Countercyclical capital buffer and the dynamics of bank lending*

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Abstract

We study how banks adjust their lending in response to tighter capital requirements. Using confidential loan-level data and a difference-in-differences framework, we exploit a countercyclical capital buffer (CCyB) tightening to identify the dynamic response of bank lending across multiple margins. We find that tighter capital requirements lead to a substantial contraction in lending and a simultaneous tightening of credit conditions, relative to banks in an unaffected control group. These adjustments occur already at the announcement stage, indicating strong anticipatory responses by banks. Rather than adjusting gradually over the phase-in period, the bulk of the response takes place immediately after announcement. We further show that the transmission is heterogeneous across borrowers. Relative to the control group, lending to small and medium-sized enterprises contracts more strongly and credit conditions tighten more persistently, whereas large firms are comparatively less affected, particularly in terms of pricing.

Keywords: *Countercyclical capital buffer, Macroprudential policy, Bank Lending, Credit Supply, Loan level data, Announcement effects.*
JEL Classification: *G21, G28, E51.*

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1 Introduction

Since the Global Financial Crisis, macroprudential policy has become an important tool for strengthening financial stability and containing the buildup of systemic risk (Galati and Moessner, 2018; Beck and Gambacorta, 2019; Ampudia et al. 2021; Kim and Mehrotra, 2022; Boar et al. 2017; Cerutti, Claessens and Laeven, 2017; Akinci and Olmstead-Rumsey, 2018). Yet important questions remain regarding how individual macroprudential instruments affect banks' lending behaviour, the timing of these adjustments, and the transmission of credit to the real economy.

More recently, the countercyclical capital buffer (CCyB), one of the key capital-based macroprudential instruments introduced under Basel III (Basel Committee on Banking Supervision, 2010), has gained increasing prominence. Several European countries have adopted the 'positive neutral' approach, which advocates maintaining a positive buffer throughout much of the financial cycle to strengthen resilience and improve releasability during downturns (ESRB, 2025). As the use of CCyB becomes more widespread, understanding the transmission through bank lending is increasingly important. Because CCyB increases are typically announced well before implementation, banks may adjust their lending behavior before the policy becomes binding, potentially affecting different borrower groups and lending margins in distinct ways.

This paper studies the effects of the January 2022 increase in Germany's CCyB from 0 % to 0.75 %, announced twelve months before implementation and applied in February 2023. We exploit this policy change in a difference-in-differences framework that compares German banks, which were subject to the tightening, with Austrian banks, which faced no corresponding increase in the CCyB. Using confidential loan-level data from the European Central Bank, we examine how the CCyB tightening affected multiple dimensions of new corporate lending, including lending volumes, the number of new loans, average loan size, lending rates, maturities, and the composition of lending across firms of different sizes. We further distinguish between the announcement and application effects and trace the monthly dynamics of banks' responses.

We document three main findings. First, CCyB tightening leads to a substantial contraction in new corporate lending and tighter credit conditions. Relative to Austrian banks, German banks reduce both the volume and the number of new loans, while loan sizes decline and lending rates increase. Second, a large share of the adjustment occurs already after the announcement of the policy change, indicating strong anticipatory responses by banks. Across several lending dimensions, announcement effects are at least as large as, and in several cases larger than, ap-

plication[1] effects. Third, the effects are heterogeneous across borrowers. SMEs and micro firms experience larger and more persistent declines in lending and stronger increases in borrowing costs, whereas large firms are comparatively less affected, particularly in terms of pricing.

The estimated effects are economically meaningful. Following the announcement of the CCyB tightening, the volume of new corporate lending by German banks declines by around 70 percent relative to the control group. The contraction operates through both the intensive and extensive margins. The number of new loans falls by roughly 40-50 percent, while the average size of new loans also decline. At the same time, lending rates increase by around 30-45 basis points, with the strongest pricing effects concentrated among SMEs.

This paper contributes to the literature in several ways. First, it provides evidence on a clearly identified CCyB tightening episode in a major euro area economy. Second, using granular loan-level data, it jointly analyses lending volumes, loan origination, and credit conditions, while distinguishing between announcement and application effects. Third, it documents substantial heterogeneity across borrower groups, showing that smaller firms bear a disproportionate share of the adjustment. Finally, by exploiting cross-country variation, the paper identifies the average effect of CCyB tightening across banks, complementing studies that rely on within-country bank-level heterogeneity. These contributions are discussed in more detail and linked to previous literature in Section 2.

The rest of the paper is organized as follows. Section 2 motivates our set-up and research questions building on relevant existing literature. Section 3 sketches the transmission channels and formulates our hypotheses. Section 4 presents the data used and our chosen methodology. Our main results are presented and discussed in Section 5. Section 6 presents robustness checks and additional analysis. Section 7 concludes.

2 Research questions and relevant literature

We pose three research questions in this paper. First, we examine *how the change in the German CCyB rate influenced lending to firms by German banks*. Second, we analyse *whether the effects took place already after the announcement or only after the application of a change*. Finally, we investigate *whether the effects are different for firms of different sizes*.

[1] In this paper "application" refers to the implementation of the previously announced change in the CCyB level, not e.g. an application for a loan. We follow the terminology used by e.g. European Systemic Risk Board.

The *first research question* is related to the broader literature on the effects of prudential capital requirements on bank lending (Jiménez et al, 2017; Gropp, Mosk, Ongena and Wix, 2019; De Jonghe, Dewachter and Ongena, 2020; Degryse, Karapetyan and Karmakar, 2021; Illueca, Norden, Pacelli and Udell, 2022; Gropp, Mosk, Ongena, Simac and Wix, 2024). This literature generally finds that tighter capital requirements lead to a contraction in credit supply, although the magnitude and transmission channels vary across settings. The literature on the effects of the CCyB is a more recent strand. Existing studies show that CCyB tightening reduces credit growth, while its release supports lending (Drehmann and Gambacorta, 2012; Benes and Kumhof, 2015; Benbouzid et al., 2022; Dursun-de Neef, Schandlbauer and Wittig, 2023; Bedayo and Galán, 2024). However, most of this literature relies on data that are either aggregated or of relatively low frequency. Moreover, the previous literature primarily use bank-level differences to identify heterogeneous responses across institutions (e.g. Bedayo and Galán (2024), Marek and Stein (2022), Auer, Matyunina and Ongena (2022) and Basten (2020)).

We provide evidence on a recent CCyB tightening in a large euro area economy using granular loan-level data. In addition, our approach identifies the average effect of CCyB tightening through cross-country variation, rather than relying on within-country bank-level heterogeneity. This way we can isolate the average effect of the policy change across banks.

Related to the *second research question*, we study both the announcement and application of the policy change. This distinction is important because CCyB adjustments are typically announced well in advance of implementation, often with lags of up to one year. Banks may therefore adjust lending before the policy becomes binding. However, most studies focus on implemented policy changes and abstract from anticipatory responses (e.g., Meuleman and Vander Vennet, 2020; Forbes 2021; Ćehajić and Košak, 2022; Bergant et al. 2024). Only a limited number of studies explicitly analyse announcement effects (Auer et al., 2022; Bedayo and Galán, 2024).

Our paper contributes to this literature by tracing monthly lending dynamics around both announcement and implementation of CCyB changes using granular loan-level data. Analysing both phases within a unified framework allows us to compare their relative importance and assess whether the adjustment is primarily driven by anticipatory behaviour or by the implementation of the buffer.

Finally, the *third research question* examines whether firms of different sizes are differentially affected by macroprudential policy. Access to finance is an important determinant of firm growth, particularly for SMEs, which remain highly dependent on bank financing in the euro area (Beck and Demirgüc-Kunt, 2006; Kim

et al., 2016; Botsari et al., 2024). Macroprudential tightening may therefore have disproportionate effects on smaller firms.

Only a few studies have thus far documented the different effects of macroprudential policy measures on corporate financing to firms of different sizes, and with inconclusive results. Ćehajić and Košak (2022) use bi-annual firm-level responses from the EU-level Survey on the Access to Finance of Enterprises and find that as macroprudential policy is tightened, smaller firms more often report their loan applications to be rejected. However, in addition to using lower frequency, survey-based data, their approach aggregates a wide-ranging menu of different macroprudential tools into one index. Ayyagari et al. (2018) use annual firm-level data for a large group of both developed and emerging economies and find that macroprudential tools targeted at financial institutions are associated with lower financing growth for micro firms but higher financing growth for SMEs, compared with large firms. Marek and Stein (2022) use granular data from Germany and find that after the introduction of the risk-based capital ratio, lending growth decreased to both SMEs and large firms, with SMEs suffering slightly more. Auer, Matyunina and Ongena (2022) consider the effects of a CCyB targeting banks' exposure to mortgages in Switzerland with loan-level data. They find that mortgage lending decreased, while lending shifted to non-financial corporates, with a stronger impact on smaller firms. Shahhosseini (2022) analyses how banks in the U.S. respond to the higher regulatory capital requirements of stress tests and finds that stress-tested banks reduce credit supply to small firms relative to large borrowers. Finally, Amado (2022) also uses granular microdata to analyse the impact of a special reserve requirement for dollar lending in Peru and finds a clear deterioration of access to finance for smaller firms.

Our loan-level data allow us to analyse the dynamic effects of CCyB tightening on multiple dimensions of corporate lending, including loan volumes, loan origination, pricing, maturity, and lending composition. Unlike earlier studies that focus primarily on mortgage lending or rely on borrower proxies, we directly identify firms by size and distinguish between micro firms, SMEs, and large firms. This level of granularity provides a more comprehensive view on how macroprudential tightening affects both the quantity and terms of credit.

3 The transmission channels and hypotheses

To formalize our approach, we follow the conceptual framework on the transmission of raising capital and provisioning requirements to the loan markets laid out by Bank for International Settlements Committee on the Global Financial System

(BIS CGFS 2012). This framework outlines the transmission of increasing capital requirements or provisions to the credit cycle via multiple channels. We focus on the loan market where the adjustment operates through both lending volumes and credit conditions. These channels reflect the margin along which banks can respond to tighter capital requirements. On the one hand, banks may reduce their balance sheet size by lowering the volume of credit supplied. On the other hand, they may tighten credit conditions, for instance by increasing lending rates or adjusting non-price terms. Importantly, our data allows us to observe these adjustments along several dimensions of lending, including the volume and number of new loans, loan size, lending rates, and loan maturities, thereby capturing both extensive and intensive margins as well as changes in credit conditions in a single empirical framework.

The CCyB has been designed to counter procyclicality in the financial system, in the sense that when the financial cycle is in expansion, the CCyB is gradually built up, with the aim of increasing resilience in the whole system. In a crisis, when there is a sharp downturn in the financial cycle, the CCyB is released to support the system by allowing banks to extend more credit. The CCyB is based on the Basel recommendations (Basel Committee on Banking Supervision, 2010), and thus it is comparable across different countries and years. For other macroprudential measures, the details and scope of the regulation can differ substantially across countries, which can restrict comparative analysis.

Based on the transmission mechanism of CCyB, we formulate three hypotheses. First, related to our first research question on the aggregate effects of CCyB tightening, we consider two channels through which banks may adjust their lending behavior. As capital requirements increase, banks can respond either by reducing their balance sheet exposure – particularly risk-weighted assets – or by tightening the terms of credit. Accordingly, we hypothesise that CCyB tightening leads to a reduction in corporate lending volumes, potentially operating through both the number and size of new loans, and to tighter credit conditions, reflected in higher lending rates, smaller loan sizes, and shorter maturities (H1).

Next, related to our second research question on the timing of the effect, we expect that as authorities announce the implementation or tightening of the CCyB with an application at a later date, banks adjust their behavior already in anticipation. A tightening of the CCyB is typically announced 12 months before its application (see Table A2 in Annex 1), precisely to allow banks time to adjust and avoid cliff edge effects. We therefore expect banks to make use of this adjustment period and begin reducing lending and tightening credit conditions already following the announcement (H2). There are several reasons why banks may adjust

early. Increasing equity to meet higher capital requirements can be slow and costly, making adjustments through lending a more immediate response. However, as our focus is on the overall effects on corporate lending, a detailed analysis of the underlying mechanisms driving banks' adjustments remains outside the scope of this paper.

Finally, related to our third research question on the role of firm size, we note that for banks, lending to smaller companies tends to be more risky than lending to large firms. For example, non-performing loans are more common among SMEs and micro companies than with large firms (Beck, Demirgüç-Kunt and Martinez Peria, 2008). As the CCyB is tightened, banks are expected to reduce exposures with higher risk weights (BIS CGFS, 2012). Accordingly, we hypothesise that the effects of CCyB tightening are more pronounced for smaller firms (H3). This may be reflected not only in a larger reduction in lending volumes, but also in tighter credit conditions for smaller firms, including higher lending rates, smaller loan sizes, and shorter maturities.

We formulate our framework and hypothesis with CCyB tightening in mind, as increases in the buffer have been more prevalent in recent years and are therefore of primary empirical evidence. While our empirical approach could in principle also be applied to easing episodes, albeit with opposite expected effects, the transmission of easing is unlikely to be symmetric to that of easing. In particular, CCyB releases typically occur during periods of economic stress, when the financial system requires extra support, whereas tightening measures are implemented in normal or expansionary conditions to build resilience. As a result, the channels through which banks adjust their lending behaviour, including both the quantity of credit supplied and the terms of lending, may differ across these regimes. Moreover, institutional features of policy design also vary: in the euro area, CCyB tightening decisions are typically announced well in advance – often with implementation lags of around 12 months – while easing decisions, particularly during the Covid-19 crisis, have been implemented much more rapidly following announcements (see Table A2 in Annex 1). These differences further suggest that the dynamics of adjustment may not be directly comparable across tightening and easing episodes.

4 Data and methodology

4.1 Data

To understand how a change in the CCyB affects bank corporate lending, we utilise six response variables capturing different margins of new lending. The first two

variables capture the quantity of lending: *volume of new corporate loans* and *number of new loans*. The next set of variables capture credit conditions. We analyse *the size of new loans*, *lending rate on new loans* and *maturity of new loans*, capturing both price and non-price dimensions of credit terms. Finally, to assess changes in the allocation of credit across firms, we examine the *relative composition of new lending*, measured as the share of loans to different firm-size groups.

We combine data from two confidential ECB datasets. AnaCredit contains detailed information on all individual bank loans to firms above €25 000, harmonized across member states. We get all our response variables directly from AnaCredit. In the main estimations we are interested in the aggregate effect of the tighter CCyB level to firm loans, and thus we use the loan-level daily data aggregated to the bank level at monthly frequency. As we are interested in the disparities between firms of different sizes, we use the loan-level information available in AnaCredit to be able to identify the size of the borrowing firms precisely. We can classify the borrowers to micro companies, SMEs, and large companies based on the actual size of the company, without relying on using the size of the loans as a proxy for firm size. To further include bank balance sheet information on banks' size and capitalization, we use iBSI, an ECB compiled database of individual bank balance sheet items.

In all estimations, we report results for the full sample (aggregate new corporate lending) as well as separately for three subsamples: micro companies, SMEs, and large companies. Altogether, our balanced panel data covers 856 banks' lending to 95,081 micro companies, 113,818 SMEs and 16,247 large companies in Germany, and 388 banks' lending to 18,693 micro companies, 13,825 SMEs and 2,048 large companies in Austria. The descriptive statistics and data sources are presented in Table 1. Summary statistics for Germany and Austria separately can be found in Annex 3, Table A3 and A4.

Variable	Source	Obs	Mean	Std. Dev.	Min	Max
Bank characteristics						
Total assets (EUR mln)	1	37,186	11500	83400	0	1,590,000
Bank size (log of total assets)	1*	37,094	20.713	1.838	9.680	28.093
Capitalization	1*	37,091	0.115	0.098	0	1.125
Volume of new lending (logs)						
Total	2	10,839	15.486	1.766	0.693	21.870
Micro companies	2	9,652	13.464	1.859	0.867	19.201
SMEs	2	9,474	12.160	1.512	0.693	18.336
Large companies	2	8,524	13.501	1.746	0.405	19.525
Number of new loans (logs)						
Total	2	10,997	2.877	1.287	0.693	10.714
Micro companies	2	10,997	1.569	1.170	0	7.690
SMEs	2	10,272	2.072	1.431	0	10.123
Large companies	2	10,997	0.987	1.368	0	9.751
Size of new loans (logs)						
Total	2	10,839	12.591	1.430	-1.253	19.014
Micro companies	2	9,652	11.771	1.601	-0.519	18.297
SMEs	2	9,474	12.160	1.512	0.693	18.336
Large companies	2	8,524	13.501	1.746	0.405	19.525
Price of new loans						
Total	2	10,839	3.129	1.724	0.010	14.307
Micro companies	2	9,652	3.451	1.868	0.010	14.245
SMEs	2	9,474	3.281	1.772	0.010	14.995
Large companies	2	8,524	2.993	1.899	0.010	16.388
Maturity of new loans (logs)						
Total	2	10,824	7.664	1.024	2.628	10.309
Micro companies	2	9,634	7.739	1.112	0.693	10.495
SMEs	2	9,463	7.397	1.149	1.335	10.268
Large companies	2	8,490	7.025	1.542	0.000	10.267
Composition of new loans						
Micro companies	2*	10,836	0.227	0.269	0	1
SMEs	2*	10,171	0.376	0.296	0	1
Large companies	2*	10,828	0.362	0.330	0	1

Notes: 1 = iBSI, 2 = AnaCredit. * Authors' calculations based on the source.

Table 1: Descriptive statistics for Germany and Austria (January 2021 – December 2023)

Our treatment variable is the change in the countercyclical capital buffer (CCyB) in Germany. The treatments are the announcement of the tightening in January 2022 and its application in February 2023. For the treatment, we use data from the European Systemic Risk Board (ESRB), which includes detailed information on CCyBs decisions.[2] To capture the pre-treatment period as well as the effects of our treatments in January 2022 and in February 2023, we use data from January 2021 to December 2023 in our estimations.

4.2 Methodology

We employ a difference-in-differences (DiD) framework using a balanced bank-month panel dataset to estimate the impact of the Germany CCyB on corporate lending. Our identification strategy compares lending by banks exposed to the tightening (German banks) with lending by banks in a control group (Austria) not subject to the policy change, before and after the announcement and application of the new buffer rate.

Our baseline specification is given by:

$$\begin{aligned} Y_{i,t} = \beta_0 + \beta_{1A}(postann_t * DE_i) + \beta_{1B}(postapp_t * DE_i) + \beta_2 DE_i \\ +\beta_{3A} postann_t + \beta_{3B} postapp_t + X_{i,t-1} + \delta_i + \theta_t + u_{i,t} \end{aligned} \tag{1}$$

where $Y_{i,t}$ denotes one of the response variables capturing different dimensions of bank lending for bank i at time t. The variable $postann_t$ is a dummy for post-announcement period, having the value of one from February 2022 to January 2023 and zero otherwise. Variable $postapp_t$ is a dummy for post-application period, having the value of one from March 2023 to December 2023 and zero otherwise. The actual months of announcement and application, January 2022 and February 2023, are omitted from the estimations. DE_i is a dummy for Germany. The coefficients of interest, β_{1A} and β_{1B}, capture the difference-in-differences effects following the announcement and application of the CCyB tightening.

The specification includes bank and country-month fixed effects (δ_i and $\theta_{c,t}$). In addition, we include lagged bank-level controls $X_{i,t-1}$ for bank size and capitalisation (equity to total assets). Standard errors are clustered at the bank level.

The empirical analysis focuses on a "clean" CCyB decision. We define such decisions as those where a change in the buffer rate is announced, subsequently implemented as planned, and not overlapping with other CCyB decisions. We

[2]There are multiple other sources for macroprudential policy measures. Our choice of using the ESRB is discussed further in Annex 4.

provide a detailed description of these criteria in Annex 1. Among the few decisions that meet these requirements in the euro area after 2020, we focus on the CCyB increase in Germany from 0 percent to 0.75 percent, announced in January 2022 and applied in February 2023.

This decision is well suited for our empirical design. It was implemented outside of the Covid-19 crisis period and was not directly confounded by simultaneous changes in macroprudential policy that would affect all banks in a similar way. While additional measures, such as the O-SII buffer and the Systemic Risk Buffer, were introduced around the same time, these were more targeted in scope and announced later than the CCyB decision, making their transmission mechanisms less comparable.[3].

Our identification strategy relies on comparing Germany to a suitable control country. By the end of 2023, several euro area countries (Austria, Finland, Greece, Italy, Malta, Portugal, and Spain) had not implemented a positive CCyB, providing potential candidates for the control group. A key requirement is that the control country exhibits similar pre-treatment trends in the outcome variables, ensuring the validity of the parallel trends assumption. After careful selection process, we chose Austria, as its banking sector is broadly comparable to that of Germany and the developments of the sectors' key characteristics follow similar trends pretreatment (see Figures A2 in Annex 2). Austria also introduced similar macroprudential measures other than CCyB as Germany in 2022.[4]

To further examine the dynamic adjustment of lending and to assess the validity of the parallel trends assumption, we complement our baseline specification with an event-study framework that estimates month-specific treatment effects. Concretely, we interact the Germany dummy with a set of monthly dummies covering the period from July 2021 to December 2023, omitting the first half of 2021 as the reference period. This allows us to trace the evolution of treatment effects at a monthly frequency both before and after the announcement and application of the CCyB tightening. At the same time, this provides a formal test of the parallel trends assumption by examining whether there are any pre-treatment differences

[3]The Other Systematically Important Institution Buffer (O-SII) was set for 16 banks in November 2022, with an application date in January 2023, and the Systemic Risk Buffer was set at 2 % for exposures related to residential real estate exposure in March 2022, with an application date in February 2023. (ESRB, 2022a, 2022b) However, the transmission mechanism of these changes is likely to be slightly different from the change in the CCyB, as the first one targeted only a handful of large banks and the other did not target all lending. They were also announced at a later date than the CCyB decision.

[4]An O-SII buffer was announced in Austria November 2022 for 7 banks, with and application date in January 2023, and a Systemic Risk Buffer related to sectoral vulnerabilities in the commercial real estate sector was announced in March 2022 for 11 banks and applied in February 2023 (ESRB, 2022c, 2022d).

in lending between treated and control banks. At the same time, the post-treatment coefficients shed light on the timing and persistence of the policy effects, enabling us to distinguish between anticipatory adjustments following the announcement and responses to the binding application of the buffer.

5 Results

We estimate equation (1) to assess the impact of CCyB tightening on bank lending across multiple dimensions. The dependent variable is in turn one of six outcome variables capturing different margins of lending: the volume and number of new loans (quantitative margins), the size of loans, lending rates, and maturities (credit conditions), as well as the composition of lending across firm sizes.

Our coefficients of interest, β_{1A} and β_{1B}, measure the difference-in-differences effects following the announcement and application of the CCyB tightening. These estimates capture how lending by German banks evolves relative to banks in the control group, rather than absolute changes in lending levels. Consistent with our hypothesis, we expect CCyB tightening to lead to a reduction in lending quantities, reflected in lower loan volumes and fewer loans, and to tighter credit conditions, reflected in higher lending rates, smaller loan sizes, and shorter maturities. If β_{1A} is statistically significant, this indicates that banks adjust their lending behavior already following the announcement, providing evidence of anticipatory effects.

5.1 Impact on the volume of new loans

The first estimations are conducted using the volume of new loans (in logs) as the response variable. We estimate the effect for total lending as well as three different samples differentiated by the size of the firms receiving loans: Micro companies, SMEs, and large companies. Table 2 presents our estimation results for the average effect of the CCyB tightening on firm lending during post-announcement and post-application periods.

Specification (1) reports the effect on the CCyB announcement and subsequent application on total new corporate lending by German banks relative to Austrian banks. The estimated coefficients should be interpreted as semi-elasticities, capturing the proportional change in the outcome variable for treated banks relative to untreated banks following the CCyB tightening. The DiD estimate of the post-announcement effect of -1.212 implies that, on average, lending by German banks declines by around 70 percent relative to Austrian banks. The effect remains similarly large post-application, at approximately 65 percent. Importantly, these es-

Dependent variable:	ln(volume of new loans)			
	Total lending	Micro company lending	SME lending	Large company lending
Specification	(1)	(2)	(3)	(4)
Post-announcement effect	-1.212***	-1.046***	-0.617	-1.013***
	(0.232)	(0.375)	(0.387)	(0.375)
Post-application effect	-1.085***	-0.722***	-0.928***	-0.741
	(0.228)	(0.341)	(0.297)	(0.450)
Observations	6,017	5,471	5,520	4,986
R-squared	0.080	0.060	0.072	0.050
Number of banks	667	650	592	611
Bank controls	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES

Robust standard errors in parentheses; *** p <0.01, ** p <0.05, * p <0.1.
Estimation of equation (3.2). Estimation period Jan 2021-Dec 2023. Post-announcement effect is the interaction between post-announcement (equals one from Feb 2022 to Jan 2023) and the Germany-dummy (equals one for German banks). Post-application effect is the interaction between post-application (equals one from Mar 2023 to Dec 2023) and the German-dummy. Actual months of announcement and application (Jan 2022 and Feb 2023) are omitted from the estimations.

Table 2: Results for volume of outstanding loans as the response variable.

timates reflect relative changes in lending compared to the control group, rather than absolute changes in lending levels.

These results provide strong support for our first hypothesis, indicating that CCyB tightening leads to a substantial contraction in lending volumes. In addition, the fact that the effect is already large and statistically significant in the post-announcement period is consistent with our hypothesis on the announcement effect, suggesting that banks adjust their lending behaviour in anticipation of the policy change rather than only upon its implementation.

When examining the composition of corporate lending across firm size groups, we do not find a clear systematic pattern (specifications (2)–(4)). Following the announcement, German banks reduce lending to both micro and large firms relative to Austrian banks, while after the application the decline is statistically significant for micro firms and SMEs. Overall, these findings do not support third hypothesis: with respect to lending volumes, banks appear to reduce lending broadly across firms of all sizes.

The internal validity of our empirical strategy relies on the parallel trends assumption. We assess this using an event-study specification with monthly treatment interaction dummies, as reported by figure A3 in Annex A5. The coefficients on the monthly interaction terms are largely statistically indistinguishable from zero before the announcement of the CCyB tightening, supporting the presence of parallel pre-treatment trends. The dynamic pattern of the coefficients further illustrates the evolution of the treatment effects following the CCyB announcement

and application, and reveal differences across firm size groups.

For SMEs, the coefficients display a clear downward trend following the announcement, with negative effects that persist throughout the post-application period, pointing to a sustained contraction in lending to this segment relative to others. For large firms, the effects appear more short-lived and less persistent over time, with coefficients fluctuating around zero after the initial adjustment. For micro firms on the other hand, the estimated effects are considerably more volatile and lack a clear pattern. This likely reflects the heterogeneous nature of this group, which encompasses a wide range of borrowers with differing characteristics and financing needs, leading to less systematic responses to the CCyB tightening [5].

5.2 Impact on the number of new loans

Table 3 reports the effects of CCyB tightening on the number of new loans.

Dependent variable:	ln(number of new loans)			
	Total lending	Micro company lending	SME lending	Large company lending
Specification	(1)	(2)	(3)	(4)
Post-announcement effect	-0.481***	-0.336*	-0.037	-0.574**
	(0.148)	(0.173)	(0.204)	(0.232)
Post-application effect	-0.697***	-0.597***	-0.383**	-0.641***
	(0.112)	(0.141)	(0.155)	(0.198)
Observations	6,075	6,075	5,827	6,075
R-squared	0.179	0.110	0.138	0.067
Number of banks	673	673	619	673
Bank controls	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES

Robust standard errors in parentheses; *** p <0.01, ** p <0.05, * p <0.1.
Estimation of equation (3.2). Estimation period Jan 2021-Dec 2023. Post-announcement effect is the interaction between post-announcement (equals one from Feb 2022 to Jan 2023) and the Germany-dummy (equals one for German banks). Post-application effect is the interaction between post-application (equals one from Mar 2023 to Dec 2023) and the German-dummy. Actual months of announcement and application (Jan 2022 and Feb 2023) are omitted from the estimations.

Table 3: Results for number of new loans as the response variable.

German banks reduced the number of total new corporate loans by approximately 38 percent relative to Austrian banks post-announcement and even more so post-application (50 percent). Together with the reduction in lending volumes,

[5] At the same time, it is worth noting that for micro firms the event-study estimates appear considerably more volatile than the corresponding DiD coefficients might suggest. While the interaction terms in Table 2 indicate statistically significant average declines in lending in both the post-announcement and post-application periods, the dynamic coefficients fluctuate substantially across individual months and are often imprecisely estimated. This reflects the fact that the DiD estimates capture average effects over relatively long time windows, whereas the event-study specification uncovers a lack of stability in the monthly responses.

these findings suggest that banks adjust credit supply along both the extensive and intensive margins. The significant post-announcement effects again support the presence of anticipatory adjustment.

The decline is visible across all firm size groups. Following the announcement, the number of loans declines most strongly for large firms (coefficient -0.574 corresponds to a reduction of about 44 percent) and for micro companies (reduction of 29 percent), while the effect for SMEs is small and statistically insignificant. After the policy application, the reduction in lending becomes sizable and statistically significant across all firm sizes: the number of loans decreases by approximately 45 percent for micro companies, 32 percent for SMEs, and 47 percent for large companies, all relative to Austrian banks.

However, the monthly interaction estimates (Figure A4 in Annex A5) highlight that the decline in lending is driven primarily by SMEs and micro companies, for which the coefficients show a persistent and sizable negative pattern after the policy change. In contrast, the estimates for large firms are less stable and do not display a persistent trend.

5.3 Impact on the average size of new loans

Table 4 presents the effects of CCyB tightening on the average size of new loans.

Dependent variable:	ln(size of a new loan)			
	Total lending	Micro company lending	SME lending	Large company lending
Specification	(1)	(2)	(3)	(4)
Post-announcement effect	-0.747***	-0.719**	-0.571**	-0.482
	(0.202)	(0.358)	(0.271)	(0.321)
Post-application effect	-0.394**	-0.084	-0.452*	-0.091
	(0.198)	(0.315)	(0.233)	(0.371)
Observations	6,017	5,471	5,520	4,986
R-squared	0.051	0.040	0.048	0.018
Number of banks	667	650	592	611
Bank controls	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES

Robust standard errors in parentheses; *** p¡0.01, ** p¡0.05, * p¡0.1.
Estimation of equation (3.2). Estimation period Jan 2021-Dec 2023. Post-announcement effect is the interaction between post-announcement (equals one from Feb 2022 to Jan 2023) and the Germany-dummy (equals one for German banks). Post-application effect is the interaction between post-application (equals one from Mar 2023 to Dec 2023) and the German-dummy. Actual months of announcement and application (Jan 2022 and Feb 2023) are omitted from the estimations.

Table 4: Results for the size of new loans as the response variable.

Following the announcement, average loan size declines significantly (-53%), suggesting that banks not only originate fewer loans but also reduce the size of

individual credit exposures. The post-application effects are generally smaller and less precisely estimated. The reduction in loan size is most evident for micro firms and SMEs, while the corresponding estimates for large firms are not statistically significant. This points to some heterogeneity in how banks adjust lending terms across borrowers.

The dynamic estimates (Figure A5, Annex A5) show that average loan sizes decline relatively quickly across all firm groups. However, the pattern differs across firm sizes. For SMEs, the coefficients exhibit a more sustained negative trend, indicating a persistent reduction in loan size throughout the post-application period. In contrast, for large firms the effects appear less pronounced and less persistent, with coefficients fluctuating closer to zero over time, consistent with the lack of statistical significance in the DiD estimates. As in previous specifications, the monthly estimates for micro firms exhibit substantial volatility.

5.4 Impact on the price of new loans

Next we turn to tighter dimensions of credit standards. Table 5 reports the effects of CCyB tightening on the price of new loans.

Following the announcement, German banks increase their lending rates by 0.44 percentage points more relative to Austrian banks. Rates remain elevated after application, indicating that CCyB tightening affects not only the quantity but also the pricing of credit. The pricing response varies across borrower groups. SMEs and micro firms experience significant increases in lending rates following the announcement, while only SMEs continue to face significantly higher borrowing costs also after application. In contrast, pricing effects for large firms remain limited throughout.

Dependent variable:	Price of new loans			
	Total lending	Micro company lending	SME lending	Large company lending
Specification	(1)	(2)	(3)	(4)
Post-announcement effect	0.439***	0.471***	0.449***	0.119
	(0.130)	(0.181)	(0.158)	(0.214)
Post-application effect	0.280***	0.259	0.479***	0.081
	(0.108)	(0.207)	(0.152)	(0.234)
Observations	6,017	5,471	5,520	4,986
R-squared	0.829	0.702	0.785	0.760
Number of banks	667	650	592	611
Bank controls	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES

Robust standard errors in parentheses; *** p <0.01, ** p <0.05, * p <0.1.

Estimation of equation (3.2). Estimation period Jan 2021-Dec 2023. Post-announcement effect is the interaction between post-announcement (equals one from Feb 2022 to Jan 2023) and the Germany-dummy (equals one for German banks). Post-application effect is the interaction between post-application (equals one from Mar 2023 to Dec 2023) and the German-dummy. Actual months of announcement and application (Jan 2022 and Feb 2023) are omitted from the estimations.

Table 5: Results for the price of new loans as the response variable.

The dynamic estimates reveal a gradual increase in lending rates after the policy announcement (Figure A6, Annex A5). This pattern is particularly pronounced for SMEs, for which the increase in lending rates is both larger and more persistent, whereas the response for large firms appears more muted and short-lived.

5.5 Impact on the maturity of new loans

Table 6 presents the effects of CCyB tightening on the maturity of new loans.

At the aggregate level, both the post announcement (-0.343) and post application (-0.196) coefficients are negative, suggesting a shortening of loan maturities by German banks of approximately 29 percent and 18 percent respectively, relative to Austrian banks, although neither effect is statistically significant.

Some heterogeneity nevertheless emerges across borrower groups. Loan maturities of SMEs shorten significantly following the announcement, while a significant post-application effect is observed for large firms. The estimates for micro firms remain statistically insignificant throughout.

The monthly interaction estimates (Figure A7, Annex A5) suggest a relatively persistent decline in maturities for SMEs following the announcement. For large firms, the negative post-application effect appears to be driven by a limited num-

Dependent variable:	Average maturity of new loans in log (days)			
	Total lending	Micro company lending	SME lending	Large company lending
Specification	(1)	(2)	(3)	(4)
Post-announcement effect	-0.343	0.250	-0.848***	-0.504
	(0.224)	(0.274)	(0.258)	(0.343)
Post-application effect	-0.196	0.204	-0.346	-0.712**
	(0.173)	(0.227)	(0.254)	(0.316)
Observations	6,011	5,461	5,514	4,968
R-squared	0.046	0.019	0.036	0.032
Number of banks	667	650	592	611
Bank controls	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES

Robust standard errors in parentheses; *** p <0.01, ** p <0.05, * p <0.1.
Estimation of equation (3.2). Estimation period Jan 2021-Dec 2023. Post-announcement effect is the interaction between post-announcement (equals one from Feb 2022 to Jan 2023) and the Germany-dummy (equals one for German banks). Post-application effect is the interaction between post-application (equals one from Mar 2023 to Dec 2023) and the German-dummy. Actual months of announcement and application (Jan 2022 and Feb 2023) are omitted from the estimations.

Table 6: Results for the maturity of new loans as the response variable.

ber of months rather than a sustained adjustment pattern. Overall, maturity responses are less stable than the effects observed for lending volumes and loan pricing.

5.6 Impact on the composition of new loans

Finally, Table 7 examines whether CCyB tightening changes the composition of new lending across firm sizes.

The estimated effects are small and statistically insignificant, providing little evidence that banks systematically reallocate lending between borrower groups following the tightening.

However, the monthly interaction estimates (Figure A8, Annex A5) indicate a more nuanced pattern, with a gradual decline in the share of lending to SMEs over time, alongside an increase in the share of lending to large firms. While these effects are visible in several post-treatment months, they remain relatively modest in magnitude—generally on the order of a few percentage points– and are not sufficiently persistent to generate significant average effects in the baseline specification.

Dependent variable:	Composition of new loans		
	Micro company lending	SME lending	Large company lending
Specification	(1)	(2)	(3)
Post-announcement effect	0.042	0.092	-0.025
	(0.059)	(0.076)	(0.071)
Post-application effect	0.043	0.029	0.027
	(0.054)	(0.069)	(0.071)
Observations	6,016	5,788	6,011
R-squared	0.019	0.021	0.036
Number of banks	667	615	667
Bank controls	YES	YES	YES
Bank FE	YES	YES	YES
Time FE	YES	YES	YES

Robust standard errors in parentheses; *** p <0.01, ** p <0.05, * p <0.1.
Estimation of equation (3.2). Estimation period Jan 2021-Dec 2023. Post-announcement effect is the interaction between post-announcement (equals one from Feb 2022 to Jan 2023) and the Germany-dummy (equals one for German banks). Post-application effect is the interaction between post-application (equals one from Mar 2023 to Dec 2023) and the German-dummy. Actual months of announcement and application (Jan 2022 and Feb 2023) are omitted from the estimations.

Table 7: Results for the composition of new loans as the response variable.

5.7 Comparison of our results to previous findings

Our results are not directly comparable to much of the existing literature, which typically relies on bank-level balance sheet data, focuses on specific lending segments such as mortgages, or examines lending stocks at annual or quarterly frequency. Comparisons are therefore mainly possible along the dimensions of lending volumes and lending rates.

Regarding lending volumes, our findings are broadly consistent with previous evidence that tighter capital requirements reduce credit supply. For example, Basten (2020) finds that banks with smaller capital buffers experience 1.8 percentage points lower annual mortgage growth following a CCyB tightening, while Dursun-de Neef et al. (2023) report that a 1 percentage-point CCyB reduction increases lending by about 5.6 percentage points relative to total assets. Although these studies use different data and identification strategies, the qualitative implications are similar to our findings.

We also find that announcement effects are at least as strong, and sometimes stronger than, application effects. This is consistent with Auer et al. (2022), who document stronger effects around the announcement than after implementation, suggesting that banks adjust their behaviour in anticipation of changes in capital requirements.

Our cross-sectional results are also consistent with previous evidence that smaller firms are disproportionately affected by macroprudential tightening (Ćehajić and

Košak, 2022: Amado, 2022). Although our baseline composition results do not reveal statistically significant reallocation across firm-size groups, the dynamic estimates indicate a stronger contraction in lending to smaller firms. Moreover, SMEs appear to experience relatively larger declines in lending and stronger increases in borrowing costs following CCyB tightening.

Our lending rate results are likewise consistent with the relatively limited literature on pricing effects. Basten (2020) reports increases of 8-9 basis points in mortgage pricing following CCyB activation, while Auer et al.(2022) find that a 1 percentage point increase in the CCyB raises lending rates by 0.34 percentage points. Moreover, they also find that the announcement effect (0.47 pp) is stronger and statistically more significant than the post-application effect (0.25 pp). Our findings point in the same direction.

6 Robustness analyses and extensions

To assess the robustness of our findings and further explore the transmission of CCyB tightening, we conduct a series of additional analyses. First, we re-estimate the announcement and application effects separately to verify that our results are not sensitive to the joint specification used in the baseline analysis. Second, we examine the cross-border dimension of CCyB transmission by analysing Austrian banks' lending to German firms subject to the reciprocity framework. Finally, we investigate whether the effects of CCyB tightening differ between banks using the Internal Ratings-Based (IRB) approach and those operating under the standardized approach, thereby examining the role of risk-sensitive capital regulation. Overall, the results confirm the main findings of the paper and provide additional insight into the mechanisms through which CCyB tightening affects bank lending.

6.1 Separate estimation of announcement and application effects

In our main estimations, we consider both post-announcement and post-application effects against the pre-treatment period in the same estimation. To ensure our empirical strategy is not sensitive to this, we perform a robustness check by examining these effects separately. Table 8 presents the results for the volume of new loans (Panel A), the number of new loans (Panel B), and the size of new loans (Panel C). Table 9 continues with results for the price of new loans (Panel D), maturity of new loans (Panel E), and the composition of new loans (Panel F). Both post-announcement and post-application effects are estimated against the pre-treatment period of January 2021 – December 2021, where the parallel trend assumption

holds, ensuring the internal validity of our strategy.

Panel A	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	Total NFC		Micro company		SME		Large company	
Volume of new loans	lending		lending		lending		lending	
Post-announcement effect	-1.222***		-0.984***		-0.569		-1.158***	
	(0.242)		(0.378)		(0.396)		(0.387)	
Post-application effect		-1.039***		-0.730**		-0.855***		-0.607
		(0.227)		(0.350)		(0.304)		(0.456)
Observations	4,037	3,598	3,707	3,310	3,709	3,309	3,363	3,062
R-squared	0.086	0.089	0.070	0.064	0.070	0.088	0.055	0.052
Number of banks	603	578	580	561	544	519	550	517
Bank controls	YES	YES	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES

Panel B	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	Total NFC		Micro company		SME		Large company	
Number of new loans	lending		lending		lending		lending	
Post-announcement effect	-0.468***		-0.327*		-0.018		-0.327*	
	(0.157)		(0.186)		(0.212)		(0.186)	
Post-application effect		-0.776***		-0.677***		-0.463***		-0.677***
		(0.115)		(0.142)		(0.157)		(0.142)
Observations	4,076	3,632	4,076	3,632	3,901	3,475	4,076	3,632
R-squared	0.236	0.202	0.152	0.100	0.172	0.169	0.152	0.100
Number of banks	609	587	609	587	566	541	609	587
Bank controls	YES	YES	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES

Panel C	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	Total NFC		Micro company		SME		Large company	
Size of new loans			lending		lending		lending	
Post-announcement effect	-0.773***		-0.659*		-0.534*		-0.641**	
	(0.206)		(0.356)		(0.277)		(0.321)	
Post-application effect		-0.269		-0.045		-0.331		0.058
		(0.200)		(0.326)		(0.241)		(0.381)
Observations	4,037	3,598	3,707	3,310	3,709	3,309	3,363	3,062
R-squared	0.056	0.052	0.048	0.046	0.044	0.054	0.020	0.016
Number of banks	603	578	580	561	544	519	550	517
Bank controls	YES	YES	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses; *** p <0.01, ** p <0.05, * p <0.1.
Specifications (1), (3), (5) and (7) estimate the post-announcement effect (interaction between post-announcement and the Germany-dummy) against the pre-treatment period (Jan 2023-Dec 2021). In these estimations post-application period is omitted. Specifications (2), (4), (6) and (8) estimate the post-application effect (interaction between post-application and the Germany-dummy) against the pre-treatment period (Jan 2023-Dec 2021). In these estimations post-announcement period is omitted. Actual months of announcement and application (Jan 2022 and Feb 2023) are omitted from all estimations.

Table 8: Robustness check: Estimating post-announcement effect and post-application effect separately, Panels A-C.

Comparing the results in Tables 8 and 9 with those in Tables 3–7, we observe similarity in both the size and statistical significance of the estimated coefficients. German banks facing a CCyB tightening decreased their lending and tightened their credit conditions to companies compared to Austrian banks, an effect visible both post-announcement and post-application.

However, there are a few minor differences in statistical significance to the baseline results. In particular, for the size of new loans, the post-application effect for

Panel D	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	Total NFC		Micro company		SME		Large company	
Price of new loans			lending		lending		lending	
Post-announcement effect	0.463***		0.488***		0.435***		0.092	
	(0.139)		(0.192)		(0.167)		(0.226)	
Post-application effect		0.233**		0.200		0.476***		0.004
		(0.107)		(0.209)		(0.156)		(0.239)
Observations	4,037	3,598	3,707	3,310	3,709	3,309	3,363	3,062
R-squared	0.623	0.887	0.464	0.774	0.575	0.833	0.491	0.813
Number of banks	603	578	580	561	544	519	550	517
Bank controls	YES	YES	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES

Panel E	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	Total NFC		Micro company		SME		Large company	
Maturity of new loans			lending		lending		lending	
Post-announcement effect	-0.340		0.284		-0.809***		-0.620*	
	(0.229)		(0.279)		(0.265)		(0.359)	
Post-application effect		-0.199		0.260		-0.375		-0.672**
		(0.176)		(0.233)		(0.259)		(0.321)
Observations	4,031	3,597	3,699	3,306	3,703	3,308	3,351	3,053
R-squared	0.049	0.051	0.026	0.017	0.043	0.038	0.037	0.038
Number of banks	603	578	580	561	543	519	550	517
Bank controls	YES	YES	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES	YES	YES

Panel F	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable:	Total NFC		Micro company		SME		Large company	
Composition of new loans			lending		lending		lending	
Post-announcement effect			0.066		0.102		-0.058	
			(0.060)		(0.078)		(0.089)	
Post-application effect				0.011		0.042		0.048
				(0.054)		(0.072)		(0.074)
Observations			4,036	3,598	3,874	3,454	4,032	3,595
R-squared			0.021	0.024	0.021	0.021	0.032	0.049
Number of banks			603	578	564	537	603	577
Bank controls			YES	YES	YES	YES	YES	YES
Bank FE			YES	YES	YES	YES	YES	YES
Time FE			YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses; *** p <0.01, ** p <0.05, * p <0.1.
Specifications (1), (3), (5) and (7) estimate the post-announcement effect (interaction between post-announcement and the Germany-dummy) against the pre-treatment period (Jan 2023-Dec 2021). In these estimations post-application period is omitted. Specifications (2), (4), (6) and (8) estimate the post-application effect (interaction between post-application and the Germany-dummy) against the pre-treatment period (Jan 2023-Dec 2021). In these estimations post-announcement period is omitted. Actual months of announcement and application (Jan 2022 and Feb 2023) are omitted from all estimations.

Table 9: Robustness check: Estimating post-announcement effect and post-application effect separately, panels D-F.

the aggregate sample is no longer statistically significant when estimated separately. At the same time, the post-announcement effect for large firms becomes statistically significant, whereas it was not in the baseline specification. These differences appear to be driven by changes in estimation precision when the post-announcement and post-application periods are considered in isolation, rather than reflecting a substantive change in the underlying economic effects.

6.2 Cross-border lending and reciprocity

Until now, our analysis has focused exclusively on domestic lending, abstracting from the fact that banks can operate across borders. The German CCyB applies to all German banks as well as to subsidiaries of foreign banks established in Germany.[6] If German banks were to shift part of their lending activity to Austrian firms – where the CCyB would not apply – this would fall outside the scope of our sample. However, such a shift would only reinforce our main findings, as it would amplify the observed difference in lending between German and Austrian firms.

Similarly, banks in other member states of the European Economic Area (EEA) are required to apply the CCyB to their exposures to Germany, up to a maximum of 2.5%, under the reciprocity framework. This means that Austrian banks that lend to German firms must apply the German CCyB to those exposures. Our baseline analysis is limited to domestic lending, and thus foreign exposures are excluded from the sample. Overall, such lending is rather limited. In total, Austrian banks' exposures to firms in Germany account for approximately 7.5% of their corporate loan portfolios. This lending is highly concentrated: Roughly 20 Austrian banks account for over 90% of the loans extended to companies located in Germany.

Following the CCyB tightening in Germany, Austrian banks may also have reduced their lending to German firms due to the reciprocity requirement. If this is the case, it would further support our main finding regarding the negative impact of CCyB tightening on lending. To investigate this, we re-estimate our equations using a sample restricted to Austrian banks, examining their lending to both domestic and German firms before and after the announcement and application of the CCyB increase in Germany. We estimate equation (1) from Section 4 and include only lending of Austrian banks to firms in Austria and Germany.

Table 10 presents the post-announcement and post-application effects of the CCyB tightening on Austrian banks' exposures to firms in Germany for total lending (Panel A) and micro companies (Panel B). Table 11 continues with effects on lending to SMEs (Panel C) and large companies (Panel D).

[6] In our sample, all subsidiaries of foreign banks in Germany are considered German and the CCyB tightening directly applies to them.

Panel A: Total NFC lending	(1)	(2)	(3)	(4)	(5)
	Volume	Number	Size	Price	Maturity
Post-announcement effect	-1.368**	-1.218**	-0.159	1.471*	1.478**
	(0.684)	(0.595)	(0.738)	(0.875)	(0.618)
Post-application effect	-1.060***	-1.156***	0.089	0.005	-0.179
	(0.404)	(0.287)	(0.259)	(0.205)	(0.722)
Observations	7,060	7,125	7,060	7,060	7,025
R-squared	0.034	0.073	0.015	0.869	0.027
Number of banks	235	235	235	235	235
Bank controls	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES

Panel B: Micro companies	(1)	(2)	(3)	(4)	(5)
	Volume	Number	Size	Price	Maturity
Post-announcement effect	0.785***	0.567***	0.227	-0.984***	-0.078
	(0.211)	(0.080)	(0.178)	(0.089)	(0.140)
Post-application effect	-1.643***	-1.212***	-0.445**	-3.221***	0.946***
	(0.213)	(0.075)	(0.184)	(0.103)	(0.140)
Observations	3,648	3,693	3,648	3,648	3,635
R-squared	0.031	0.086	0.014	0.859	0.025
Number of banks	127	127	127	127	127
Bank controls	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES

Robust standard errors in parentheses; *** p <0.01, ** p <0.05, * p <0.1.
The sample includes lending by Austrian banks to firms located in Austria and Germany. The dependent variables capture different dimensions of new corporate lending as defined in the main analysis. Post-announcement effect is the interaction between the post-announcement dummy (equals one from Feb 2022 to Jan 2023) and an indicator for lending to German firms (equals one for exposures to firms located in Germany). Post-application effect is the interaction between the post-application dummy (equals one from Mar 2023 to Dec 2023) and the indicator for lending to German firms. Actual months of announcement and application (Jan 2022 and Feb 2023) are omitted from the estimations. All specifications include bank fixed effects and time fixed effects, as well as lagged bank-level controls for size and capitalization.

Table 10: Robustness check: Cross-border dimension: Austrian banks' lending to domestic firms vs. firms in Germany subject to German CCyB, Panels A–B.

Panel C: SMEs	(1)	(2)	(3)	(4)	(5)
	Volume	Number	Size	Price	Maturity
Post-announcement effect	-3.828***	-0.059	-3.762***	3.448***	-0.096
	(0.214)	(0.097)	(0.179)	(0.108)	(0.162)
Post-application effect	-0.649***	-0.919***	0.255	0.724***	-2.962***
	(0.210)	(0.090)	(0.174)	(0.091)	(0.142)
Observations	2,972	3,031	2,972	2,972	2,959
R-squared	0.052	0.093	0.030	0.869	0.045
Number of banks	104	104	104	104	104
Bank controls	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES

Panel D: Large companies	(1)	(2)	(3)	(4)	(5)
	Volume	Number	Size	Price	Maturity
Post-announcement effect	-0.972**	-2.509***	1.578***	1.372***	2.785***
	(0.370)	(0.244)	(0.329)	(0.245)	(0.433)
Post-application effect	0.038	-1.053*	1.096**	0.035	-0.582*
	(0.489)	(0.532)	(0.435)	(0.410)	(0.337)
Observations	668	683	668	668	665
R-squared	0.113	0.159	0.077	0.811	0.136
Number of banks	23	23	23	23	23
Bank controls	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES

Robust standard errors in parentheses; *** p <0.01, ** p <0.05, * p <0.1.
The sample includes lending by Austrian banks to firms located in Austria and Germany. The dependent variables capture different dimensions of new corporate lending as defined in the main analysis. Post-announcement effect is the interaction between the post-announcement dummy (equals one from Feb 2022 to Jan 2023) and an indicator for lending to German firms (equals one for exposures to firms located in Germany). Post-application effect is the interaction between the post-application dummy (equals one from Mar 2023 to Dec 2023) and the indicator for lending to German firms. Actual months of announcement and application (Jan 2022 and Feb 2023) are omitted from the estimations. All specifications include bank fixed effects and time fixed effects, as well as lagged bank-level controls for size and capitalization.

Table 11: Robustness check: Cross-border dimension: Austrian banks' lending to domestic firms vs. firms in Germany subject to German CCyB, Panels C–D.

The results provide clear evidence that CCyB tightening in Germany also affects cross-border lending by Austrian banks to German firms. At the aggregate level, both loan volumes and the number of new loans decline significantly following the announcement and the application, indicating that Austrian banks reduce their exposures to German firms when the CCyB becomes more binding. This is consistent with the reciprocity framework and mirrors the contraction in domestic

lending observed in our baseline results.

At the same time, the adjustment operates along multiple margins. For SMEs in particular, the decline in lending volumes is substantial and persistent, and is accompanied by a pronounced increase in lending rates and a shortening of maturities. This closely aligns with the baseline findings, where SMEs were shown to be the most affected segment in terms of both quantities and credit conditions. For micro firms, the results are more mixed, with some evidence of reductions in lending volumes post-application and increases in borrowing costs, but with greater variability across specifications.

For large firms, the evidence again points to more limited and less systematic effects. While there is some reduction in loan volumes and number of loans following the announcement, these effects are not consistently present after application. Moreover, changes in credit conditions for large firms are relatively muted, particularly in terms of pricing, which is consistent with the baseline results suggesting that large firms remain comparatively less affected.

Overall, the cross-border evidence reinforces our main findings. It suggests that the contractionary effects of CCyB tightening are not limited to domestic lending but also extend to foreign exposures subject to reciprocity requirements. Importantly, the patterns of heterogeneity across firm sizes remain broadly consistent: SMEs are most strongly affected, while large firms are relatively insulated. This supports the interpretation that CCyB tightening primarily operates through a broad-based tightening of credit supply, with more pronounced effects on smaller and more credit-constrained borrowers.

6.3 Risk-sensitive capital regulation: Evidence from IRB banks

To examine whether the transmission of CCyB tightening depends on risk sensitivity of regulatory capital requirements, we interact the treatment effects with an indicator for banks using the Internal Ratings-Based (IRB) approach relative to banks under the standardized approach (SA). Under the IRB approach, regulatory capital requirements are explicitly linked to estimated borrower risk, whereas capital charges under SA are generally less sensitive to differences in borrower risk. As a result, tighter capital requirements may disproportionately affect the relative cost of lending to riskier borrowers at IRB banks (Kashyap and Stein, 2004; Repullo and Suarez, 2004, 2013).

This mechanism may be particularly relevant for smaller firms. SMEs and micro firms are often more opaque borrowers, making their creditworthiness more difficult to assess and potentially resulting in higher model-implied risk weights

and capital requirements (Gallo, 2021; Marek and Stein, 2022; Ćehajić and Košak, 2022). Consequently, if risk-sensitive capital regulation shapes banks' responses to macroprudential tightening, one would expect IRB banks to reduce lending to these firms more strongly than banks operating under the standardized approach.

Tables 12 and 13 report the results. Relative to banks operating under SA, IRB banks reduce the number of new loans more strongly following the CCyB tightening, particularly for micro firms and SMEs. At the same time, the average size of new loans does not decline more strongly among IRB banks. The results for the amount of new lending indicate that CCyB tightening is associated with a decline in lending among both SA and IRB banks. However, the positive interaction terms imply that the contraction is generally less pronounced for IRB banks. This difference is statistically significant for the full sample and for lending to large firms, whereas the interaction effects for micro firms and SMEs are not statistically significant. Thus, the evidence suggests that IRB banks reduce lending less than SA banks primarily in the segment of large corporate borrowers. The composition results further support this interpretation. Following the announcement of the CCyB tightening, IRB banks increase the share of lending to large firms relatively more.

The pricing results indicate that IRB banks raise lending rates more than SA banks following the implementation of the CCyB. This effect is particularly pronounced for SME lending, where the post-application interaction term is positive and statistically significant. In contrast, there is little evidence of systematic differences in loan maturity adjustments between IRB and standardized banks.

Taken together, the results are consistent with theoretical models of risk-sensitive capital regulation (Kashyap and Stein, 2004; Repullo and Suarez, 2004, 2013). Because capital requirements under the IRB approach are more closely linked to borrower risk, a tightening of regulatory capital requirements increases the relative cost of lending to riskier borrowers. Rather than reducing aggregate lending proportionately across all borrower groups, IRB banks appear to respond by becoming more selective, originating fewer loans to smaller firms while simultaneously shifting lending towards larger borrowers and larger individual exposures.

The results also resonate with the empirical literature on model-based capital regulation. Behn et al.(2016) show that increases in model-based capital requirements led German IRB banks to contract lending more strongly than banks using SA, while Gallo (2021) finds that IRB adoption in Italy reduced supply and increased borrowing costs for riskier firms. We find that although CCyB tightening reduces lending among both IRB and SA banks, the adjustment at IRB banks appears to occur primarily through changes in the composition of credit. The stronger reduction towards larger firms and higher loan pricing for SMEs suggest

that risk sensitivity amplifies the distributional effects of macroprudential capital requirements across borrowers.

Panel A: All companies	(1)	(2)	(3)	(4)	(5)
	Volume	Number	Size	Price	Maturity
Post-announcement effect	-1.253***	-0.451***	-0.814***	0.423***	-0.330
	(0.233)	(0.148)	(0.203)	(0.132)	(0.224)
Post-application effect	-1.109***	-0.685***	-0.433**	0.251**	-0.182
	(0.228)	(0.112)	(0.199)	(0.109)	(0.172)
Post-announcement effect × IRB dummy	0.365***	-0.224**	0.507***	0.139	-0.125
	(0.104)	(0.094)	(0.114)	(0.159)	(0.134)
Post-application effect × IRB dummy	0.363***	-0.166	0.486***	0.323***	-0.196
	(0.133)	(0.126)	(0.121)	(0.096)	(0.131)
Observations	6,017	6,075	6,017	6,017	6,011
R-squared	0.083	0.183	0.058	0.830	0.047
Number of banks	667	673	667	667	667
Bank controls	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES

Panel B: Micro companies	(1)	(2)	(3)	(4)	(5)	(6)
	Volume	Number	Size	Price	Maturity	Composition
Post-announcement effect	-1.032***	-0.298*	-0.744**	0.454**	0.251	0.047
	(0.375)	(0.173)	(0.359)	(0.181)	(0.274)	(0.059)
Post-application effect	-0.747**	-0.579***	-0.148	0.242	0.202	0.042
	(0.342)	(0.141)	(0.317)	(0.207)	(0.227)	(0.054)
Post-announcement effect × IRB dummy	-0.110	-0.284***	0.214	0.128	-0.012	-0.036*
	(0.183)	(0.094)	(0.133)	(0.140)	(0.078)	(0.020)
Post-application effect × IRB dummy	0.238	-0.233**	0.614***	0.174	0.014	-0.001
	(0.205)	(0.111)	(0.178)	(0.139)	(0.127)	(0.021)
Observations	5,471	6,075	5,471	5,471	5,461	6,016
R-squared	0.060	0.114	0.044	0.702	0.019	0.020
Number of banks	650	673	650	650	650	667
Bank controls	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses; *** p <0.01, ** p <0.05, * p <0.1.
Post-announcement effect and Post-application effect report the estimated treatment effects for banks using the standardized approach (IRB = 0). The interaction terms capture the additional effects for IRB banks relative to standardized approach banks. The total effects for IRB banks are obtained by summing the baseline and interaction coefficients. All specifications include bank fixed effects, time fixed effects, and lagged bank-level controls.

Table 12: Heterogeneous effects of CCyB tightening by IRB status: Panels A-B.

Panel C: SMEs	(1)	(2)	(3)	(4)	(5)	(6)
	Volume	Number	Size	Price	Maturity	Composition
Post-announcement effect	-0.636	0.005	-0.636**	0.431***	-0.860***	0.096
	(0.388)	(0.204)	(0.272)	(0.161)	(0.258)	(0.076)
Post-application effect	-0.950***	-0.360**	-0.502**	0.463***	-0.329	0.030
	(0.297)	(0.155)	(0.233)	(0.153)	(0.254)	(0.069)
Post-announcement effect × IRB dummy	0.183	-0.314***	0.488***	0.143	0.077	-0.036
	(0.160)	(0.094)	(0.145)	(0.167)	(0.144)	(0.029)
Post-application effect × IRB dummy	0.307	-0.299**	0.604***	0.195*	-0.189	-0.025
	(0.218)	(0.123)	(0.169)	(0.102)	(0.196)	(0.035)
Observations	5,520	5,827	5,520	5,520	5,514	5,788
R-squared	0.073	0.144	0.054	0.786	0.038	0.021
Number of banks	592	619	592	592	592	615
Bank controls	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES

Panel D: Large companies	(1)	(2)	(3)	(4)	(5)	(6)
	Volume	Number	Size	Price	Maturity	Composition
Post-announcement effect	-1.074***	-0.567**	-0.544*	0.134	-0.484	-0.033
	(0.375)	(0.230)	(0.324)	(0.215)	(0.342)	(0.088)
Post-application effect	-0.786*	-0.648***	-0.122	0.071	-0.684**	0.025
	(0.446)	(0.192)	(0.373)	(0.232)	(0.313)	(0.070)
Post-announcement effect × IRB dummy	0.454***	-0.037	0.382**	-0.074	-0.174	0.072***
	(0.159)	(0.130)	(0.155)	(0.138)	(0.187)	(0.024)
Post-application effect × IRB dummy	0.491*	0.066	0.314*	0.083	-0.310	0.038
	(0.265)	(0.229)	(0.172)	(0.154)	(0.209)	(0.035)
Observations	4,986	6,075	4,986	4,986	4,968	6,011
R-squared	0.053	0.067	0.021	0.761	0.033	0.037
Number of banks	611	673	611	611	611	667
Bank controls	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES
Time FE	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses; *** p <0.01, ** p <0.05, * p <0.1.
Post-announcement effect and Post-application effect report the estimated treatment effects for banks using the standardized approach (IRB = 0). The interaction terms capture the additional effects for IRB banks relative to standardized approach banks. The total effects for IRB banks are obtained by summing the baseline and interaction coefficients. All specifications include bank fixed effects, time fixed effects, and lagged bank-level controls.

Table 13: Heterogeneous effects of CCyB tightening by IRB status: Panels C-D.

7 Conclusions

We investigate the impact of a change in the countercyclical capital buffer (CCyB) on bank lending for firms in Germany. Using granular loan-level data within a difference-in-differences framework, we provide robust evidence on how banks adjust both the quantity and the conditions of credit in response to macroprudential tightening. Our results show that CCyB tightening leads to a substantial contraction in new corporate lending: both the volume and the number of new loans

decline following the policy change. At the same time, banks tighten credit standards along several dimensions, with average loan size decreasing, lending rates increasing, and, to a lesser extent, loan maturities shortening.

We show that these effects materialise not only upon the application of the new CCyB rate but already following its announcement. Across several outcomes, including lending volumes and loan pricing, the effects emerge following the announcement and often continue after the policy is applied. This anticipatory behaviour by banks underscores the importance of considering both the announcement and implementation phases of macroprudential policy changes for policymakers and researchers alike. Our results highlight that banks adjust their lending practices in anticipation of regulatory changes, which can have immediate implications for credit availability. Ignoring such anticipatory behavior can lead to an incomplete assessment of the effectiveness and timing of the policy.

Importantly, our analysis reveals a heterogeneous impact on firms of different sizes. While the baseline estimates point to a broad based contraction on lending, the dynamic evidence shows that the adjustment is more pronounced and persistent for SMEs and micro firms. These firms experience larger declines in lending and stronger increases in borrowing costs, whereas large firms appear comparatively less affected. Evidence for a systematic reallocation of lending is limited, although the dynamic patterns suggest a modest shift in lending away from SMEs and towards larger firms.

Overall, the findings indicate that CCyB tightening operates primarily through a reduction in credit supply and a tightening of lending conditions, with smaller firms bearing a relatively larger share of the adjustment. This has important policy implications, especially in economies such as Germany where SMEs play a central role and rely heavily on bank financing. While higher capital buffers enhance the resilience of the banking system, they may also have unintended distributional consequences by disproportionately affecting more bank-dependent firms.

In conclusion, our results highlight the importance of considering both the timing and the distributional effects of macroprudential policy. The strong announcement effects and the differential impact across firm sizes suggest that CCyB tightening can influence credit conditions well before implementation and may unevenly affect firms' access to finance. Future research could extend this analysis to other euro area countries and explore the longer-term implications of these effects for firm investment, growth, and financial stability.

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Annex

Annex 1

We define "clean" CCyB decisions as decisions where a change was made to the level of the CCyB, where the announced decision eventually came into force and where there were no decisions with overlapping announcement-to-application periods. For example, as illustrated in Figure A1, in Germany in June 2019 a tightening of the CCyB was announced with an application date in July 2020. However, before the new CCyB rate came into force, the tightening was reversed due to the Covid-19 pandemic, with a new decision in March 2020 that was applied immediately in April 2020. Thus, the June 2019 decision is not a clean CCyB decision we can make use of.[7] There are also decisions of the same direction that overlap in the sense that their announcement-to-application periods overlap: a second decision of the same direction was announced before the first decision was applied. Again, Figure A1 illustrates an example of France announcing and applying two overlapping CCyB decisions during 2022–2024.

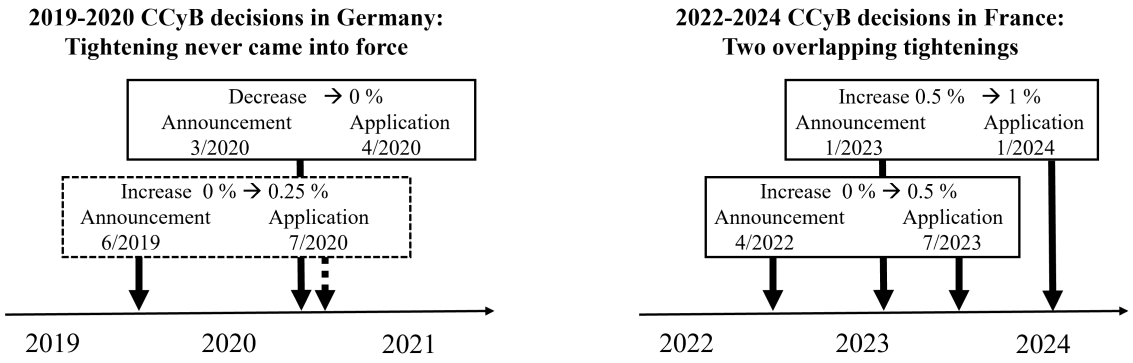


Figure A1: Examples of overlapping CCyB decisions.

However, to keep our identification as sharp as possible, we need a single clean CCyB decision with no overlaps with other CCyB decisions. We also want to avoid decisions related to the economic crisis caused by the Covid-19 pandemic, because these decisions were applied with lags of only some weeks and thus their transmission mechanism should be quite different from the decisions announced and applied during normal times and with lags of on average 12 months. To reduce the risk of the peculiarity of the Covid-19 crisis driving our results, we want to choose a decision not related to the crisis. There are only a few CCyB decisions that fulfill our strict criteria for a clean CCyB decision taken by Euro area countries (Table A1) during our sample period of 2020 to 2024. Incidentally these are all tightening decisions, but there is no reason per se why our approach would not work for easing decisions also.

[7] Moreover, Anacredit data of sufficiently good quality is not available for mid-2019. Otherwise, we could use this reversed decision as a validation for the announcement effect we uncover.

Country	Date of announcement	CCyB rate CCyB rate	Type of setting	Application since
Germany	31.1.2022	0,75	Increase	1.2.2023
Latvia	18.12.2023	0,5	Increase	18.12.2024
Lithuania	5.10.2022	1	Increase	1.10.2023
Slovakia	22.6.2022	1,5	Increase	1.8.2023

Table A1: Clean CCyB decisions by Euro area countries. See Table A2 for the full sample of CCyB decisions by Euro area countries. Source: ESRB.

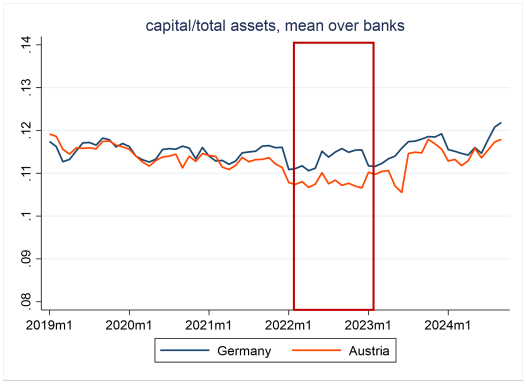
The full sample of CCyB-decisions taken by Euro area countries is given by Table A2. The decisions are categorized as ”Clean CCyB decisions” (a), ”Overlapping CCyB decisions” (b), ”Decisions that were not applied” (c) and ”Decreases related to Covid-19 crisis” (d).

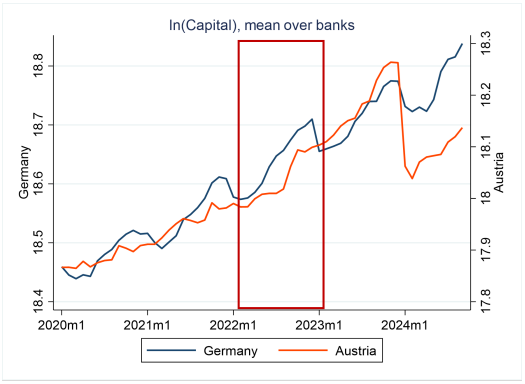
Country	Date of announcement	CCyB rate CCyB rate	Type of setting	Application since	Categorization of decisions
Belgium	28.6.2019	0,5	Increase	1.7.2020	c
Belgium	27.3.2020	0	Decrease	1.4.2020	d
Belgium	29.9.2023	0,5	Increase	1.4.2024	b
Belgium	29.9.2023	1	Increase	1.10.2024	b
Croatia	30.3.2022	0,5	Increase	31.3.2023	b
Croatia	16.12.2022	1	Increase	31.12.2023	b
Croatia	30.6.2023	1,5	Increase	30.6.2024	b
Cyprus	1.12.2022	0,5	Increase	30.11.2023	b
Cyprus	2.6.2023	1	Increase	2.6.2024	b
Estonia	30.11.2021	1	Increase	7.12.2022	b
Estonia	29.11.2022	1,5	Increase	1.12.2023	b
France	1.7.2018	0,25	Increase	1.7.2019	b
France	3.4.2019	0,5	Increase	2.4.2020	b
France	1.4.2020	0	Decrease	1.4.2020	d
France	7.4.2022	0,5	Increase	7.4.2023	b
France	2.1.2023	1	Increase	2.1.2024	b
Germany	28.6.2019	0,25	Increase	1.7.2020	c
Germany	31.3.2020	0	Decrease	1.4.2020	d
Germany	31.1.2022	0,75	Increase	1.2.2023	a
Ireland	5.7.2018	1	Increase	5.7.2019	a
Ireland	1.4.2020	0	Decrease	1.4.2020	c
Ireland	15.6.2022	0,5	Increase	15.6.2023	b
Ireland	24.11.2022	1	Increase	24.11.2023	b
Ireland	7.6.2023	1,5	Increase	7.6.2024	b
Latvia	18.12.2023	0,5	Increase	18.12.2024	a
Lithuania	21.12.2017	0,5	Increase	31.12.2018	b
Lithuania	21.6.2018	1	Increase	30.6.2019	b
Lithuania	31.3.2020	0	Decrease	1.4.2020	c
Lithuania	5.10.2022	1	Increase	1.10.2023	a
Luxembourg	31.12.2018	0,25	Increase	1.1.2020	b
Luxembourg	27.12.2019	0,5	Increase	1.1.2021	b
Netherlands	25.5.2022	1	Increase	25.5.2023	b
Netherlands	31.5.2023	2	Increase	31.5.2024	b
Slovakia	29.7.2016	0,5	Increase	1.8.2017	b
Slovakia	21.7.2017	1,25	Increase	1.8.2018	b
Slovakia	10.7.2018	1,5	Increase	1.8.2019	b
Slovakia	26.7.2019	2	Increase	1.8.2020	b
Slovakia	30.4.2020	1,5	Decrease	1.5.2020	c
Slovakia	17.7.2020	1	Decrease	1.8.2020	c
Slovakia	22.6.2022	1,5	Increase	1.8.2023	a
Slovenia	30.12.2022	0,5	Increase	31.12.2023	b
Slovenia	19.12.2023	1	Increase	1.1.2025	b

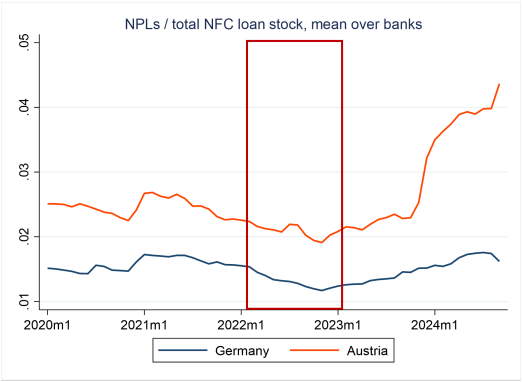
Table A2: All CCyB decisions announced by Euro area countries 2018-2024. Source: ESRB.

Annex 2

Figure A2: Visual inspection of pre-treatment parallel trends in bank characteristics for Germany and Austria. Announcement-to-application period illustrated by the red box.







Annex 3

Variable	Source	Obs	Mean	Std. Dev.	Min	Max
Bank characteristics						
Total assets (EUR mln)	1	31,922	12200	89300	0	1,590,000
Bank size (log of total assets)	1*	31,833	20.723	1.845	9.680	28.093
Capitalization	1*	31,830	0.115	0.101	0	1.125
Volume of new lending (logs)						
Total	2	8,808	15.452	1.800	0.693	21.870
Micro companies	2	7,648	13.466	1.870	0.867	19.201
SMEs	2	7,720	12.024	1.473	0.693	18.336
Large companies	2	6,666	13.460	1.726	0.405	19.525
Number of new loans (logs)						
Total	2	8,965	2.986	1.337	0.693	10.714
Micro companies	2	8,965	1.631	1.210	0	7.690
SMEs	2	8,494	2.197	1.481	0	10.123
Large companies	2	8,965	1.036	1.440	0	9.751
Size of new loans (logs)						
Total	2	8,808	12.442	1.440	-1.253	19.014
Micro companies	2	7,648	11.673	1.628	-0.519	18.297
SMEs	2	7,720	12.024	1.473	0.693	18.336
Large companies	2	6,666	13.460	1.726	0.405	19.525
Price of new loans						
Total	2	8,808	3.193	1.748	0.010	14.307
Micro companies	2	7,648	3.539	1.906	0.010	14.245
SMEs	2	7,720	3.353	1.798	0.010	14.995
Large companies	2	6,666	3.066	1.950	0.010	16.388
Maturity of new loans (logs)						
Total	2	8,802	7.577	1.053	2.628	10.309
Micro companies	2	7,640	7.638	1.147	0.693	10.495
SMEs	2	7,716	7.268	1.166	1.335	10.268
Large companies	2	6,650	6.875	1.576	0.000	10.267
Composition of new loans						
Micro companies	2*	8,805	0.222	0.271	0	1
SMEs	2*	8,394	0.385	0.303	0	1
Large companies	2*	8,797	0.350	0.330	0	1

Notes: 1 = iBSI, 2 = AnaCredit. * Authors' calculations based on the source.

Table A3: Descriptive statistics for Germany (January 2021 – December 2023)

Variable	Source	Obs	Mean	Std. Dev.	Min	Max
Bank characteristics						
Total assets (EUR mln)	1	5,264	7300	27600	0	261,000
Bank size (log of total assets)	1*	5,261	20.655	1.793	13.816	26.286
Capitalization	1*	5,261	0.109	0.076	0	1
Volume of new lending (logs)						
Total	2	2,031	15.634	1.601	4.059	20.766
Micro companies	2	2,004	13.453	1.816	4.787	18.421
SMEs	2	1,754	12.761	1.536	3.441	16.341
Large companies	2	1,858	13.646	1.810	2.015	18.826
Number of new loans (logs)						
Total	2	2,032	2.398	0.896	0.693	5.858
Micro companies	2	2,032	1.294	0.926	0	4.369
SMEs	2	1,778	1.473	0.958	0	5.220
Large companies	2	2,032	0.771	0.963	0	5.056
Size of new loans (logs)						
Total	2	2,031	13.235	1.188	3.366	17.499
Micro companies	2	2,004	12.145	1.434	4.787	17.323
SMEs	2	1,754	12.761	1.536	3.441	16.341
Large companies	2	1,858	13.646	1.810	2.015	18.826
Price of new loans						
Total	2	2,031	2.851	1.586	0.309	8.857
Micro companies	2	2,004	3.112	1.673	0.086	12.670
SMEs	2	1,754	2.966	1.620	0.347	11.231
Large companies	2	1,858	2.730	1.675	0.010	8.680
Maturity of new loans (logs)						
Total	2	2,022	8.044	0.779	3.355	9.487
Micro companies	2	1,994	8.126	0.868	2.565	9.483
SMEs	2	1,747	7.967	0.866	3.761	9.705
Large companies	2	1,840	7.569	1.275	1.946	9.595
Composition of new loans						
Micro companies	2*	2,031	0.248	0.259	0	1
SMEs	2*	1,777	0.332	0.260	0	1
Large companies	2*	2,031	0.416	0.323	0	1

Notes: 1 = iBSI, 2 = AnaCredit. * Authors' calculations based on the source.

Table A4: Descriptive statistics for Austria (January 2021 – December 2023)

Annex 4

The ESRB data has many advantages over other sources of information on the use of macroprudential measures, such as the *iMaPP by the International Monetary Fund* (Alam et al., 2025, used by e.g. Ćehajić and Košak, 2021, Forbes, 2021, Bergant et al., 2024), *IBRN Prudential Database* (Cerrutti et al., 2017) *Global Macroprudential Index or GMPI* (Cerutti, Claessens, Laeven, 2017, used by e.g. Hu and Gong, 2019; Belkhir et al., 2022; Brana et al., 2024), or the *Macroprudential Policies Evaluation Database or MaPPED by the ECB* (Budnik and Kleibl, 2018, used by e.g. Meuleman and Vander Vennet, 2020; Ćehajić and Košak, 2022). The GMPI records only the number of macroprudential policy tools implemented by a country in a given year, thus making it a very coarse measure of macroprudential policy. iMaPP, IBRN Prudential Database and MaPPED record macroprudential decisions, coding tightening and easing decisions with different signs. Crucially, all of these data record changes in macroprudential policy only once the decision has been implemented, that is by application date, not announcement date.

The ESRB data provides much more precise information as it includes the exact level of the CCyB and the announcement date of each change. The data indicates whether a decision related to the CCyB was an implementation, a tightening, or an easing. It also includes the exact level of the CCyB rate, the dates when a decision was announced and applied, and whether an announcement eventually came into effect. The information is supplemented with rich metadata, allowing us to trace back to the original motivation and arguments used by macroprudential authorities when they were making the decision. Finally, the ESRB data is very up to date, as European countries need to notify the ESRB of macroprudential decisions within a set timeframe. Of the other widely used data sets, GMPI and MaPPED end in 2017 and are not currently updated, and the iMaPP and the IBRN Prudential Database are updated with considerable lag given the large country samples involved.

Annex 5

To construct the monthly dynamic effects presented here, we extend our baseline difference- in-differences framework by estimating an event-study specification at the bank-month level. Specifically, we interact the treatment indicator for German banks with a full set of month dummies spanning the period from July 2021 to December 2023, using the first half od 2021 as the omitted reference period. This approach yields a sequence of month-specific difference-in-differences coefficients that capture how lending behavior by treated banks evolves relative to the control group at each point in time. As in the baseline specification (equation (1)), the regressions include bank fixed effects and time fixed effects, as well as lagged bank-level controls for size and capitalisation, and standard errors are clustered at the bank level. The resulting coefficints can be interpreted as dynamic treatment effects, allowing us to trace the timing and persistence of the adjustment following the CCyB announcement and application, as well as to assess the validity of the parallel trends assumptions by examining pre-treatment estimates.

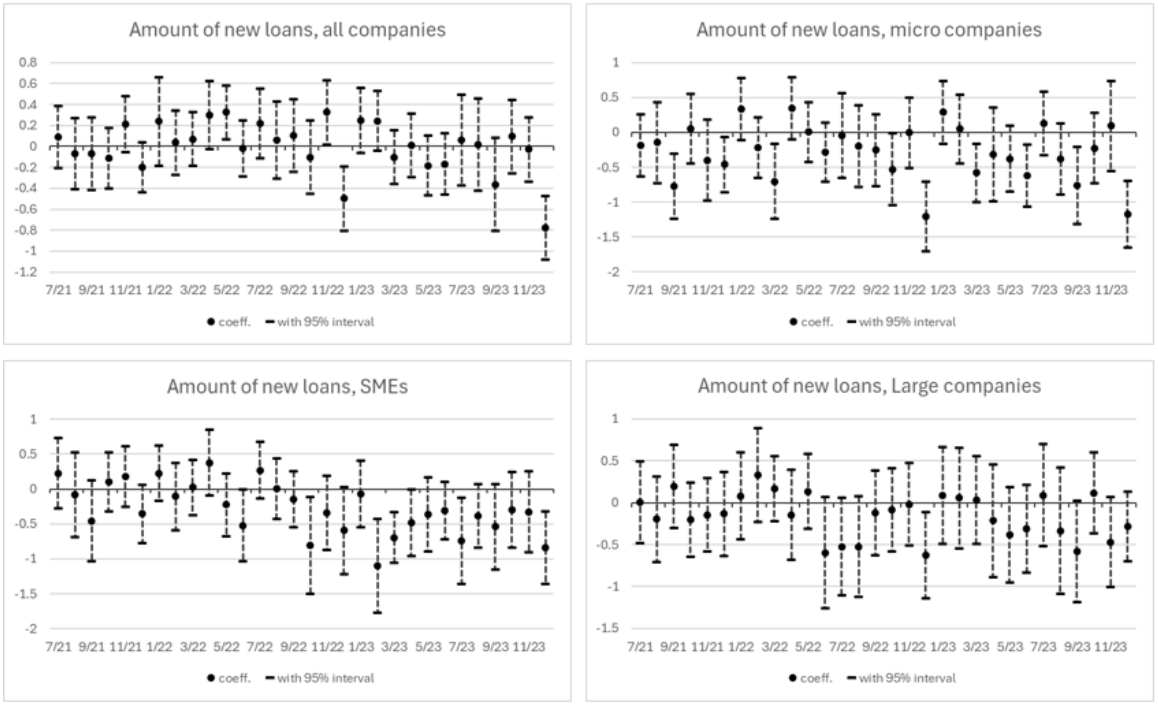


Figure A3: Dynamic effects of CCyB tightening on the volume of new loans.

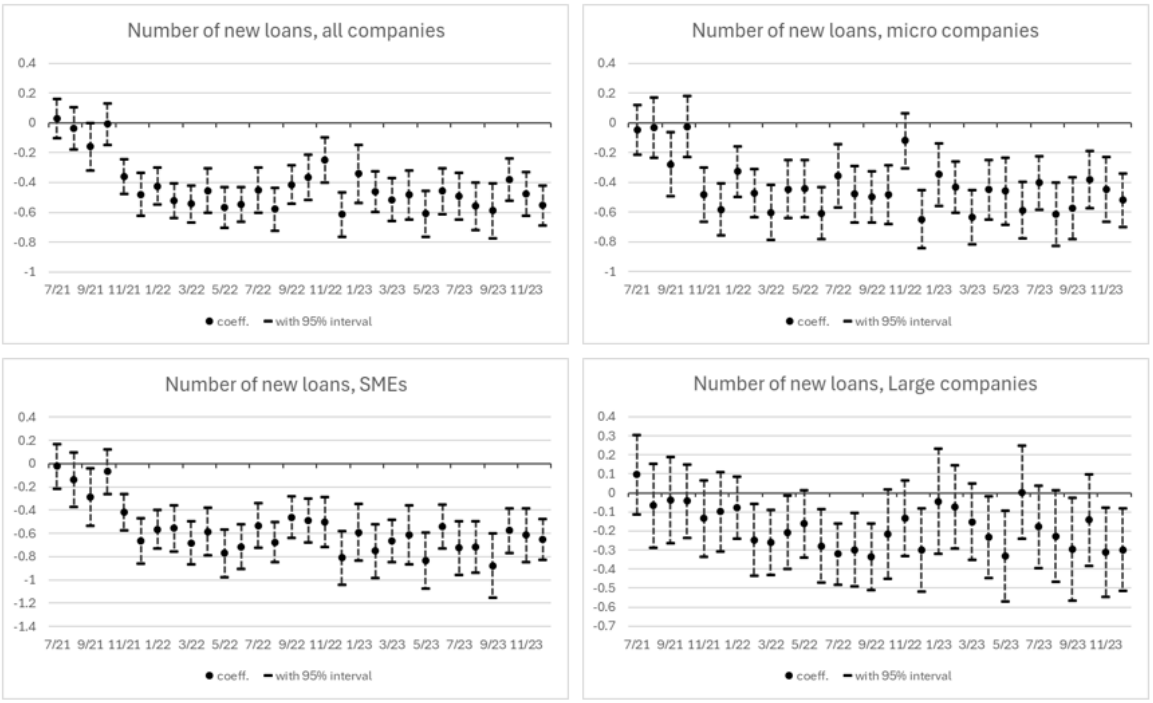


Figure A4: Dynamic effects of CCyB tightening on the number of new loans.

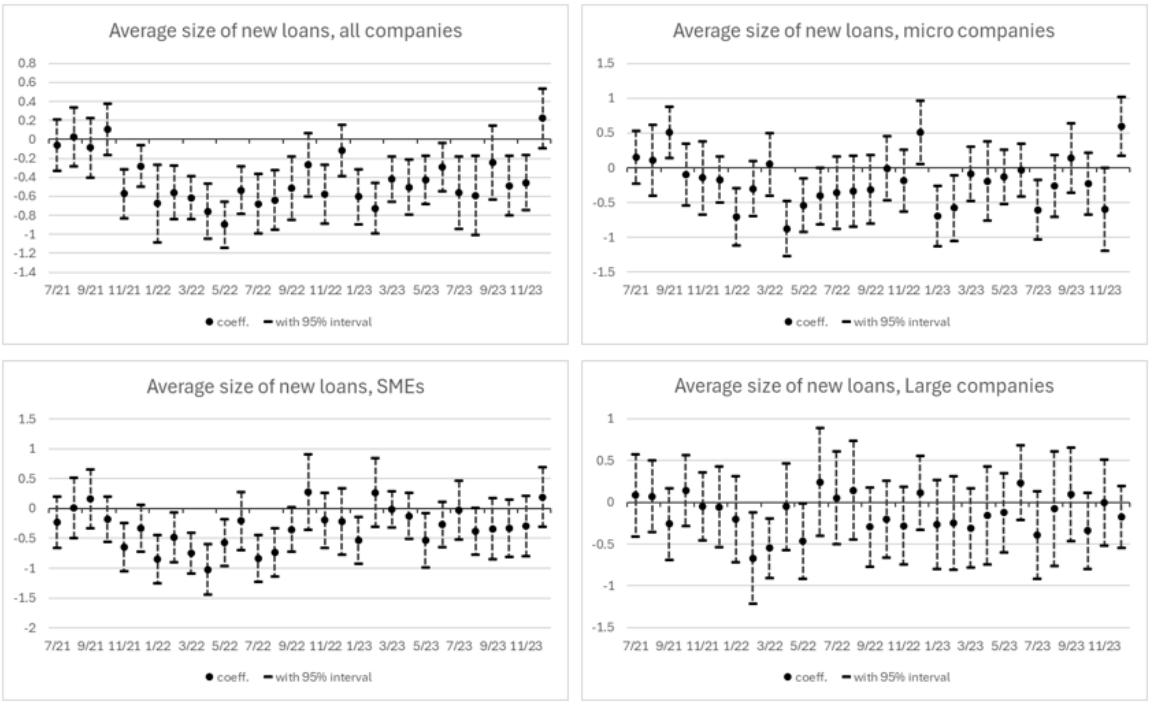


Figure A5: Dynamic effects of CCyB tightening on the average size of new loans.

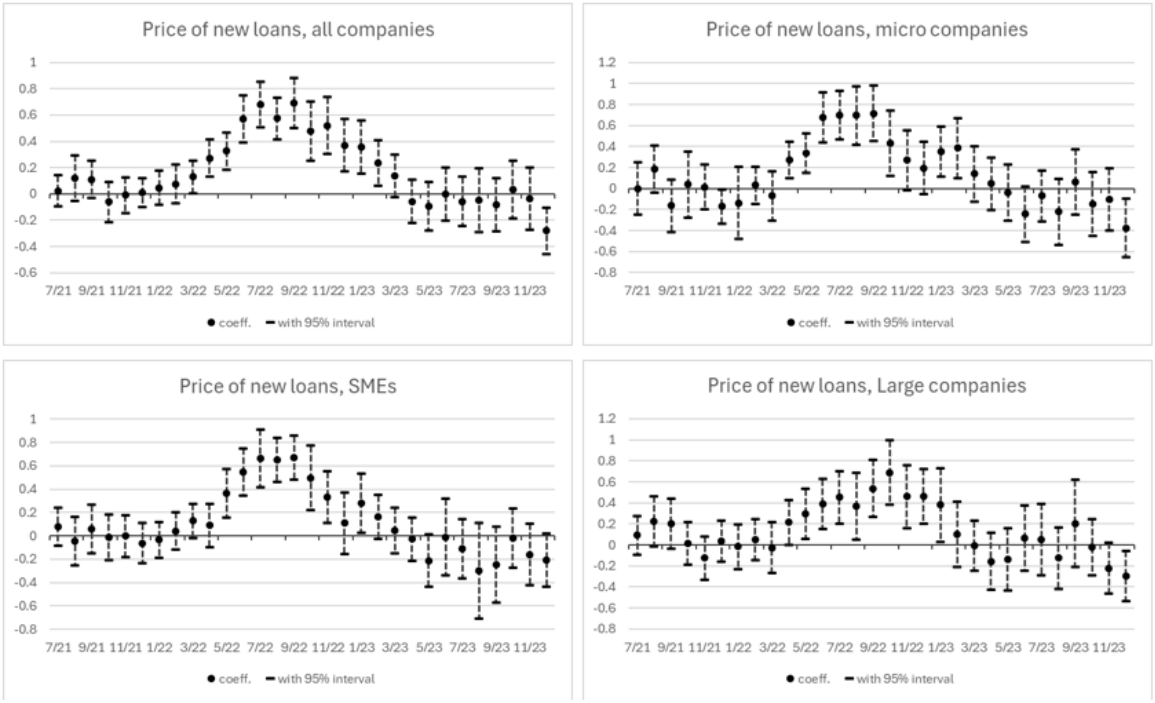


Figure A6: Dynamic effects of CCyB tightening on the price of new loans.



Figure A7: Dynamic effects of CCyB tightening on the maturity of new loans.

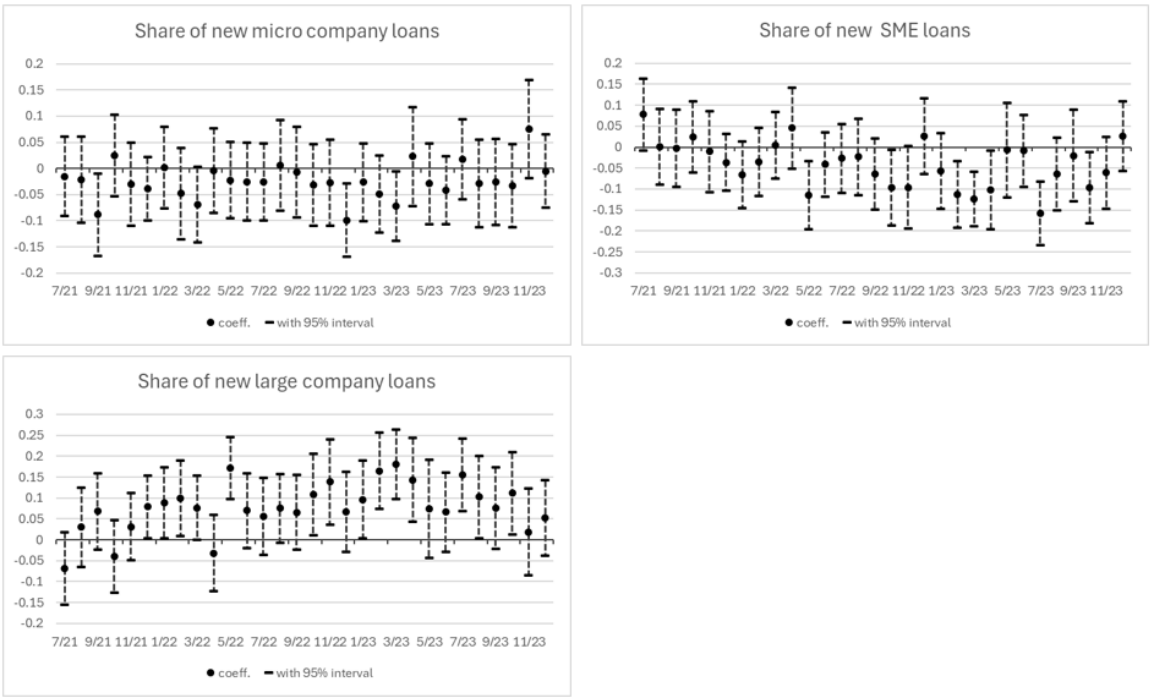


Figure A8: Dynamic effects of CCyB tightening on the composition of new loans across firm sizes.