, given that in March 2020 many countries either fully or partially decreased their CCyB rates.

Table B.9: Linear BCBS CCyB models without the COVID-19 period

	BCBS 1	BCBS 2	BCBS 3	BCBS 4	BCBS 5	BCBS 6	BCBS 7
Intercept					−0.1867	−0.2795	0.0725*
					(0.2528)	(0.3479)	(0.0430)
BCBS CCyB guide (-2)	−0.0855				0.1125	0.1614	−0.0317
	(0.1021)				(0.1130)	(0.1947)	(0.1000)
BCBS CCyB guide (-4)		−0.0417					
		(0.1409)					
Credit-to-GDP gap (-2)			−0.0034				
			(0.0029)				
Credit-to-GDP ratio (-2)			0.0032				
			(0.0030)				
Credit-to-GDP gap (-4)				−0.0003			
				(0.0046)			
Credit-to-GDP ratio (-4)				0.0026			
				(0.0031)			
Funding banks, other					0.1402		
					(0.1599)		
Funding gov					1.5747***		
					(0.0869)		
Funding gov, banks					0.7597		
					(0.6362)		
Funding other					0.2536		
					(0.1904)		
Funding no banks						0.4529	
						(0.3079)	
Mapru supervision index					0.1027	0.1730	
					(0.0974)	(0.1088)	
positive CCyB dummy							1.2871***
							(0.1420)
Country fixed effects	*yes*	*yes*	*yes*	*yes*	*no*	*no*	*no*
Within R-Squared	0.01	0.00	0.01	0.00			
Between R-Squared	0.08	0.09	0.10	0.06			
Overall R-Squared	0.01	0.02	0.07	0.06	0.34	0.10	0.61
Nof Obs	498	498	498	498	485	485	498
Nof Groups	29.00	29.00	29.00	29.00	29.00	28.00	29.00
Avg. Obs. per Group	17.17	17.17	17.17	17.17	16.72	17.32	17.17
Min Obs. per Group	10	11	10	11	5	10	10
Max Obs. per Group	25	22	25	22	25	23	23

Source: Own calculations. BIS. SDW.
$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$. We use cluster robust standard errors with clustering at the country level.
The dependent variable is the CCyB decision rate. The observation period is from 2015Q1 to 2020Q1.
In BCBS Model 1, the explanatory variable is the BCBS CCyB guide lagged by two quarters. In BCBS Model 2, the explanatory variable is the BCBS CCyB guide lagged by four quarters.
In BCBS Model 3, the explanatory variables are the credit-to-GDP gap and the credit-to-GDP ratio lagged by two quarters.
In BCBS Model 4, the explanatory variables are the credit-to-GDP gap and the credit-to-GDP ratio lagged by four quarters.
In BCBS Model 5, the explanatory variables are the BCBS CCyB guide lagged by two quarters, the supervisory funding source with the reference category "banks" and the index for the macroprudential supervision which takes values between 0 and 4 depending on the sophistication of a country's macroprudential supervision.
In BCBS Model 6, the explanatory variables are the BCBS CCyB guide lagged by two quarters, the supervisory funding dummy without banks' participation (Funding no banks), and the index for macroprudential supervision.
In BCBS Model 7, the explanatory variables are the BCBS CCyB guide lagged by two quarters and the positive CCyB dummy, which takes the value of 1 if the observation is from one of the following countries after they implemented the positive cycle-neutral CCyB: Czech Republic, Denmark, Estonia, Ireland, Iceland, Lithuania, Netherlands, Sweden, or Norway.
To avoid any multicollinearity, we do not add country fixed effects to the models BCBS 5, BCBS 6, and BCBS 7.

Table B.10: Linear ESRB models without the COVID-19 period

	ESRB Model 1	ESRB Model 2	ESRB Model 3	ESRB Model 4	ESRB Model 5	ESRB Model 6
Intercept				−2.0206***	−2.3816***	−0.7818**
				(0.4432)	(0.5105)	(0.3370)
Credit-to-GDP gap (-2)	−0.0135*	−0.0078	−0.0043	0.0111***	0.0099***	0.0034
	(0.0074)	(0.0059)	(0.0042)	(0.0036)	(0.0035)	(0.0028)
Credit-to-GDP ratio (-2)	0.0070	0.0159**	0.0216**	0.0082***	0.0097***	0.0033***
	(0.0078)	(0.0071)	(0.0086)	(0.0017)	(0.0013)	(0.0010)
Two-year HH loan growth (-2)	0.0093	0.0065	0.0067	0.0130	0.0329***	0.0178***
	(0.0106)	(0.0096)	(0.0098)	(0.0096)	(0.0073)	(0.0057)
Two-year NFC loan growth (-2)	0.0061	0.0034	−0.0007	−0.0008	−0.0054	0.0052***
	(0.0067)	(0.0052)	(0.0034)	(0.0065)	(0.0068)	(0.0020)
RPP to GDP gap (-2)	0.0037	−0.0203	−0.0444**	0.0120	0.0092	0.0040
	(0.0127)	(0.0143)	(0.0178)	(0.0130)	(0.0089)	(0.0052)
Lending margins to HH (-2)	−0.2327	−0.2632*	0.0471	0.1640	0.1453	−0.0651
	(0.1839)	(0.1454)	(0.1532)	(0.1319)	(0.1024)	(0.1019)
Lending margins to NFC (-2)	0.0468	0.1382	−0.1096	−0.0422	0.0475	−0.1107
	(0.1559)	(0.1447)	(0.1277)	(0.1234)	(0.1171)	(0.0990)
Leverage ratio (-2)	0.0399	0.0189	−0.0157	0.0213	0.0132	0.0377
	(0.0303)	(0.0208)	(0.0309)	(0.0270)	(0.0275)	(0.0301)
Current account (% of GDP) (-2)	−0.2449	−0.7566	0.6062	−1.7623	−1.6959	−2.8652**
	(1.8994)	(1.6944)	(1.9849)	(1.1536)	(1.4344)	(1.1934)
Unemployment rate (-2)		−0.1528***	−0.1231***	0.0110	0.0348**	0.0388***
		(0.0542)	(0.0336)	(0.0182)	(0.0164)	(0.0138)
y-o-y GDP growth (-2)		−0.0002	−0.0043	−0.0117	−0.0075	0.0046
		(0.0021)	(0.0046)	(0.0134)	(0.0122)	(0.0056)
CBR (% of RWA) (-1)			0.1009	0.1439*	0.1482**	0.0724**
			(0.0713)	(0.0817)	(0.0650)	(0.0346)
ROA (-2)			0.0760	−0.0355	0.0663	0.0650
			(0.0868)	(0.1086)	(0.1157)	(0.0817)
NPL ratio (-2)			−0.0425	−0.0116	−0.0211***	−0.0062
			(0.0261)	(0.0095)	(0.0074)	(0.0090)
Euro area CISS			−0.6794	−0.1954	−0.0716	−0.2177
			(0.5752)	(0.6884)	(0.6709)	(0.5887)
Funding banks, other				0.4559**		
				(0.1806)		
Funding gov				1.3089***		
				(0.3426)		
Funding gov, banks				−0.0010		
				(0.1824)		
Funding other				0.8911***		
				(0.2280)		
Funding no banks					0.9235***	
					(0.1845)	
Mapru supervision index				0.1884**	0.1644**	
				(0.0792)	(0.0687)	
positive CCyB Dummy						1.3281***
						(0.1532)
Country fixed effects	*yes*	*yes*	*yes*	*no*	*no*	*no*
Within R-Squared	0.14	0.27	0.49			
Between R-Squared	0.36	0.53	0.95			
Overall R-Squared	0.29	0.30	0.53	0.80	0.77	0.82
Nof Obs	349	349	219	206	206	219
Nof Groups	28	28	24	18	18	19
Avg. Obs. per Group	12.46	12.46	9.12	11.44	11.44	11.53
Min Obs. per Group	1	1	1	3	3	3
Max Obs. per Group	21	21	17	18	18	18

Source: ECB SDW. BIS. Own Calculations.
$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$. We use cluster robust standard errors with clustering at the country level.
The dependent variable is the CCyB decision. The observation period is from 2015Q1 to 2020Q1.
In ESRB Model 1, the explanatory variables are the two-year household loan growth, the two-year NFC loan growth, the two-year RPP-to-GDP gap lagged by two quarters, two-year lending margin to NFC and HH lagged by two quarters, the current account (% of GDP) and the leverage ratio (Tier 1 capital divided by total assets). In ESRB Model 2, we add the unemployment rate and the year-on-year nominal GDP growth to the list of explanatory variables of ESRB Model 1. In ESRB Model 3, we add the combined buffer requirements expressed in percentage of risk weighted assets lagged by one quarter to the list of explanatory variables of ESRB Model 2. In ESRB Model 4, we add the supervisory funding source with the reference category banks and the macroprudential supervision index which takes values between 0 and 4 depending on the sophistication of a country's macroprudential supervision to the list of explanatory variables of ESRB Model 3. In ESRB Model 5, we add the supervisory funding dummy without banks' participation (Funding no banks) instead of all categories of supervisory funding.
In ESRB Model 6, we add the positive CCyB dummy to the list of explanatory variables of ESRB Model 3, which takes the value of 1 if the observation is from one of the following countries after they implemented the positive cycle-neutral CCyB: Czech Republic, Denmark, Estonia, Ireland, Iceland, Lithuania, Netherlands, Sweden, or Norway. To avoid any multicollinearity, we do not add country fixed effects to ESRB Model 4, ESRB Model 5, and ESRB Model 6.

Appendix C. Fractional response model with correlated random effects

In this section, we estimate the BCBS and ESRB models as in Section 6.2 and Section 6.3 with the correlated random effects models described in Section 5.1. In Table C.11, we estimate the same models as in Table 5.

As mentioned in Section 5.1, we have to compare the estimated coefficients of the average partial effects in Table C.12, which are defined in Eq. (13), with the coefficients in Table 5. The average partial effects in Table C.12 are in line with the results in Table 5. It is important to note that the dependent variable is not the actual CCyB buffer, but any actual CCyB buffer divided by 2.5 to achieve that any CCyB rate lies in the interval [0, 1].

Table C.11: BCBS models: Fractional Response Model with Correlated Random Effects

	FR CRE M-1	FR CRE M-2	FR CRE M-3	FR CRE M-4	FR M-5	FR M-6	FR M-7
Intercept	−1.3515***	−1.2634***	−1.5454***	−1.4885***	−2.5103***	−2.1761***	−1.8337***
	(0.2512)	(0.2313)	(0.4284)	(0.4022)	(0.5150)	(0.6580)	(0.2369)
BCBS CCyB guide (-2)	0.1080				0.1284	0.2345	0.0303
	(0.1802)				(0.1314)	(0.1986)	(0.1229)
BCBS CCyB guide (-4)		0.1474					
		(0.1898)					
Credit-to-GDP gap (-2)			0.0028				
			(0.0081)				
Credit-to-GDP ratio (-2)			0.0100				
			(0.0072)				
Credit-to-GDP gap (-4)				0.0064			
				(0.0085)			
Credit-to-GDP ratio (-4)				0.0063			
				(0.0068)			
Funding banks, other					0.2924		
					(0.4179)		
Funding gov					1.5900***		
					(0.2253)		
Funding gov, banks					1.1945*		
					(0.7011)		
Funding other					0.6673*		
					(0.3569)		
Funding no banks						0.6517*	
						(0.3681)	
Mapru supervision index					0.3009*	0.2822	
					(0.1751)	(0.1822)	
positive CCyB dummy							1.6833***
							(0.2428)
Pseudo R-Squared	0.18	0.13	0.25	0.19	0.41	0.30	0.52
Nof Obs	709.00	725.00	709.00	725.00	689.00	689.00	709.00
Nof Groups	29.00	29.00	29.00	29.00	28.00	28.00	29.00
Avg. Obs. per Group	24.45	25.00	24.45	25.00	24.61	24.61	24.45
Min Obs. per Group	12.00	13.00	12.00	13.00	12.00	12.00	12.00
Max Obs. per Group	36.00	38.00	36.00	38.00	36.00	36.00	36.00

Source: ECB SDW. BIS. Own Calculations.
$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$. We use cluster robust standard errors with clustering at the country level.
The dependent variable is the CCyB decision mapped on the interval [0, 1] by dividing the CCyB decision by 2.5%.
The Pseudo R^2 is based on the deviance of the model in comparison to the "null" model, where the endogenous variable only depends on an intercept.
"FR CRE" refers to fractional response with correlated random effects. Since we do not include "country fixed effects" in the last three models, the model names are FR BCBS M-5, FR BCBS M-6, and FR BCBS M-7.
In FR CRE BCBS M-1, the explanatory variable is the BCBS CCyB guide lagged by two quarters. In FR CRE BCBS M-2, the explanatory variable is the BCBS CCyB guide lagged by four quarters. In FR CRE BCBS M-3, the explanatory variables are the credit-to-GDP gap and the credit-to-GDP ratio lagged by two quarters. In FR CRE BCBS M-4, the explanatory variables are the credit-to-GDP gap and the credit-to-GDP ratio lagged by four quarters. In FR BCBS M-5, the explanatory variables are the BCBS CCyB guide lagged by two quarters, the supervisory funding source with the reference category banks, and the index for the macroprudential supervision, which takes values between 0 and 4 depending on the sophistication of a country's macroprudential supervision. In FR BCBS M-6, we add the supervisory funding dummy without banks' participation (Funding no banks) instead of all categories of supervisory funding.
In the FR BCBS M-7, the explanatory variables are the BCBS CCyB guide lagged by two quarters and the positive CCyB dummy which takes the value of 1 if the observation is from one of the following countries: CZ, EE, DK, IE, IS, LT, SE, NL or NO.

Table C.12: BCBS: Average partial effects for Table C.11

	FR CRE M-1	FR CRE M-2	FR CRE M-3	FR CRE M-4	FR M-5	FR M-6	FR M-7
BCBS CCyB guide (-2)	0.0220				0.0221*	0.0451**	0.0044
	(0.0144)				(0.0116)	(0.0178)	(0.0098)
BCBS CCyB guide (-4)		0.0307**					
		(0.0150)					
Credit-to-GDP gap (-2)			0.0006				
			(0.0007)				
Credit-to-GDP ratio (-2)			0.0020***				
			(0.0006)				
Credit-to-GDP gap (-4)				0.0013*			
				(0.0007)			
Credit-to-GDP ratio (-4)				0.0013**			
				(0.0006)			
Funding banks, other					0.0380**		
					(0.0178)		
Funding gov					0.4133***		
					(0.0650)		
Funding gov, banks					0.2680***		
					(0.0615)		
Funding other					0.1124***		
					(0.0259)		
Mapru supervision index					0.0519***	0.0543***	
					(0.0100)	(0.0092)	
Funding no banks						0.1254***	
						(0.0213)	
positive CCyB dummy							0.2461***
							(0.0118)

See notes under Table C.11

In Table C.14, we estimate the same ESRB models as in Table 6. As mentioned in Section 5.1, we have to compare the estimated coefficients of the average partial effects defined in Eq. (13) with the coefficients in Table 5.

Table C.13: ESRB models: Fractional response models with correlated random effects

	FR CRE M-1	FR CRE M-2	FR CRE M-3	FR M-4	FR M-5	FR M-6
Intercept	−4.0290***	−5.9349***	−19.3804**	−6.7898***	−6.4432***	−5.3113***
	(1.0418)	(1.4727)	(7.7288)	(1.1075)	(1.2092)	(0.8809)
Credit-to-GDP gap (-2)	−0.0308**	−0.0282	−0.0175	−0.0116	−0.0021	−0.0239**
	(0.0151)	(0.0195)	(0.0196)	(0.0098)	(0.0075)	(0.0101)
Credit-to-GDP ratio (-2)	−0.0104	−0.0100	−0.0084	0.0300***	0.0331***	0.0089**
	(0.0214)	(0.0244)	(0.0296)	(0.0033)	(0.0035)	(0.0045)
Two-year HH loan growth (-2)	0.1067***	0.0895***	0.0400	0.1239***	0.1715***	0.1106***
	(0.0259)	(0.0301)	(0.0348)	(0.0433)	(0.0307)	(0.0381)
Two-year NFC loan growth (-2)	−0.0205	−0.0151	−0.0203	−0.0237	−0.0404**	−0.0262**
	(0.0146)	(0.0161)	(0.0143)	(0.0210)	(0.0187)	(0.0128)
RPP to GDP gap (-2)	−0.0030	−0.0010	0.0200	0.0032	0.0104	0.0098
	(0.0146)	(0.0160)	(0.0320)	(0.0179)	(0.0213)	(0.0169)
Lending margins to HH (-2)	−0.3066	−0.1037	0.6437*	0.7047***	0.4972**	−0.0371
	(0.3105)	(0.3057)	(0.3799)	(0.2064)	(0.2124)	(0.2958)
Lending margins to NFC (-2)	0.0139	−0.0923	−0.7718***	−1.3469***	−1.2240***	−0.4475
	(0.3548)	(0.3654)	(0.1789)	(0.1780)	(0.1514)	(0.3224)
Leverage ratio (-2)	−0.0199	0.1203	−0.2850	−0.0857	−0.0406	0.0770
	(0.1030)	(0.1773)	(0.1918)	(0.0541)	(0.0585)	(0.0898)
Current account (% of GDP) (-2)	−5.5708	−4.2881	−2.3801	−12.4453***	−12.1087***	−6.3394
	(4.3119)	(4.9593)	(3.5678)	(1.4320)	(1.6756)	(5.4587)
Unemployment rate (-2)		−0.2990***	−0.1753*	−0.1142*	−0.2827***	−0.0431
		(0.1031)	(0.1059)	(0.0680)	(0.0617)	(0.0548)
y-o-y GDP growth (-2)		−0.0004	0.0050	0.0232***	0.0207**	0.0191
		(0.0078)	(0.0109)	(0.0080)	(0.0093)	(0.0139)
CBR (% of RWA) (-1)			0.5259***	0.5160***	0.4315***	0.4590***
			(0.1102)	(0.0970)	(0.0737)	(0.1090)
ROA (-2)			0.8240	−0.2235	−0.0695	−0.1149
			(0.6688)	(0.3501)	(0.3150)	(0.2744)
NPL ratio (-2)			−0.0145	−0.0468**	0.0030	0.0076
			(0.0273)	(0.0228)	(0.0188)	(0.0181)
Euro area CISS			−1.7984	−1.3890	−1.3247	−1.8663*
			(1.3497)	(0.9542)	(0.9657)	(1.0644)
Funding banks, other				1.2175***		
				(0.4505)		
Funding gov				0.2424		
				(0.2770)		
Funding gov, banks				−3.3153***		
				(0.5677)		
Funding other				1.6032***		
				(0.2649)		
Funding no banks					0.4205**	
					(0.2064)	
Mapru supervision index				0.4404***	0.5263***	
				(0.1491)	(0.1741)	
positive CCyB Dummy						1.6918***
						(0.2108)
Pseudo R-Squared	0.68	0.71	0.81	0.82	0.82	0.80
Nof Obs	495	495	333	314	314	314
Nof Groups	24	24	20	19	19	19
Avg. Obs. per Group	20.62	20.62	16.65	16.53	16.53	16.53
Min Obs. per Group	7	7	3	3	3	3
Max Obs. per Group	31	31	26	26	26	26

Source: ECB SDW. BIS. Own Calculations.

$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$. We use cluster robust standard errors with clustering at the country level.

The dependent variable is the CCyB decision mapped on the interval [0, 1] by dividing the CCyB decision by 2.5%.

The Pseudo R^2 is based on the deviance of the model in comparison to the "null" model where the endogenous variable only depends on an intercept.

"FR CRE" refers to fractional response with correlated random effects. Since we do not include "country fixed effects" in the last two models, the model names are FR ESRB M-5 and FR ESRB M-6.

In FR CRE ESRB M-1, the explanatory variables are the two-year household loan growth, the two-year NFC loan growth, the two-year RPP-to-GDP gap lagged by two quarters, two-year lending margin to NFC and households lagged by two quarters, the current account (% of GDP) and the leverage ratio (Tier 1 capital divided by total assets). In FR CRE ESRB M-2, we add the unemployment rate and the year-on-year nominal GDP growth to the list of explanatory variables of FR CRE ESRB M-1. In FR CRE ESRB M-3, we add the combined buffer requirements expressed in percentage of risk weighted assets lagged by one quarter to the list of explanatory variables of FR CRE ESRB M-2. In FR ESRB M-4, we add the supervisory funding source with the reference category banks and the macroprudential supervision index which takes values between 0 and 4 depending on the sophistication of a country's macroprudential supervision to the list of explanatory variables of FR CRE ESRB M-3. In FR CRE M 5, we add the supervisory funding dummy without banks' participation (Funding no banks) instead of all categories of supervisory funding.

In FR ESRB M-6, we add the positive CCyB dummy to the list of explanatory variables of ESRB Model 3, which takes the value of 1 if the observation is from one of the following countries: CZ, DK, EE, IE, IS, LT, SE, NL or NO.

To avoid any multicollinearity, we do not add country fixed effects to ESRB Model 4, ESRB Model 5, and ESRB Model 6.

Table C.14: ESRB: Average partial effects for Table C.13

	FR CRE M-1	FR CRE M-2	FR CRE M-3	FR M-4	FR M-5	FR M-6
Credit-to-GDP gap (-2)	−0.0042**	−0.0033**	−0.0017	−0.0011	−0.0002	−0.0026***
	(0.0017)	(0.0016)	(0.0022)	(0.0008)	(0.0007)	(0.0007)
Credit-to-GDP ratio (-2)	−0.0014	−0.0012	−0.0008	0.0029***	0.0033***	0.0010***
	(0.0015)	(0.0016)	(0.0026)	(0.0003)	(0.0003)	(0.0003)
Two-year HH loan growth (-2)	0.0145***	0.0105***	0.0039	0.0118***	0.0169***	0.0118***
	(0.0018)	(0.0020)	(0.0029)	(0.0030)	(0.0020)	(0.0027)
Two-year NFC loan growth (-2)	−0.0028	−0.0018	−0.0020	−0.0023*	−0.0040***	−0.0028***
	(0.0018)	(0.0012)	(0.0015)	(0.0012)	(0.0012)	(0.0010)
RPP to GDP gap (-2)	−0.0004	−0.0001	0.0020	0.0003	0.0010	0.0011
	(0.0014)	(0.0014)	(0.0028)	(0.0019)	(0.0024)	(0.0015)
Lending margins to HH (-2)	−0.0417	−0.0122	0.0629	0.0671***	0.0489**	−0.0040
	(0.0277)	(0.0248)	(0.0404)	(0.0206)	(0.0212)	(0.0221)
Lending margins to NFC (-2)	0.0019	−0.0109	−0.0754***	−0.1282***	−0.1204***	−0.0479*
	(0.0321)	(0.0329)	(0.0290)	(0.0185)	(0.0247)	(0.0245)
Leverage ratio (-2)	−0.0027	0.0142	−0.0279**	−0.0082	−0.0040	0.0082
	(0.0097)	(0.0118)	(0.0135)	(0.0058)	(0.0054)	(0.0067)
Current account (% of GDP) (-2)	−0.7571	−0.5049	−0.2326	−1.1847***	−1.1910***	−0.6787**
	(0.4836)	(0.3122)	(0.2373)	(0.2593)	(0.2782)	(0.3135)
Unemployment rate (-2)		−0.0352***	−0.0171	−0.0109**	−0.0278***	−0.0046
		(0.0070)	(0.0114)	(0.0047)	(0.0062)	(0.0051)
y-o-y GDP growth (-2)		−0.0000	0.0005	0.0022*	0.0020	0.0020
		(0.0007)	(0.0015)	(0.0013)	(0.0015)	(0.0016)
CBR (% of RWA) (-1)			0.0514***	0.0491***	0.0424***	0.0491***
			(0.0109)	(0.0069)	(0.0074)	(0.0088)
NPL ratio (-2)			−0.0014	−0.0045**	0.0003	0.0008
			(0.0032)	(0.0022)	(0.0020)	(0.0015)
ROA (-2)			0.0805	−0.0213	−0.0068	−0.0123
			(0.0643)	(0.0319)	(0.0272)	(0.0222)
Euro area CISS			−0.1758	−0.1322	−0.1303	−0.1998*
			(0.1192)	(0.1034)	(0.1082)	(0.1192)
Funding banks, other				0.1387**		
				(0.0617)		
Funding gov				0.0190		
				(0.0318)		
Funding gov, banks				−0.0696***		
				(0.0114)		
Funding other				0.2044***		
				(0.0444)		
Funding no banks					0.0414*	
					(0.0236)	
Mapru supervision index				0.0419*	0.0518**	
				(0.0227)	(0.0204)	
positive CCyB Dummy						0.1811***
						(0.0223)

See notes under Table C.13.

Appendix D. CCyB models excluding positive cycle-neutral CCyB approach countries

Table D.15: Fixed Effects Estimation: BCBS CCyB models – no positive cycle-neutral CCyB approach countries

	BCBS Model 1	BCBS Model 2	BCBS Model 3	BCBS Model 4	BCBS Model 5	BCBS Model 6
Intercept					−0.0914	−0.0005
					(0.1179)	(0.0906)
BCBS CCyB guide (-2)	0.0122				0.0234	0.0237
	(0.0258)				(0.0242)	(0.0191)
BCBS CCyB guide (-4)		0.0199				
		(0.0229)				
Credit-to-GDP gap (-2)			0.0012			
			(0.0016)			
Credit-to-GDP ratio (-2)			−0.0002			
			(0.0016)			
Credit-to-GDP gap (-4)				0.0025		
				(0.0018)		
Credit-to-GDP ratio (-4)				−0.0017		
				(0.0018)		
Funding banks, other					0.1507	
					(0.1579)	
Funding gov, banks					−0.0847**	
					(0.0424)	
Funding other					0.1314	
					(0.1365)	
Funding no banks						0.0606
						(0.1300)
Mapru supervision index					0.0440	0.0275
					(0.0390)	(0.0308)
Country fixed effects	*yes*	*yes*	*yes*	*yes*	*no*	*no*
Within R-Squared	0.00	0.00	0.00	0.01		
Between R-Squared	0.00	0.00	0.03	0.01		
Overall R-Squared	0.00	0.00	0.02	0.01	0.06	0.01
Nof Obs	551	560	551	560	542	542
Nof Groups	25	25	25	25	25	24.
Avg. Obs. per Group	22.04	22.40	22.04	22.40	21.68	22.58
Min Obs. per Group	8	9	8	9	8	9
Max Obs. per Group	37	37	37	37	37	33

Source: Own calculations. BIS. SDW.
$^{***}p < 0.01$; $^{**}p < 0.05$; $^{*}p < 0.1$. We use cluster robust standard errors with clustering at the country level.
The dependent variable is the CCyB decision rate. The observation period is from 2015Q1 to 2023Q4. We only include countries/observations that do not follow the positive cycle-neutral CCyB approach.
In BCBS Model 1, the explanatory variable is the BCBS CCyB guide lagged by two quarters. In BCBS Model 2, the explanatory variable is the BCBS CCyB guide lagged by four quarters.
In BCBS Model 3, the explanatory variables are the credit-to-GDP gap and the credit-to-GDP ratio lagged by two quarters.
In BCBS Model 4, the explanatory variables are the credit-to-GDP gap and the credit-to-GDP ratio lagged by four quarters.
In BCBS Model 5, the explanatory variables are the BCBS CCyB guide lagged by two quarters, the supervisory funding source with the reference category "banks" and the index for the macroprudential supervision, which takes values between 0 and 4 depending on the sophistication of a country's macroprudential supervision.
In BCBS Model 6, the explanatory variables are the BCBS CCyB guide lagged by two quarters, the supervisory funding dummy without banks' participation (Funding no banks), and the index for macroprudential supervision.
Because of multicollinearity, we do not add country fixed effects to the models BCBS 5 and BCBS 6.

Appendix E. Regulatory capture: intervention analysis

Table E.16: BCBS: Supervisory funding intervention results

	BCBS Model Interaction 1	BCBS Model Interaction 2
Intercept	−0.3248	−0.3306
	(0.2940)	(0.2765)
BCBS CCyB guide (-2)	0.1827	
	(0.1293)	
BCBS CCyB guide (-4)		0.2113
		(0.1468)
Funding no banks	0.4775**	0.4832**
	(0.2410)	(0.2335)
Supervisory funding: No Banks x BCBS CCyB guide (-2)	−0.4924**	
	(0.2041)	
Supervisory funding: No Banks x BCBS CCyB guide (-4)		−0.4913**
		(0.1959)
Mapru supervision index	0.1842**	0.1876**
	(0.0931)	(0.0909)
Country fixed effects	*no*	*no*
Overall R-Squared	0.11	0.11
Nof Obs	689	705
Nof Groups	28	28
Avg. Obs. per Group	24.61	25.18
Min Obs. per Group	12	13
Max Obs. per Group	36	38

Source: Own calculations. BIS.
*** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$. We use cluster-robust standard errors with clustering at the country level.
The dependent variable is the CCyB decision rate. The observation period is from 2015Q1 to 2023Q4.
In BCBS Model Interaction 1, the explanatory variables are the BCBS CCyB guide lagged by two quarters, the supervisory funding dummy without banks' participation (funding no banks), an interaction term of these two variables, and the index for the macroprudential supervision which takes values between 0 and 4 depending on the sophistication of a country's macroprudential supervision.
In BCBS Model Interaction 2, the explanatory variables are the BCBS CCyB guide lagged by four quarters, the supervisory funding dummy without banks' participation (funding no banks), an interaction term of these two variables, and the index for the macroprudential supervision which takes values between 0 and 4 depending on the sophistication of a country's macroprudential supervision.

The *Working Paper series of the Oesterreichische Nationalbank* is designed to disseminate and to provide a platform for discussion of either work of the staff of the OeNB economists or outside contributors on topics which are of special interest to the OeNB. To ensure the high quality of their content, the contributions are subjected to an international refereeing process. The opinions are strictly those of the authors and do in no way commit the OeNB.

The Working Papers are also available on our website (http://www.oenb.at) and they are indexed in RePEc (http://repec.org/).

Publisher and editor	*Oesterreichische Nationalbank* *Otto-Wagner-Platz 3, 1090 Vienna, Austria* *PO Box 61, 1011 Vienna, Austria* *www.oenb.at* *oenb.info@oenb.at* *Phone (+43-1) 40420-6666* *Fax (+43-1) 40420-046698*
Editor	*Martin Summer*
Cover Design	*Information Management and Services Division*
Data protection information	*www.oenb.at/en/dataprotection*

ISSN 2310-5321 (Print)
ISSN 2310-533X (Online)