Macroprudential Policy Leakage through Firms

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August 18, 2023

Abstract

How do internationally operating firms respond to national macroprudential policies affecting their banks? To answer this question, we analyze changes in credit obtained by German multinational corporations (MNCs) from banks, nonbanks, and internal capital markets in response to changes in countercyclical capital buffers (CCyBs) abroad, and the implications for their banks' loan portfolio risk. We find that banks lend less to affected firms and relatively decrease their loan portfolio probability of default (PD) in affected countries. Credit to affected firms from nonbanks, which are not subject to CCyBs, remains unchanged. Concurrently, we find that unaffected parent firms fully substitute for the decrease in bank lending to affected subsidiaries. The parents finance this substitution with domestic bank and nonbank credit. This new lending relatively increases their banks' loan portfolio PD and constitutes an unintended policy spillover. Overall, CCyBs imply a relative decrease of banks' cross-border lending to affected countries and in PD, but at the same time may relatively increase bank risk through funding substitution within MNCs. (165 words)

Keywords: multinational corporation, countercyclical capital buffer, banks, nonbanks, internal capital markets.

JEL-Codes: F23, F34, F36, G21.

We thank Christopher-Johannes Schild and Benjamin Weisselberg for making the combined use of the datasets possible. The views expressed in this paper are those of the authors and do not necessarily represent those of the Deutsche Bundesbank or the Eurosystem.

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1 Introduction

How effective is national macroprudential policy in a globalized world? The countercyclical capital buffer (CCyB) was introduced by many countries after the global financial crisis with the intention of reducing procyclicality of bank lending and increasing bank resilience. It should contain excessive credit growth during credit cycle upswings and support credit growth during downturns. Regulators included the feature of automatic reciprocity to account for potential regulatory arbitrage through the cross-border lending of banks. It requires foreign banks to reciprocate the capital requirement of domestic banks for their lending to the jurisdiction where the CCyB is in place. Accordingly, independent of lender location the same CCyB applies to all bank credit in this jurisdiction.

An important aspect, still entirely missing in the literature, is the overall financing response of multinational corporations (MNCs). These MNCs have the possibility to circumvent unfavorable financing conditions in some jurisdictions by borrowing in other jurisdictions and by using internal capital markets. Unaffected parts of the MNC might simply borrow domestically and lend to the subsidiaries affected by a CCyB. While this would be in line with the intentions of the domestic regulator of the CCyB to reduce domestic bank risk, financial stability in other countries might be affected. In this study, we investigate whether and how national CCyBs may leak through MNC responses.

To make empirical headway, we turn to a rich quasi-experimental setting. We analyze the responses of MNCs to the many changes that took place in the CCyBs imposed abroad on one or many of its relationship banks. While bank versus nonbank corporate borrowing subject to bank capital requirement shocks has been analyzed in a domestic setting (e.g., Irani, Iyer, Meisenzahl and Peydró (2021); Bednarek, Briukhova, Ongena and von Westernhagen (2023)),[1] and cross-border monetary and macroprudential

[1] Jiménez, Ongena, Peydró and Saurina (2017) study the impact of the introduction and subsequent modifications of a related macroprudential policy, i.e., dynamic provisioning in Spain, while Auer, Matyunina and Ongena (2022) study the compositional changes in the supply of credit by Swiss banks, following the activation in 2013 of the CCyB in Switzerland which targeted banks' exposure to residential mortgages (see also Basten (2020) and Behncke (2023)). Aiyar, Calomiris and Wieladek (2014), Imbierowicz, Kragh and Rangvid (2018), Gropp, Mosk, Ongena and Wix (2019), and Favara, Ivanov and Rezende (2021) for example study how an increase in banks' capital requirements reduces banks' lending, and Gropp, Mosk, Ongena, Simac and Wix (2023) how it may affect bank capital ratio adjustments.

policy spillovers have been documented for many countries (e.g., Baskaya, di Giovanni, Kalemli-Özcan, Peydro and Ulu (2017); Buch and Goldberg (2017)),[2] entirely missing from the literature so far has been an investigation of the overall financing response of MNCs to shocks affecting (their) banks abroad, in their borrowing from banks, nonbanks, and from internal capital markets, as well as the response in terms of the MNCs' refinancing itself.

We investigate the introduction (and adjustment) of the CCyBs as a recurring salient shock affecting banks. Norway was the first country to implement the CCyB in 2015. Thereafter, several countries followed and out of the 30 countries where the borrowing firms in our data set are located, one-third had a positive CCyB at the end of our observation period. Important for our study is the automatic reciprocity of the CCyB. As mentioned earlier, this rule is to avoid regulatory arbitrage and international risk spillovers through the circumvention of capital requirements, for instance by cross-border lending of banks.

For our analysis, we turn to a unique combination of data sets that cover credit received as well as all foreign direct investment by German MNCs from a sample period starting after the global financial crisis in 2013 and ending in 2019 just prior to the COVID-19 pandemic. We use credit register data containing quarterly information on German banks' and nonbanks' credit to individual corporate borrowers. We augment the credit register data with information on borrowing firms. The latter include detailed information on ownership, various balance sheet and income statement items, and, most importantly, the funding structure of firms, including internal debt. These detailed data are available for all subsidiaries of MNCs, which are the main focus of our analysis. We incorporate those firms where the main investor is located in Germany (parent) and invests into firms outside Germany (subsidiaries). These data allow us to explore both how bank and non-bank lending changes in response to a (higher) CCyB and the resulting dynamics of internal capital markets within an MNC.

[2] Relatedly is an emerging literature on international "regulatory arbitrage" that involves credit flows between countries (e.g., Houston, Lin and Ma (2012); Benincasa, Kabas and Ongena (2021); Laeven and Popov (2021); Burietz, Ongena and Picault (2023)), cross-border lending and the affiliate presence of US banks abroad (Temesváry (2018)), and risk-taking by banks across locales in Central and Eastern Europe (Ongena, Popov and Udell (2013)), or the UK and Ireland (McCann and O'Toole (2019)).

In the first part of our paper, we investigate the effect of a CCyB on bank and nonbank credit volume and borrower probability of default (PD). The introduction and increase of a CCyB implies higher costs for banks and accordingly potentially higher loan interest rates.[3] In a first step, we aggregate our data to the bank-country-time level to observe the impact of a higher CCyB on bank credit volume at the country level. The results show that a higher CCyB implies a decrease in bank lending. In a second step, we analyze data at the bank-firm-time level to be able to better account for firm heterogeneity and compare affected to unaffected subsidiaries only. Also in this case, our results show that a higher CCyB causes firms to reduce their bank borrowings as, ceteris paribus, a higher capital requirement likely worsens the terms and conditions under which banks offer loans. To provide further confidence in our identification approach and fully carve out the substitution of bank borrowing of subsidiaries with other sources of funding, we also look at borrowings from nonbanks. Nonbanks are not subject to a CCyB implying that changes in the CCyB should have no dampening effect on firms' nonbank borrowings. Our results support this hypothesis for the firms in our study.[4]

We repeat this two-step approach to also investigate banks' portfolio PD. A higher CCyB implies that banks have an incentive to decrease risk-weighted assets (see, e.g., Imbierowicz, Kragh and Rangvid (2018) and Gropp, Mosk, Ongena and Wix (2019) on the impact of changes in bank-specific capital requirements). This implies that in addition to the decrease in bank credit volume we would might expect a decrease in bank loan portfolio risk. Our results support this conjecture. Aggregating data in a first step again to the bank-country-time level, we observe that banks reduce the loan portfolio PD in countries with a higher CCyB. In a second step, we use data at the bank-firm-time level and investigate PD differences within a bank-MNC relationship. That is, we use all firms

[3] None of the banks in our sample is capital constrained as the increase in the bank specific capital requirement resulting from the foreign CCyBs would have been significantly lower than their available excess capital. Therefore, the CCyBs do not restrict banks' capacity to extend credit but might have an impact on credit conditions. Higher capital requirements tend to increase banks' refinancing costs as for them capital is more expensive than debt due, for instance, the favourable tax treatment of debt or underpriced deposit insurance (see for example Miles, Yang and Marcheggiano (2013)). If banks' higher refinancing costs are passed on to borrowers in form of higher lending rates borrowers have an incentive to adjust their funding structure.

[4] In our study, we only include firms which are part of an MNC and accordingly have access to internal capital markets. We acknowledge that results might be different for stand-alone firms. However, as these are in general smaller this usually also implies that they are less likely to borrow from nonbanks.

within an MNC with the same lender and compare the effect of a higher CCyB on their PD. The results show that average borrower PD decreases in affected countries relative to the borrower PD in unaffected countries. Importantly, as is the problem for the difference-in-differences approach in general, we cannot speak to the aggregate effect. However, to better understand the aggregate implications of our findings, we perform another test and compare the relative change in PD between affected and unaffected borrowers only within subsidiaries and only within parents. We observe that the decreasing effect of borrower PD in affected countries relative to the borrower PD in unaffected countries derives by roughly one-third from a decrease in PD for affected subsidiaries but by about two-thirds from an *increase* in PD for parents with affected subsidiaries. Note that the latter are included in the control group in our previous general difference-in-differences approach. This result provides a first indication that a change in CCyB might have effects beyond the country in which it is implemented. We dig deeper into the implications of this result in the second part of our paper. Overall, the first part of our paper shows that a higher CCyB implies a decrease in bank lending and bank loan portfolio PD while nonbank lending remains unchanged.

In the second part of our paper, we look deeper into the international structures of MNCs. As mentioned earlier, MNCs have the possibility to circumvent unfavorable financing conditions by shifting bank borrowing to unaffected firms in the MNC and using internal capital markets. We first look at the borrowings of subsidiaries from their parent company. Importantly, the parent companies in our study are not subject to a CCyB as all are located in Germany that has not implemented a positive CCyB during our sample period. Our results show that a higher CCyB in a country where a subsidiary is located implies more internal debt from the parent company of affected subsidiaries. An increase in the CCyB of 1 percentage point (pp) is related to an increase of 1 pp of the ratio of internal debt from the parent to total assets and of 2 pp of the ratio of internal debt from the parent to total liabilities. This is large as it implies an increase of roughly one-third of parental debt.

In the following, we ask whether the increase in internal funding from the parent fully substitutes for the decrease in bank credit to the subsidiary.[5] For this purpose, we investigate the impact of the CCyBs on the total liabilities of subsidiaries. We observe that the funding through internal capital markets compensates the decrease in bank borrowing in response to the CCyBs.

We next investigate the parent companies in more detail to better assess the indirect effects of a change in the CCyB in certain countries. We are interested in the refinancing of parents when providing more loans to affected subsidiaries. As before, we analyze both bank and nonbank lending. Our results show that parent companies refinance the increase in internal lending to affected firms not only with bank but also with additional nonbank credit.[6] This suggests that the decrease in bank borrowing by affected firms is substituted through external borrowings of their parent companies. Our results indicate that a parent with a subsidiary located in a country with a positive CCyB obtains 5% more bank and 13% more nonbank credit.

In the last part of this analysis, we also examine whether the scope of this redistribution depends on the riskiness of the parent. Our earlier results have shown that on average the PD of parents with affected subsidiaries increases relative to other parent companies. We are interested in whether banks in general shift risks to parent companies. Our results show that this is not the case. Distinguishing by borrower risk shows that riskier parent companies receive smaller loan amounts from both banks and nonbanks. However, looking at the distribution of PDs of parents we observe that almost all parent companies increase their bank as well as their nonbank credit at least to some extent. Accordingly, while risk shifting of banks appears to be limited, it cannot be fully ruled out, also being reflected in our earlier results on the average increase in PD of parents with affected relative to unaffected subsidiaries. These results suggests that the substitution of affected subsidiaries' bank borrowings with funding from the parent is heterogeneous and depends on the riskiness of their parent companies. As another

[5] We also investigate whether affected subsidiaries borrow internally from other, unaffected, subsidiaries but do not find this confirmed. The results are shown in Appendix A-3, In further tests, unreported for brevity, we also analyze the impact of a higher CCyB on external funding from capital markets but do not find any effects.

[6] Appendix A-4 shows that they do not, however, obtain more credit from subsidiaries of the MNC.

confirmation of the economic mechanism, we therefore also investigate whether the smaller additional credit amounts for riskier parents translate into less additional lending to affected subsidiaries and find this confirmed.

A concern regarding our statistical tests might be the setup of staggered and heterogeneous treatment (e.g., Callaway and Sant'Anna (2021); Sun and Abraham (2021); Athey and Imbens (2022)) and differential effects between early and later treated units (Goodman-Bacon (2021)). We address this potential concern by including only the period until 2015:Q2 when only Norway had introduced the CCyB. We additionally also investigate results for the period until 2016:Q4 where only Sweden additionally implemented the CCyB (in 2015:Q3), in- and excluding all Swedish firms. All results are confirmed.

We contribute to the literature by not only investigating the effects of a CCyB in the country of its implementation but also by showing that it has wide-ranging implications for financial stability and might also affect other countries. The latter derives from international affiliations of firms and the internal capital markets these MNCs operate. Accordingly, a CCyB in one country reduces the cross-border credit volume issued to firms in this country, as intended by reciprocity rules. However, the substitution of funding within MNCs might also imply more credit and a corresponding increase in PDs of firms in another country, at least partially increasing bank risk again. In sum, macroprudential policy might leak through international firms. Therefore, the more homogeneous the macroprudential stance across countries the less likely are such kind of waterbed effects.

The remainder of the paper is organized as follows. Section 2 reviews the literature, while Section 3 discusses the institutional setting and the data. Section 4 presents the methodology. Results on the direct effects of the CCyB with regard to affected firms are reported in Section 5 and estimates on the indirect impact of the CCyB on credit substitution and MNCs' adjustment of funding structures are discussed in Section 6. Some robustness analyses can be found in Section 7 and Section 8 concludes.

2 Related literature

Our paper for the most parts relates to two strands of literature. First, we add to the literature on the transmission mechanism of broad-based macroprudential capital

requirements. The idea of the CCyB is to require banks to build up additional capital in normal times that can be used to absorb losses in a crisis. Then, the extra loss absorption capacity lowers the risk of procyclical lending cuts (Kashyap and Stein (2004); Repullo and Suarez (2013); Chen and Friedrich (2021)).

Our paper focuses on the pre-crisis build-up phase of the CCyBs linking our analysis to the literature on the impact of higher capital requirements on bank lending. Most papers tend to find negative effects, which are transitory (e.g., Peek and Rosengren (1995); Bridges, Gregory, Nielsen, Pezzini, Radia and Spaltro (2014); Behn, Haselmann and Wachtel (2016); Deli and Hasan (2017); Gropp, Mosk, Ongena and Wix (2019); Imbierowicz, Löffler and Vogel (2021); Gropp, Mosk, Ongena, Simac and Wix (2023)). Some papers also analyse, whether the decline in bank lending by banks that are affected by higher capital requirements is substituted by unaffected banks. For instance, De Jonghe, Dewachter and Ongena (2020) find that tighter bank specific capital requirements in Belgium lead to negative effects on their credit supply. Firms are not able to fully substitute the reduction in credit by borrowing more from banks with lower capital requirements. Also, for Spain Jiménez, Ongena, Peydró and Saurina (2017) document that in reaction to tighter provisioning requirements firms switch to less or unaffected banks. They also find that there are important compositional effects in credit supply related to risk. Partial credit substitution between affected und unaffected banks is also found by Aiyar, Calomiris, Hooley, Korniyenko and Wieladek (2014) and Fraisse, Lé and Thesmar (2019).

However, in contrast to bank specific capital requirements the reciprocity rule of the CCyB ensures that all banks and their lending to firms in the country that has activated the CCyB is affected, irrespective of whether banks are domestic or foreign. Therefore, within a banking system credit substitution, if any, should be lower. Chen and Friedrich (2021) for example investigate the impact of foreign CCyBs on cross-border lending of Canadian banks. They find that foreign CCyB changes negatively affect Canadian banks' cross-border lending to the CCyB activating country. This is in contrast to the increase of cross-border lending to countries that tighten capital regulation that only apply to domestic banks found by Damar and Mordel (2017). In case of MNCs, our results, however, indicate sizable credit substitution effects even when capital requirements are broad-based. Affected affiliates largely offset the decline in (direct) borrowing from

banks with non-CCyB affected bank and nonbank debt through their internal capital markets.

In addition to our results on lending adjustments, we document a channel for international risk spillovers by examining the impact of the CCyBs on banks' loan portfolio risk. In this regard, we add new insights to the international implications of macroprudential policies (see for instance Buch and Goldberg (2017) and European Central Bank (2020)).

Second, we contribute to the literature on internal capital markets of MNCs. In general, firms tap internal capital markets to minimize their financing costs or tax burden by exploiting differences in international corporate tax rates (e.g., Mintz and Smart (2004); Buettner and Wamser (2013); and, for a meta study see Feld, Heckemeyer and Overesch (2013)), institutional quality, and financial development (e.g., Desai, Foley and Hines Jr. (2004); Aggarwal and Kyaw (2008); Egger, Keuschnigg, Merlo and Wamser (2014); Goldbach, Møen, Schindler, Schjelderup and Wamser (2021)). Our work relates to the latter studies, which examine how funding structures of MNCs change when they face external borrowing constraints.

External borrowing constraints are typically measured in terms of country or firm characteristics that are plausibly linked to the availability of external funding.[7] Desai, Foley and Hines Jr. (2004) for example find for foreign affiliates of U.S. MNCs that they increase their internal borrowing from the parent company to compensate for a reduction in external borrowing due to unfavorable capital market and legal conditions, as measured by the ratio of total bank loans to GDP and a five-point creditor rights index. In line with these results, in a study by Goldbach, Møen, Schindler, Schjelderup and Wamser (2021) an increase in a survey-based credit constraint indicator is associated with less parental loans to affiliates of German MNCs. Dewaelheyns and Van Hulle (2010) find that for

[7] The saliency of the internal versus external financing for corporations (or lack thereof, see, e.g., Modigliani and Miller (1958)), and the external finance premium, for corporate and macroeconomic outcomes have long been the focus of both a key theoretical and empirical literature (e.g., Bernanke and Gertler (1989); Calomiris and Hubbard (1990); Paravisini (2008)). Further stages in the "financial graduation" by entrepreneurs such as from informal to formal financing (e.g., Degryse, Lu and Ongena (2016)), and by firms within the formal financial sector from group to individual loans (e.g., Li, Mishra, Ongena and Ioannidou (2023)), from single to multiple bank relationships (e.g., Detragiache, Garella and Guiso (2000); Ongena and Smith (2000); Farinha and Santos (2002)), or from bank to bond market finance (e.g., Diamond (1991); Santos and Winton (2008)), has also been theoretically and empirically well analyzed.

domestic business groups in Belgium, external borrowing at the subsidiary level declines with larger available resources in the internal capital market, proxied by group size and age, while, on the contrary, with higher group leverage bank borrowing increasingly occurs in subsidiaries with many collateral assets to arguably minimize external borrowing costs. Our results are consistent with these findings suggesting high substitutability between external and internal debt.

Complementing the literature on internal capital markets, we examine the role of national macroprudential bank capital requirements on the financing structures of multinational firms. The specific design of the CCyB as a broad-based capital requirement, that is unrelated to bank characteristics, and its automatic reciprocity by foreign banks provides us with a well-identified setting where the CCyB affects the conditions for bank debt for some, but not all, MNC affiliated firms. This, together with our bank-firm level dataset, allows us to trace the adjustments in the funding mix of affected firms very granularly – distinguishing between bank and nonbank debt as well as internal funding through non-affected subsidiaries and/or parent companies.

Regarding the identification strategy, related to our analysis are studies that investigate the transmission of financial shocks via MNCs. Biermann and Huber (2023) for example study a credit supply shock to parents during the global financial crisis. Consistent with our results, but the other way around, they find that subsidiaries provide internal funds to their affected parent. Similarly, Santioni, Schiantarelli and Strahan (2019) find for Italian MNCs that their recourse to internal capital markets increased when Italian banks were distressed during the global financial crisis and the sovereign debt crisis in 2011. Our findings suggest that internal capital markets are not only an alternative when external borrowing is difficult, for example, due to underdeveloped capital markets or a credit supply shock resulting from a financial crisis, but that even small changes in the conditions for bank debt lead affected MNCs to change their funding strategy.

We also provide new insights into how the increase in internal funds is refinanced and how this affects risk. Parent companies refinance the additional funds they provide to affected subsidiaries with both bank and nonbank debt. In this context, their creditworthiness determines their scope to borrow externally and thus the extent to which affected subsidiaries can replace the decline in bank debt with internal funds. Our results

indicate that this increases the PD of parents and accordingly implies a leak of macroprudential policy through funding substitution within MNCs.

3 Institutional Setting and the Data

3.1 The Countercyclical Capital Buffer (CCyB)

The CCyB was introduced by many countries after the global financial crisis as an internationally agreed countercyclical capital requirement (Basel Committee on Banking Supervision (2010)). In normal times, national authorities should increase the CCyB, requiring banks to build up an additional capital buffer above minimum requirements, which can then be drawn down or released during periods of stress. The aim of the CCyB is to reduce procyclicality by enabling banks to absorb losses without cutting back lending in a downturn. The effectiveness of countercyclical capital requirements to stabilize banks' credit supply in a downturn and crises, for example, is documented by the European Central Bank (2022) and the Basel Committee on Banking Supervision (2022) and the literature cited in these reports. As a secondary objective, the CCyB might also help to contain excessive credit growth during the upswing of the credit cycle - although the impact on lending should be much smaller than in a crisis when banks are capital-constrained (see for example European Central Bank (2022) and Lang and Menno (2023)).

An important and defining feature of the CCyB is its automatic reciprocity. This means that any CCyB set by a national regulator to banks' domestic exposures is to be reciprocated by banks operating from outside the regulating jurisdiction. This rule is to avoid regulatory arbitrage through the circumvention of capital requirements, for instance by cross-border lending. Accordingly, a positive CCyB ratio applies to all bank exposures in the regulating jurisdiction, independent from where the exposures are issued. Thus, internationally active banks face different capital requirements on their foreign claims, contingent on the level of the CCyB in the respective jurisdiction.

Figure 1 shows the development of the CCyB for those countries in our sample with a positive CCyB during our sample period from 2013:Q1 to 2019:Q4. The data derives from the jurisdictions' notifications of their CCyB decisions to the European Systemic Risk Board (ESRB).

[Figure 1 around here]

3.2 The Multinational Corporation (MNC) and Its Borrowing

For our analysis, we combine two proprietary datasets from the Deutsche Bundesbank. For bank and nonbank lending to firms we rely on the MiMik (*Mikrodatenbank Millionenkredite*) database. The data include domestic as well as international loans. We focus on loans towards non-financial private sector firms located in all EU27 countries and Iceland, Norway, and the UK. We only include lending relationships which exist at least for eight consecutive quarters (i.e., two years). Our data on borrower probability of default (PD) also derive from this database. We calculate the weighted average of all PD estimates for a borrower in a given quarter across all lenders to mitigate potential lender-specific biases.

On the borrower side, we augment these data with the MiDi (*Microdatabase Direct Investment*), which covers the universe of German firms' outward foreign direct investments (FDI). We identify those firms where the main investor is located in Germany (parent) and invests into firms outside Germany (subsidiaries). The MiDi dataset is based on annual balance sheet reports of subsidiaries and accordingly provides us with detailed information on asset and liability structures as well as several other characteristics such as the economic sector for each firm. The dataset also includes information on the parent companies, such as their size or the number of employees. We use the MiDi data with end-of-year values.

Crucial for our analysis is the detailed information on the firms' liability structure. For each subsidiary, we know its total amount of liabilities as well as how much of these liabilities are external, e.g., from banks, nonbanks, or bond holders, and how much are internal, e.g., from the parent company or other subsidiaries of the MNC. These data allow us to explore the dynamics of internal capital markets within an MNC and how they are put to use in reaction to changes in the CCyB in countries where firms are located.

Appendix Table A1 lists all countries where the firms in our sample are located together with information on the respective CCyB. Summary statistics on the number of lenders and borrowers; number of borrower-lender relationships, the distribution of the CCyB, credit exposure and probability of default (PD) of all firms and the decomposition

of liabilities of subsidiary firms are shown in Appendix Table A2. We also refer to this table for a list of variable descriptions.

4 Methodology

In order to explore the direct implications of CCyBs for firms, we start with investigating the differential effect of the CCyB rate on banks' cross-border lending to subsidiaries at both the bank-country-time and lender-firm-time level. As to the bank-country-time level, we estimate:

$$Y_{l,c,t} = \beta * CCyB_{c,t} + I_{l,t} + \varepsilon_{l,c,t} \quad (1)$$

with $Y_{l,c,t}$ as the logarithm of the total credit exposure of lender l in country c in year:quarter t. $CCyB_{c,t}$ is the level of the CCyB in country c in year:quarter t and $I_{l,t}$ are lender times year:quarter fixed effects. Regarding the lender-firm-time level, we estimate the following regression equation:

$$Y_{l,f,t} = \beta * CCyB_{f,c,t} + I_f + I_{i,t} + I_{l,t} + \varepsilon_{l,f,t} \quad (2)$$

The dependent variable $Y_{l,f,t}$ is the logarithm of credit issued by lender l to firm f in year:quarter t. It might be the case that the lending to subsidiaries differs depending on one or more of the other subsidiaries in the MNC being exposed to a positive CCyB. As an example, within an MNC a bank might lend more to unaffected and less to affected firms. When incorporating all subsidiaries without distinction, these potentially indirectly affected subsidiaries are included in the control group and might bias results. Besides including all subsidiaries, we therefore also report all results excluding all subsidiaries with zero CCyB where another subsidiary of the MNC is subject to a positive CCyB.

The independent variable $CCyB_{f,c,t}$ is the rate of the CCyB in quarter *t* in country *c* where firm *f* is located. Lenders *l* are either banks or nonbanks, located in Germany. To control for changes in firm credit demand we include a set of firm-industry times year:quarter fixed effects $I_{i,t}$. These dummies proxy firms' credit demand on a higher level than the individual firm (see, e.g., Jakovljević, Degryse and Ongena (2015); Degryse, De Jonghe, Jakovljevic, Mulier and Schepens (2019); Greenstone, Mas and Nguyen (2020); Berg, Reisinger and Streitz (2021)). We are not able to include firm times year:quarter fixed effects (as in Khwaja and Mian (2008)) as these would not allow us to investigate the effects of the CCyB on a firm in a country because the model would be

fully saturated. Firm fixed effects I_f control for time invariant firm characteristics, while industry times year:quarter fixed effects I_{it} for industry factors varying over time. Lender times year:quarter fixed effects $I_{l,t}$ account for observable and unobservable time-varying factors at the bank level.

Next, we investigate the direct effect of the CCyB on borrower risk, distinguishing again by both the bank-country-time and lender-firm-time level. In these analyses, we first include both subsidiaries and parents of an MNC receiving credit from the same lender. For the bank-country-time level, we estimate again equation (1), using as dependent variable $Y_{l,c,t}$ the average weighted PD of borrowers of lender l in country c in year:quarter t. As to the lender-firm-time level, we estimate the following regression equation.

$$Y_{l,f,t} = \beta * CCyB_{f,c,t} + I_f + I_{i,t} + I_{l,t} + I_{l,MNC,t} + \varepsilon_{l,f,t} \quad (3)$$

The dependent variable $Y_{l,f,t}$ is the weighted PD of a firm in a given year:quarter t. The equation differs from equation (2) by additionally including lender times MNC times year:quarter fixed effects $I_{l,MNC,t}$. This allows to investigate the change in PD for all firms within the same MNC which receive loans from the same lender. In further tests, we re-run variations of the regression equation and include only subsidiaries and only lenders. These test allow to compare changes in borrower PD between subsidiaries, and between parents, in addition to the comparison of PD between firms within an MNC.

In order to explore the implications of CCyBs on the internal capital markets of firms, we then investigate the effects of the CCyB on subsidiaries' internal debt employing versions of regression equation (2) with $Y_{f,t}$ as the logarithm of a subsidiaries' internal debt, its internal debt over total assets, or its internal debt over total liabilities. These variables are split by internal debt from the parent and internal debt from other subsidiaries within the MNC. Again, $I_{i,t}$ are a set of firm-industry times year:quarter fixed effects to control for changes in firm demand, and firm fixed effects I_f to account for time invariant firm characteristics, and fixed effects I_t for time varying factors. In the last part of these analyses, we also investigate the impact of CCyBs on the total liabilities of subsidiaries following the same regression approach and use both the logarithm of subsidiaries' total liabilities and the ratio of total liabilities to total assets as dependent variables.

In the second part of our analysis, we explore the funding of parents in more detail. Specifically, we investigate whether parents, that increase their lending to affected subsidiaries, obtain these funds from banks or nonbanks, or both. To do so we include all parents with foreign subsidiaries in our sample countries. Note that we have data on all investments of German parents into subsidiaries abroad but that these subsidiaries do not have to be borrowers of German lenders. This implies a larger number of lending observations for parents than for subsidiaries. We investigate versions of the following regression equation:

$$Y_{l,f,t} = \beta * I_{affected} + I_f + I_{i,t} + I_{l,t} + \varepsilon_{l,f,t} \quad (4)$$

The specification is very comparable to equation (2), with the main difference that we estimate the lending to parents and use the indicator variable $I_{affected}$ to investigate the effect on a parent's borrowings as the variable is one when at least one subsidiary in its MNC is located in a country with a positive CCyB. In addition to bank and nonbank lending to parents we also examine the lending from affected subsidiaries to the parent using the specification of equation (4).

Finally, we investigate the impact of heterogeneity in the risk of the parent on our results to further provide confidence in the identification of our results. We first use equation (4) and interact our indicator variable $I_{affected}$ with the probability of default of the parent in a given year:quarter. Thereafter, we implement equation (2) again but interact our variable $CCyB_{f,c,t}$ with the probability of default of the parent (and the probability of default of the subsidiary) to test for differences in internal lending from the parent to the subsidiary depending on firm risk.

5 The Direct Effects of the CCyB

The aim of the CCyB is to reduce procyclicality of bank lending. This implies that in an upturn of the financial cycle, an increase in the CCyB should increase the resilience of banks by requiring a higher capital cushion needed for lending. In addition, a higher CCyB incentivizes banks to relatively reduce their risk exposure by dampening (risky) lending. In a crisis, the release of a previously built-up CCyB increases banks' excess capital, which can be used to absorb losses without having to cut back lending too severely. Our sample period covers only the build-up phase of the CCyB in European

countries until 2019. Therefore, our focus is on the effect increases of CCyBs have on banks' lending and portfolio risk.

5.1 The Effect of the CCyB on the Lending to Affected Subsidiaries

We start by investigating the impact of increasing CCyBs on bank lending volume. Our sample includes German banks' lending relationships to all corporate borrowers of MNCs, where the latter consist of parent companies in Germany and subsidiaries abroad. Given that Germany did not introduce a CCyB during our sample period all parent companies are not subject to a positive CCyB. We therefore label parents and subsidiaries located in countries with no positive CCyB as unaffected. Subsidiaries in countries with a positive CCyB are considered to be affected.

In a first step, we try to understand the more aggregate effects increasing CCyBs have on bank's lending abroad and use our data at the bank-country-time level. That is, we calculate the total lending amount of a bank towards subsidiaries of MNCs in a specific country in a given quarter and regress its logarithm on the variable *CCyB rate*, which measures the level of the CCyB in this country at this point in time, and fixed effects. Our definition of the variable *CCyB rate* and the regression specification is analogous to a staggered difference-in-differences estimation with heterogeneous treatment.[8] The results are shown in Table 1.

[*Table 1 around here*]

Table 1 shows that a larger CCyB rate in a given country implies a relative decrease in cross-border bank credit to firms located in this country. Including more granular fixed effects in columns (2) to (4) slightly reduces the economic effect which nevertheless remains large and statistically strong also in the most rigid specification in column (4) with a t-value of the estimated coefficient of 8.27. An increase of the CCyB of 1 pp in a given country relates to a decrease of roughly one-third of the standard deviation of a banks' lending to this country.

In a second step, we account for firm heterogeneity and incorporate data at the bank-firm-time level. That is, we regress the logarithm of the credit volume a bank has

[8] We provide further robustness tests regarding the specification later on.

issued to a specific firm at a given quarter on our variable *CCyB rate*. Again, we increase the saturation with fixed effects across specifications. Ideally, we would like to include firm times year:quarter fixed effects to fully account for firm demand (as in Khwaja and Mian (2008)). But that is not possible due to the lower granularity of our main independent variable. Instead we follow Degryse, De Jonghe, Jakovljevic, Mulier and Schepens (2019) and include industry times year:quarter fixed effects in addition to the lender times year:quarter fixed effects already included in the previous table. As explained in the methodology section, we run our specifications including all subsidiaries as well as excluding subsidiaries with zero CCyBs where another subsidiary of the MNC is subject to a positive CCyB to account for a potential bias from within-MNC differences in bank lending due to CCyBs. Table 2 reports the results.

[*Table 2 around here*]

Both Panels A and B confirm the decreasing effect of larger CCyBs also at the bank-firm level. Irrespective of including subsidiaries with other subsidiaries of the MNC in CCyB countries, the coefficient of the CCyB rate is negative and significant at the 1%-level in the model with the most saturated fixed effects setting (column 5). In general, Panel A shows that subsidiaries in a country where the CCyB is increased by 1 pp receive 8.6% less bank credit compared to subsidiaries in non-CCyB countries. The effect is even stronger in Panel B with 13.6%, where we exclude subsidiaries with other subsidiaries with a positive CCyB in their MNC. This indicates that banks might consider firms and their idiosyncratic shocks to some extent also jointly at the overall MNC-level, lowering the economic magnitude we observe in Panel A. Interestingly, in both Panels the economic magnitude of the coefficient does not change substantially over different saturation levels via fixed effects. This supports that CCyBs are set rather unrelated to specific banks and/or firms in an economy but follow more aggregate measures such as the credit-to-GDP gap.

In the last part of our analysis, we look at the impact of increasing CCyBs on nonbank lending volume. Nonbanks are not subject to CCyB regulation changes. Accordingly, a change in CCyB in a given country should have no effect on the lending of nonbanks to firms in this country. We use the same regression specification as in Table 2 and again split the sample by including all subsidiaries and excluding subsidiaries with

zero CCyB where another subsidiary of the MNC is subject to a positive CCyB. The results are reported in Table 3.

[*Table 3 around here*]

Table 3 confirms our hypothesis. Nonbanks do not change the lending to firms in countries which increase the CCyB. In columns (1) and (2), we compare subsidiaries' borrowings from nonbanks in CCyB-countries with all other subsidiaries, in columns (3) and (4) only with subsidiaries that singularly operate in non-CCyB countries. The saturation with fixed effects is the same as in columns (4) and (5) of Table 2. Irrespective of the saturation and the sample, all coefficients are insignificant. This supports our identification strategy and the economic mechanism we would expect. Importantly, it also shows that the lending of banks and nonbanks should not be analyzed jointly as it might result in wrong conclusions. As an example, if we would regress both bank and nonbank lending on an indicator variable for nonbanks we would observe an increase in nonbank lending as a response to increasing CCyBs. Our results confirm that this is not the case but only applies relative to the lending of banks. In sum, the choice of control group is important to understand aggregate effects.

5.2 The Effect of the CCyB on the Probability of Default of Affected Subsidiaries

In this section, we are interested in how the CCyB affects banks' portfolio risk. The purpose of the CCyB is to increase banks' resilience by also limiting their risk-taking in the upward phase of a financial cycle. Accordingly, we would expect that the risk of borrowers decreases in response to increasing CCyBs. This would compare to the literature on increases in microprudential capital requirements which shows that banks have an incentive to decrease risk-weighted assets (e.g., Imbierowicz, Kragh and Rangvid (2018); Gropp, Mosk, Ongena and Wix (2019)). We do not have the risk weights for the individual loans available but know the probability of default (PD) assigned to firms by their lenders. To avoid any idiosyncratic errors and/or biases and also to increase statistical power, we aggregate the lender-firm specific PDs to the firm level.

As in the section on lending before, we first start by examining the effect of the CCyB on banks' portfolio PD at the bank-country-time level. We calculate a bank's country-portfolio PD as the weighted PD for all borrower-lending relationships in a given country for a given bank. We regress this variable again on our variable *CCyB rate*, which

measures the level of the CCyB in this country at this point in time, and fixed effects. Table 4 reports the results.

[*Table 4 around here*]

Table 4 confirms in all regressions a strongly significantly negative effect of increasing CCyBs on banks country-portfolio PD. Thus, an increase of the CCyB leads banks to relatively reduce the riskiness of their lending to firms in countries with an increasing CCyB. Despite its strong statistical significance, its absolute economic magnitude is small but from a low base still somewhat meaningful. Indeed, a 1 pp increase in the CCyB relates to a decrease in a bank's average country-portfolio PD by 0.053 pp. This relates to an average borrower PD of 0.716% and accordingly a change of 7.4%.

In a second step, we use data at the bank-firm level and investigate PD differences within a bank-MNC relationship. We are specifically interested whether the same lender assigns a different PD to different firms of the same MNC in response to increasing CCyBs. That is, we use all firms of an MNC with the same lender and compare the effect of an increasing CCyB for some of the subsidiaries on their PD relative to the parent and the other subsidiaries of this MNC. Table 5 shows the results.

[*Table 5 around here*]

Columns (1) to (4) include both parent companies and subsidiaries of MNCs together with MNC and year:quarter fixed effects. Irrespective of the granularity of our fixed effects, we observe that larger CCyBs imply a lower borrower PD. With a coefficient of -0.083, the effect is stronger than at the aggregate level in Table 4 and relates to a change in the PD of 11.6%.

As emphasized earlier, to be able to better understand aggregate effects the choice of control group is important. We therefore rerun our regressions separately only for subsidiaries (column (5)) and only for parents (column (6)). We acknowledge that a direct comparison is not entirely possible as we cannot use the same granularity of fixed effects in the specifications. The reason is that we are able to include several firms of an MNC when analyzing subsidiaries but MNCs only have one parent. This means that including MNC fixed effects for the latter is analogous to firm fixed effects. Accordingly, including MNC times year:quarter (or, as in column (4), MNC times lender times year:quarter) implies that we cannot estimate our main independent variable as its granularity is lower.

We therefore can only use slightly less granular fixed effects when investigating the effect of increasing CCyBs for their subsidiaries on the PD of parents.

Including the same firms as in columns (1) to (4) but splitting these between only subsidiaries and parents shows that a larger CCyB implies a slightly smaller PD for subsidiaries but a larger PD for parents of affected subsidiaries. This suggests that an increase in CCyB implies a decrease in average PD of 5% for subsidiaries but an increase of 9.5% for their parents. It confirms our hypothesis that the risk of borrowers decreases in response to increasing CCyBs, comparable to microprudential regulation. However, it also indicates that larger CCyBs do not only impact the firms in a country with a positive CCyB directly but might also have an effect on other firms of MNCs, which are not located in this country, such as is the case for the parent companies in our sample. In the following part, we therefore first analyze the capital flows between parents and subsidiaries and thereafter the implications for the capital structure of parents of affected subsidiaries in more detail.

To summarize the findings in this section on the direct effects of the CCyB, we observe that increasing CCyBs imply a decrease in bank lending and loan riskiness while nonbank lending remains unchanged. These results are in line with the intention of the CCyB reciprocation mechanism aiming to ensure an international level playing field and to reduce risk spillover. Importantly, however, our results on borrower PD indicate that there are additional, indirect, effects which should also be considered. We therefore next turn to the parent companies located in Germany with no positive CCyB during our sample period to analyze indirect effects of a change in CCyBs for their subsidiaries abroad.

6 The Indirect Effects of the CCyB

In the second part of our analysis, we investigate the more indirect effects of CCyBs. As mentioned before, the aim of the CCyB is to reduce procyclicality of bank lending. Yet, this applies only nationally, i.e., only to the country of a firm to which a bank lends. However, as our previous results on bank portfolio risk already indicate, a larger CCyB in one country might also have implications for other firms despite a zero CCyB in their country of location. In this part, we therefore first ask whether subsidiaries in countries with a positive CCyB replace the decline in bank funding with internal MNC funds, and

if so, which entities within the MNC provide those additional funds. And second, we look into the external funding sources of these additional funds. By analyzing the redistribution of funds within the MNC network and the adjustment of external funding of MNCs we want to shed light on whether there are leakages in national CCyB regulation through multinational firms when the latter have access to internal capital markets.

6.1 Credit Substitution through Parents of Affected Subsidiaries

The previous section shows that subsidiaries obtain roughly 10 pp less bank credit in response to a 1 pp increase of the CCyB in their country of location. In the first part of our analyses in this section, we therefore first examine whether affected subsidiaries borrow more from their parent company when the CCyB increases. Our data allows us to distinguish internal funding of subsidiaries through either the parent or via other subsidiaries of the MNC. We use data at the individual firm level and again split the sample by including all subsidiaries and excluding subsidiaries with zero CCyB where another subsidiary of the MNC is subject to a positive CCyB. We examine the impact of CCyBs on subsidiaries' internal debt received from their parent company and investigate three different dependent variables: i) the logarithm of internal debt from the parent; ii) internal debt from the parent over total assets; and iii) internal debt from the parent over total liabilities. We thereby ensure that our results are not solely driven by changes in either firm size or firm leverage, or both. Comparable to our regressions before, we regress these dependent variables on our variable *CCyB rate*, which measures the level of the CCyB at this point in time in the country where a subsidiary is located, and different fixed effects. As regards our fixed effects, we control for firm demand for internal debt by including also industry times year:quarter fixed effects in the more rigid specification included in the even numbers of the table. Table 6 reports the results.

[*Table 6 around here*]

In all specifications, we find a positive and significant coefficient of the CCyB, suggesting that affected subsidiaries borrow more internal funds from their parent company. For instance, the results in column 6 indicate that subsidiaries in countries with a 1 pp higher CCyB fund themselves with a 1.9 pp relatively higher share of parental debt as a fraction of total liabilities. Here, again, the effect is somewhat stronger when the control group only includes subsidiaries of MNCs that have no further ties to other

positive CCyB countries (Panel B). As another example, the results in column (4) of Table 6 relate to an increase of 11.8% relative to the average. We rerun these analyses for the internal funding from other subsidiaries but do not observe any significances.[9] This suggests that parents substitute the decrease in bank funding in response to a larger CCyB in the country where a subsidiary is located.

In the second part of our analyses, we are interested in the degree of substitution of bank funding with parental debt. That is, we ask whether parents on average only partly or even fully substitute for the decrease of bank funding for affected subsidiaries.[10] We use the logarithm of subsidiaries' total liabilities as well as their total liabilities as a fraction of total assets as dependent variables and regress these again on our variable *CCyB rate* and fixed effects. Table 7 shows the regressions results for the overall impact of the CCyB on affected subsidiaries' total debt relative to the total debt of unaffected subsidiaries.

[*Table 7 around here*]

Table 7 does not reveal any significant effect of the CCyB on the overall leverage of affected subsidiaries. Irrespective of whether we compare affected subsidiaries with all other subsidiaries (columns (1) and (2)) or only with subsidiaries of MNCs that have no other subsidiaries located in countries with a positive CCyB (columns (3) and (4)), or whether we investigate the total volume of liabilities (columns (1) and (3)) or their value as a fraction of total assets (columns (2) and (4)), a larger CCyB on average does not change the total liabilities of firms. These findings indicate that funding through internal capital markets from parents fully compensates for the decline in cross-border bank funding in response to an increase of the CCyB. Considering firms which are part of an MNC we therefore would not expect any real effects due to changes in the CCyB because of its overall insignificant impact on firm leverage. Regarding banks, however, the CCyB seems to improve the loss absorption capacity of the banking system. So far, our results also suggest that the CCyB leads banks to reduce (the riskiness of) their lending to affected subsidiaries.

[9] We report the results in Appendix Table A3.

[10] In unreported tests, we do not observe any statistically significant impact of the CCyB on other sources of external funding, such as bonds.

6.2 Refinancing of the Parent

In this section, we are interested in the external funding sources of the additional funding the parents provide to their affected subsidiaries. The aim is to examine how parent companies refinance the increase in internal lending to their affected subsidiaries. The parent companies in our sample are all located in Germany which did not introduce a CCyB until the end of our sample period. In these analyses, we are able to rely on the population of parents borrowing from German banks as well as the population of parents of German MNC. This implies a much larger data sample on external borrowing from banks and nonbanks than in the previous section, as most German parents borrow from at last one German lender in contrast to their subsidiaries abroad. Comparable to our earlier analyses at the bank-firm-time level, we use the logarithm of bank credit and nonbank credit as dependent variables. We regress these on an indicator variable *Parent with affected subsidiary* which is one when a parent has a subsidiary with a positive CCyB in its MNC and zero otherwise, and the same set of fixed effects as in our most rigid specifications in Tables 2 and 3. Table 8 shows the results.

[*Table 8 around here*]

Table 8 confirms that parents of subsidiaries located in countries with a positive CCyB obtain relatively more external funding both from banks (columns (1) and (2)) and from nonbanks (columns (3) and (4)). Bank lending relatively increases by 5%, nonbank lending by 13.1%. In addition to this, we also investigate whether parents obtain more internal debt from subsidiaries but do not find this confirmed.[11] Taken together, our results show that affected subsidiaries borrow more from their parents while these parents obtain more funding from both banks and nonbanks to provide these funds. These results align with our earlier finding in Table 5 that the PD of parents increases in response to a larger CCyB for subsidiaries within their MNC. It indicates that the increase of the CCyB in one country might imply spillover effects to other countries when the two differ in their

[11] The results are shown in Appendix A4. For each parent, the data are only available at the aggregate subsidiary level. That is, we do not know whether the insignificant effect is due no change in borrowing from subsidiaries in general or due to opposite effects between affected and unaffected subsidiaries. It might e.g. be the case that parents borrow internally less from affected but more from unaffected subsidiaries, what we cannot rule out given our data.

level of the CCyB. It provides empirical evidence for a leakage of macroprudential policy through a reallocation of funding within MNCs.

In the last part of these analyses, we are interested whether lenders account for the riskiness of the individual borrowers when they shift their lending to parent companies in response to an increasing CCyB for subsidiaries of an MNC. That is, we are especially interested in the heterogeneity of our results as regards the creditworthiness of parents. We use the same regression specification as in Table 8 but additionally interact our indicator variable *Parent with affected subsidiary* with the PD of the parent in a given year:quarter. This setup allows us to investigate the main effect together with potential heterogeneities due to parent PD. Table 9 reports the results.

[*Table 9 around here*]

Table 9 shows that lenders account for the riskiness of parents when they provide additional funding to these. Both for the lending by banks and nonbanks, the coefficient of the interaction between *Parent with affected subsidiary* and the PD of the parent is statistically significant and negative. This confirms that lenders account for parent risk such that riskier parents can (only) obtain smaller amounts from both banks and non-banks. Thus, the scope for funding from parents of affected subsidiaries seems to be constrained by the creditworthiness of the parent. Two further insights from these results are worth mentioning when we look at the distribution of parent PDs. First, the effect on both bank and nonbank lending is larger for the least risky parents compared with the effect in Table 8 as these have PDs very close to zero. And second, the overall effect on the relative change in lending is positive for almost all parents with affected subsidiaries. For a zero or negative effect on bank (nonbank) lending, parents would need to have a PD of 2.18% (3.77%) or larger. This relates to an average (median) value in parent PD of 0.53% (0.25%) and a standard deviation of 1.32. In other words, taking into account the distribution of PDs of parents we observe that almost all parent companies except the very few ones in the right tail of the distribution obtain more bank as well as nonbank credit at least to some extent. Accordingly, the substitution of affected firms' bank borrowing is heterogeneous and depends on the riskiness of their parent companies. Thus, risk shifting of banks appears to be limited but it cannot be fully ruled out, though. It relates to earlier results in the first part of our paper – the increase in bank and nonbank

debt for most parents we observe in this section is in line with our earlier result on the increase in parent PD (Table 5).

The results in Table 9 indicate that riskier parents obtain less additional credit from banks and nonbanks. In the last part of these analyses we therefore investigate whether affected subsidiaries' substitution of bank credit with parental debt is also constrained by the creditworthiness of the parents. We repeat our analyses from Table 6 and additionally interact our main independent variable *CCyB rate* with the PD of the parent. That is, we again use data at the individual firm level and split the sample by including all subsidiaries and excluding subsidiaries with zero CCyB where another subsidiary of the MNC is subject to a positive CCyB. Our independent variables are: i) the logarithm of internal debt from the parent; ii) internal debt from the parent over total assets; and iii) internal debt from the parent over total liabilities. We control for firms' demand for internal debt by including industry times year:quarter fixed effects. To provide further confidence in the economic mechanism as well as our identification strategy, we also interact the variable *CCyB rate* with the PD of the subsidiary. This allows us to distinguish whether effects derive directly from the risk of the subsidiary or whether the risk of parents and the corresponding smaller additional external credit amounts for these translate into differences in internal funding provision to their affected subsidiaries. Table 10 reports the results.

[*Table 10 around here*]

The table confirms that the smaller additional lending amounts for riskier parents from banks and nonbanks translate into less additional internal credit to their affected subsidiaries. The variable *CCyB rate* is interacted with the PD of parents in columns (1), (3) and (5). The coefficient of this interaction term is negative and statistically significant in all of these specifications irrespective of how we measure internal debt or if we include all subsidiaries or only those with no other affected subsidiary in their MNC. Thus, Table 10 shows that the substitution of affected subsidiaries' cross-border bank funding with parental debt depends on the PD of their parent. In columns (2), (4) and (6), we interact the *CCyB rate* with the PD of the subsidiary instead to ensure that these results are not driven by a higher risk of affected subsidiaries. None of these regressions shows a significant coefficient. This adds to our identification strategy and supports our finding of the heterogeneity in parents' risk driving our results.

Figure 2 summarizes again the main results of our study regarding credit amounts. It shows that an increase of the CCyB of 1 pp in a country implies a decrease of cross-border bank credit to a subsidiary of an MNC of 8.6% while it does not change nonbank credit. This decrease in bank credit for affected subsidiaries is compensated with internal lending of parents which increases 31.2%, relating to an increase of 1.9 pp as a fraction of total liabilities. Parents finance this increase in internal lending by borrowing 5% more from domestic banks and 13.1% from domestic nonbanks. Affected subsidiaries on average do not borrow more from other subsidiaries and these other subsidiaries do not lend more to the parent. Note that for each firm we only have available the total internal credit from other subsidiaries but are not able to observe individual amounts from each subsidiary. This does not allow to distinguish whether parents borrow more from unaffected subsidiaries or not but only to analyze aggregate effects. In addition to the increase of domestic debt for parents both from banks and nonbanks, our results furthermore show a relative increase in parent PD in response to an increasing CCyB for a subsidiary within their MNC. This argues for spillover effects of CCyBs to other countries when the level of the CCyB differs between both countries. Our results show that macroprudential policy might leak through a reallocation of funds within internal capital markets of firms when CCyB levels are not harmonized across countries.

[*Figure 2 around here*]

7 Robustness

The literature on difference-in-differences estimation has recently evolved substantially. One concern regarding our statistical test might be the setup of a staggered and heterogeneous treatment (e.g., Callaway and Sant'Anna (2021); Sun and Abraham (2021); Athey and Imbens (2022)) and differential effects between early and later treated units (Goodman-Bacon (2021)). We address this potential concern by rather simple but also very intuitive tests.

Figure 1 shows that Norway was the first country to implement the CCyB on June 30th, 2015. Until the end of 2016, only Sweden additionally introduced the CCyB on September 13th, 2015. Given that we incorporate quarterly data, in a first test we only include the period until 2015:Q2. This implies that only firms located in Norway become

subject to the CCyB in the last quarter of this sample period. We rerun our regressions from Table 2 using credit from banks to subsidiaries and only include subsidiaries with no other subsidiary with a positive CCyB in their MNC. Table 11 reports the results.

[*Table 11 around here*]

Columns (1) to (5) replicate Panel B of Table 2 for the period 2013:Q1 until 2015:Q2. It confirms our results that a larger CCyB implies less cross-border lending to affected subsidiaries. As another test, we prolong this observation period until 2016:Q4 and both estimate the most rigid specification (from column (5)) including (column (6)) and excluding (column (7)) subsidiaries located in Sweden. Both Norway and Sweden increased their CCyB further in June 2016. Accordingly, column (6) includes only the two first treated countries where column (7) implies that only firms in one country are treated and effects are compared to all other countries with a zero CCyB. Irrespective of these choices, the main result is again confirmed.

8 Conclusion

The main objective of the CCyB is to increase banks' resilience to risks stemming from the financial cycle by enhancing their loss absorption capacity. As a secondary objective an increase of the CCyB might help to dampen excessive credit growth in the upswing of the financial cycle, thereby reducing the buildup of risks on banks' balance sheets. Automatic reciprocation is meant to limit international risk spillovers via banks and to contribute to a level playing field. According to our results, banks' (cross-border) risk exposure to firms in countries that have increased the CCyB declines – both in terms of lending and banks portfolio PD. At first glance, this suggests that reciprocity rules indeed seem to limit leakages.

At the same time, however, MNCs can circumvent the CCyB through their access to internal capital markets. We find that MNC affiliated firms subject to the CCyB offset the decline in bank funding by drawing more internal funds from their parents, which in turn increase external borrowing in the local market. The circumvention via banks is not complete, however, as the parent companies only partially refinance the additional internal loans with local bank debt but also increase their borrowings from non-banks. In

addition, the creditworthiness of the parents limits their ability to obtain additional external borrowing and thus also to extend internal credit to affiliated affected firms.

Importantly, our results show that estimated effects of CCyBs on the PD of firms have to be treated with caution when both parents and subsidiaries are included in the estimation. Parents of affected subsidiaries receive more bank and nonbank lending. This suggests that at least part of the difference-in-differences effect of the relative decline of affected subsidiaries' PD is due to the increase of the average PD of the parent. Thus, there is some risk shifting triggered by the increase of the foreign CCyB that spurs the rerouting of credit flows away from international bank lending to affected firms towards local bank lending to the parents of those firms in countries with a zero CCyB. The scope for this arbitrage and risk shifting depends on the relative regulatory stance between countries, the extent to which financial cycles are synchronized across countries, as well as on the share of bank lending to multinationals. If the redistribution of bank lending towards borrowers in countries with a zero CCyB is large enough to fuel a credit boom, authorities might respond by increasing the CCyB. This would reduce or even close the loopholes that exist for multinationals. In sum, comparable levels of CCyBs across countries would substantially limit the potential arbitrage opportunities for MNC.

We acknowledge that we cannot deduce from our findings the effect the CCyB may have on bank funding of standalone firms. Even a very small change in the relative price of bank funding and internal debt might lead to a shift in the funding mix of MNCs. In contrast, the bank funding of standalone firms might virtually be unaffected by an increase in the CCyB. It suggests that further research on the effects of macroprudential policy measures on the economy in general and on firms in particular is necessary.

References

Aggarwal, Raj and NyoNyo A. Kyaw. 2008. "Internal Capital Networks as a Source of Mnc Competitive Advantage: Evidence from Foreign Subsidiary Capital Structure Decisions." *Research in International Business and Finance*, 22(3), 409-39.

Aiyar, Shekhar; Charles W. Calomiris; John Hooley; Yevgeniya Korniyenko and Tomasz Wieladek. 2014. "The International Transmission of Bank Capital Requirements: Evidence from the UK." *Journal of Financial Economics*, 113(3), 368-82.

Aiyar, Shekhar; Charles W. Calomiris and Tomasz Wieladek. 2014. "Does Macro-Pru Leak? Evidence from a UK Policy Experiment." *Journal of Money, Credit and Banking*, 46, 181-214.

Athey, Susan and Guido W. Imbens. 2022. "Design-Based Analysis in Difference-in-Differences Settings with Staggered Adoption." *Journal of Econometrics*, 226(1), 62-79.

Auer, Raphael; Alexandra Matyunina and Steven Ongena. 2022. "The Countercyclical Capital Buffer and the Composition of Bank Lending." *Journal of Financial Intermediation*, Forthcoming.

Basel Committee on Banking Supervision. 2010. *Basel III: A Global Regulatory Framework for More Resilient Banks and Banking Systems*. Basel: Bank for International Settlements, Report.

____. 2022. *Buffer Usability and Cyclicality in the Basel Framework*. Basel: Bank for International Settlements, Report,

Baskaya, Yusuf Soner; Julian di Giovanni; Şebnem Kalemli-Özcan; José-Luis Peydro and Mehmet Fatih Ulu. 2017. "Capital Flows and the International Credit Channel." *Journal of International Economics*, 108, S15-S22.

Basten, Christoph. 2020. "Higher Bank Capital Requirements and Mortgage Pricing: Evidence from the Countercyclical Capital Buffer." *Review of Finance*, 24(2), 453–95.

Bednarek, Peter; Olga Briukhova; Steven Ongena and Natalja von Westernhagen. 2023. *Effects of Bank Capital Requirements on Lending by Banks and Non-Bank Financial Institutions*. Frankfurt DE: Deutsche Bundesbank, Mimeo.

Behn, Markus; Rainer Haselmann and Paul Wachtel. 2016. "Procyclical Capital Regulation and Lending." *Journal of Finance*, 71(2), 919-56.

Behncke, Stefanie. 2023. "Effects of Macroprudential Policies on Bank Lending and Credit Risks." *Journal of Financial Services*, 63(1), 175–99.

Benincasa, Emanuela; Gazi Kabas and Steven Ongena. 2021. *"There Is No Planet B", but for Banks There Are "Countries B to Z": Domestic Climate Policy and Cross-Border Bank Lending*. London UK: Centre for Economic Policy Research, Discussion Paper, 16665.

Berg, Tobias; Markus Reisinger and Daniel Streitz. 2021. "Spillover Effects in Empirical Corporate Finance." *Journal of Financial Economics*, 142(3), 1109-27.

Bernanke, Ben S. and Mark Gertler. 1989. "Agency Costs, Net Worth, and Business Fluctuations." *American Economic Review*, 79(1), 14-31.

Biermann, Marcus and Kilian Huber. 2023. *Tracing the International Transmission of a Crisis through Multinational Firms*. Cambridge MA: National Bureau of Economic Research, Working Paper, 31061.

Bridges, Jonathan; David Gregory; Mette Nielsen; Silvia Pezzini; Amar Radia and Marco Spaltro. 2014. *The Impact of Capital Requirements on Bank Lending*. London: Bank of England, Working Paper, 486.

Buch, Claudia M. and Linda S. Goldberg. 2017. "Cross-Border Prudential Policy Spillovers: How Much? How Important? Evidence from the International Banking Research Network." *International Journal of Central Banking*, 13(S1), 505-58.

Buettner, Thiess and Georg Wamser. 2013. "Internal Debt and Multinational Profit Shifting: Empirical Evidence from Firm-Level Panel Data." *National Tax Journal*, 66(1), 63-95.

Burietz, Aurore; Steven Ongena and Matthieu Picault. 2023. "Taxing Banks Leverage and Syndicated Lending: A Cross-Country Comparison." *International Review of Law and Economics*, 73, Forthcoming.

Callaway, Brantly and Pedro H. C. Sant'Anna. 2021. "Difference-in-Differences with Multiple Time Periods." *Journal of Econometrics*, 225(2), 200-30.

Calomiris, C.W. and R.G. Hubbard. 1990. "Firm Heterogeneity, Internal Finance and 'Credit Rationing'." *Economic Journal*, 100, 90-104.

Chen, David and Christian Friedrich. 2021. *The Countercyclical Capital Buffer and International Bank Lending: Evidence from Canada*. Ottawa ON: Bank of Canada, Staff Working Paper, 2021-61.

Damar, H. Evren and Adi Mordel. 2017. "International Banking and Cross-Border Effects of Regulation: Lessons from Canada." *International Journal of Central Banking*, 13(2), 35-64.

De Jonghe, Olivier; Hans Dewachter and Steven Ongena. 2020. "Bank Capital (Requirements) and Credit Supply: Evidence from Pillar 2 Decisions." *Journal of Corporate Finance*, 60, Forthcoming.

Degryse, Hans; Olivier De Jonghe; Sanja Jakovljevic; Klaas Mulier and Glenn Schepens. 2019. "Identifying Credit Supply Shocks with Bank-Firm Data: Methods and Applications." *Journal of Financial Intermediation*, Forthcoming.

Degryse, Hans; Liping Lu and Steven Ongena. 2016. "Formal, Informal or Co-Funding? Evidence on the Co-Funding of Chinese Firms." *Journal of Financial Intermediation*, 27(1), 31-60.

Deli, Yota D. and Iftekhar Hasan. 2017. "Real Effects of Bank Capital Regulations: Global Evidence." *Journal of Banking and Finance*, 82(1), 217-28.

Desai, Mihir A.; C. Fritz Foley and James R. Hines Jr. 2004. "A Multinational Perspective on Capital Structure Choice and Internal Capital Markets." *Journal of Finance*, 59(6), 2451-87.

Detragiache, Enrica; Paola G. Garella and Luigi Guiso. 2000. "Multiple Versus Single Banking Relationships: Theory and Evidence." *Journal of Finance*, 55(3), 1133-61.

Dewaelheyns, Nico and Cynthia Van Hulle. 2010. "Internal Capital Markets and Capital Structure: Bank Versus Internal Debt." *European Financial Management*, 16(3), 345-73.

Diamond, Douglas W. 1991. "Monitoring and Reputation: The Choice between Bank Loans and Privately Placed Debt." *Journal of Political Economy*, 99(4), 689-721.

Egger, Peter; Christian Keuschnigg; Valeria Merlo and Georg Wamser. 2014. "Corporate Taxes and Internal Borrowing within Multinational Firms." *American Economic Journal: Economic Policy*, 6(2), 54-93.

European Central Bank. 2020. *Cross-Border Spillover Effects of Macroprudential Policies: A Conceptual Framework*. Frankfurt DE: Financial Stability Committee Task Force on Cross-border Spillover Effects of Macroprudential Measures, Occasional Paper.

____. 2022. *Transmission and Effectiveness of Capital-Based Macroprudential Policies*. Frankfurt DE: European Central Bank, Financial Stability Report, May.

Farinha, Luisa A. and João A. C. Santos. 2002. "Switching from Single to Multiple Bank Lending Relationships: Determinants and Implications." *Journal of Financial Intermediation*, 11, 124-51.

Favara, Giovanni; Ivan Ivanov and Marcelo Rezende. 2021. "GSIB Surcharges and Bank Lending: Evidence from US Corporate Loan Data." *Journal of Financial Economics*, Forthcoming.

Feld, Lars P.; Jost H. Heckemeyer and Michael Overesch. 2013. "Capital Structure Choice and Company Taxation: A Meta-Study." *Journal of Banking and Finance*, 37(8), 2850-66.

Fraisse, Henri; Mathias Lé and David Thesmar. 2019. "The Real Effects of Bank Capital Requirements." *Management Science*, 66(1), 5-23.

Goldbach, Stefan; Jarle Møen; Dirk Schindler; Guttorm Schjelderup and Georg Wamser. 2021. "The Tax-Efficient Use of Debt in Multinational Corporations." *Journal of Corporate Finance*, 71, 102119.

Goodman-Bacon, Andrew. 2021. "Difference-in-Differences with Variation in Treatment Timing." *Journal of Econometrics*, 225(2), 254-77.

Greenstone, Michael; Alexandre Mas and Hoai-Luu Nguyen. 2020. "Do Credit Market Shocks Affect the Real Economy? Quasi-Experimental Evidence from the Great Recession and "Normal" Economic Times." *American Economic Journal: Economic Policy*, 12(1), 200-25.

Gropp, Reint; Thomas C. Mosk; Steven Ongena; Ines Simac and Carlo Wix. 2023. "Supranational Rules, National Discretion: Increasing Versus Inflating Regulatory Bank Capital?" *Journal of Financial and Quantitative Analysis*, Forthcoming.

Gropp, Reint; Thomas C. Mosk; Steven Ongena and Carlo Wix. 2019. "Bank Response to Higher Capital Requirements: Evidence from a Quasi-Natural Experiment." *Review of Financial Studies*, 32(1), 266-99.

Houston, Joel F.; Chen Lin and Y. U. E. Ma. 2012. "Regulatory Arbitrage and International Bank Flows." *Journal of Finance*, 67(5), 1845-95.

Imbierowicz, Björn; Jonas Kragh and Jesper Rangvid. 2018. "Time-Varying Capital Requirements and Disclosure Rules: Effects on Capitalization and Lending Decisions." *Journal of Money, Credit and Banking*, 50(4), 573-602.

Imbierowicz, Björn; Axel Löffler and Ursula Vogel. 2021. "The Transmission of Bank Capital Requirements and Monetary Policy to Bank Lending in Germany." *Review of International Economics*, 29(1), 144-64.

Irani, Rustom M.; Rajkamal Iyer; Ralf R. Meisenzahl and José-Luis Peydró. 2021. "The Rise of Shadow Banking: Evidence from Capital Regulation." *Review of Financial Studies*, 34(5), 2181-235.

Jakovljević, Sanja; Hans Degryse and Steven Ongena. 2015. "A Review of Empirical Research on the Design and Impact of Regulation in the Banking Sector." *Annual Review of Financial Economics*, 7(1), 423-43.

Jiménez, Gabriel; Steven Ongena; José-Luis Peydró and Jesús Saurina. 2017. "Macroprudential Policy, Countercyclical Bank Capital Buffers and Credit Supply: Evidence from the Spanish Dynamic Provisioning Experiments." *Journal of Political Economy*, 125(6), 2126-77.

Kashyap, A. and J. C. Stein. 2004. "Cyclical Implications of the Basel-Ii Capital Standards." *Federal Reserve Bank of Chicago Economic Perspectives*, 28, 18-31.

Khwaja, Asim Ijaz and Atif Mian. 2008. "Tracing the Impact of Bank Liquidity Shocks: Evidence from an Emerging Market." *American Economic Review*, 98(4), 1413-42.

Laeven, Luc and Alexander Popov. 2021. *Carbon Taxes and the Geography of Fossil Lending*. London UK: Centre for Economic Policy Research, Discusion Paper, 16745.

Lang, Jan Hannes and Dominik Menno. 2023. *The State-Dependent Impact of Changes in Bank Capital Requirements*. Frankfurt DE: European Central Bank, Working Paper, 2828.

Li, Sheng; Mrinal Mishra; Steven Ongena and Vasso Ioannidou. 2023. *Graduating from Group to Individual Loans, with the Help of Personal Guarantees*. Zurich CH: Swiss Finance Institute, Research Paper, 22-50.

McCann, Fergal and Conor O'Toole. 2019. "Cross-Border Macroprudential Policy Spillovers and Bank Risk-Taking." *International Journal of Central Banking*, 15(4), 267-311.

Miles, David; Jing Yang and Gilberto Marcheggiano. 2013. "Optimal Bank Capital." *Economic Journal*, 123(567), 1-37.

Mintz, Jack and Michael Smart. 2004. "Income Shifting, Investment, and Tax Competition: Theory and Evidence from Provincial Taxation in Canada." *Journal of Public Economics*, 88(6), 1149-68.

Modigliani, Franco and Merton H. Miller. 1958. "The Cost of Capital, Corporation Finance and the Theory of Investment." *American Economic Review*, 48(3), 261-97.

Ongena, Steven; Alexander A. Popov and Gregory F. Udell. 2013. ""When the Cat's Away the Mice Will Play": Does Regulation at Home Affect Bank Risk-Taking Abroad?" *Journal of Financial Economics*, 108, 727-50.

Ongena, Steven and David C. Smith. 2000. "What Determines the Number of Bank Relationships? Cross-Country Evidence." *Journal of Financial Intermediation*, 9(1), 26-56.

Paravisini, Daniel. 2008. "Local Bank Financial Constraints and Firm Access to External Finance." *Journal of Finance*, 63(5), 2161-93.

Peek, J. and E. S. Rosengren. 1995. "Bank Regulation and the Credit Crunch." *Journal of Banking and Finance*, 19(3), 679-92.

Repullo, Rafael and Javier Suarez. 2013. "The Procyclical Effects of Bank Capital Regulation." *Review of Financial Studies*, 26(2), 452-90.

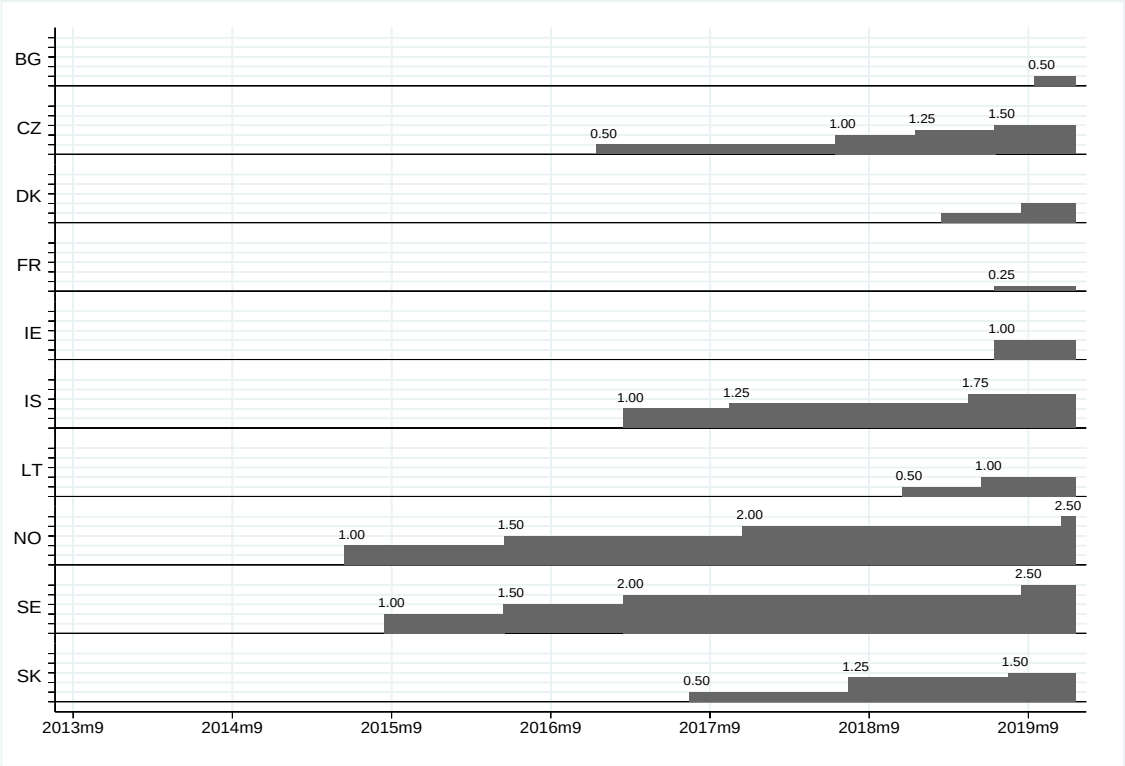
Santioni, Raffaele; Fabio Schiantarelli and Philip E Strahan. 2019. "Internal Capital Markets in Times of Crisis: The Benefit of Group Affiliation." *Review of Finance*, 24(4), 773-811.

Santos, João A. C. and Andrew Winton. 2008. "Bank Loans, Bonds, and Information Monopolies across the Business Cycle." *Journal of Finance*, 63, 1315-59.

Sun, Liyang and Sarah Abraham. 2021. "Estimating Dynamic Treatment Effects in Event Studies with Heterogeneous Treatment Effects." *Journal of Econometrics*, 225(2), 175-99.

Temesváry, Judit. 2018. "The Role of Regulatory Arbitrage in U.S. Banks' International Lending Flows: Bank-Level Evidence." *Economic Inquiry*, 56(4), 2077-98.

Figure 1: Countries with a positive CCyB during 2013 to 2019.



The figure shows the levels of CCyB rates per country for the period 2014 to 2019, including only sample countries with a positive CCyB rate during the sample period. The CCyB is defined as a percentage of risk-weighted assets in the country where the CCyB is set. Automatic reciprocity applies, i.e., foreign banks must also meet this capital requirement on their claims to borrowers in the respective country. The figure indicates each country using their ISO 3166-1 alpha-2 code. For an additional overview of CCyB rates implemented across countries see Appendix Table 1. Sources: ESRB, authors' compilation.

Figure 2: Summary of the Estimates.

The figure shows the estimated impact on the firms in a German MNC of a 1 percentage point change in a CCyB abroad.

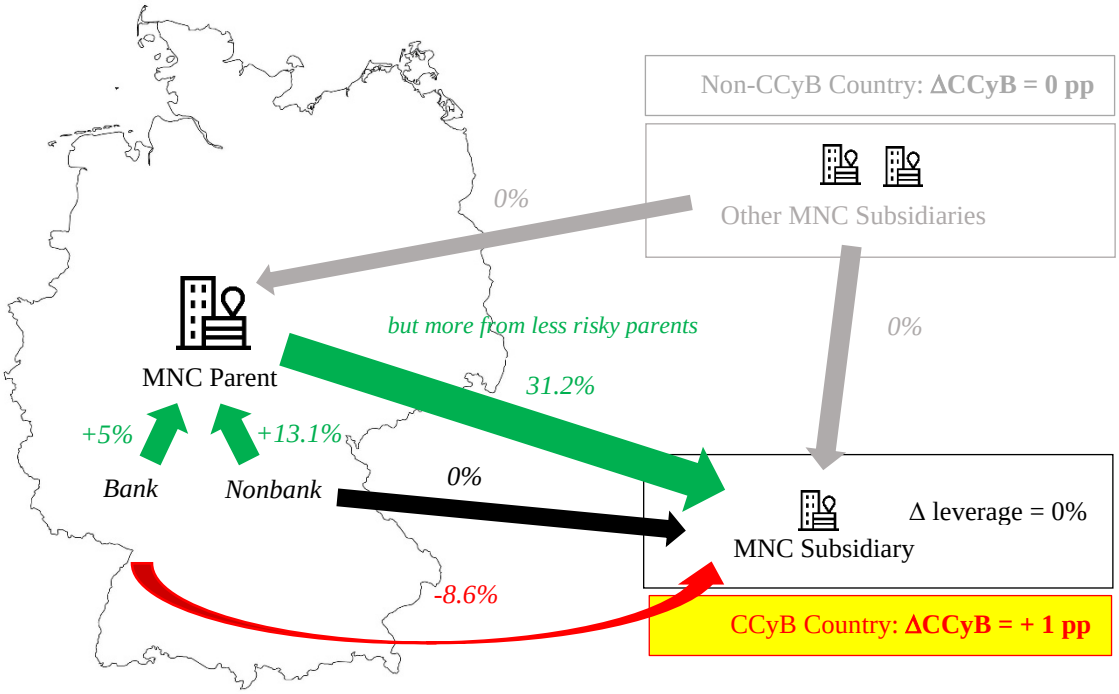


Table 1: The Effect of the CCyB on Bank Lending at the Aggregate Level

The table uses data aggregated to the bank-country-year:quarter level and shows regression results of the logarithm of the credit volume at the bank-country-year:quarter level on the level of the countercyclical capital buffer (CCyB) in percent and fixed effects. The sample period is 2013:Q1 to 2019:Q4. The data include all corporate borrowers of banks in Germany which are either a parent company in Germany or its subsidiaries abroad. The statistical significance of results is indicated by * = 10%-level, ** = 5%-level, and *** = 1%-level using heteroscedasticity-robust standard errors clustered at the bank and year:quarter level.

Credit volume of a bank in a given country

	Bank lending			
	(1)	(2)	(3)	(4)
CCyB rate (%)	-1.261***	-1.224***	-0.965***	-0.930***
	(-10.057)	(-11.005)	(-8.875)	(-8.269)
FIXED EFFECTS				
Year:quarter	No	Yes	Yes	Yes
Lender	No	No	Yes	Yes
Lender x Year:quarter	No	No	No	Yes
Observations	37,540	37,540	37,540	37,540
Adj. R-squared	0.035	0.058	0.409	0.291

Table 2: The Effect of the CCyB on Bank Lending

The table shows regression results of the logarithm of bank-firm credit on the level of the countercyclical capital buffer (CCyB) in percent and fixed effects, including only subsidiaries. Panel B includes only subsidiaries with no other subsidiaries in their MNC subject to a positive CCyB. The sample period is 2013:Q1 to 2019:Q4. The statistical significance of results is indicated by * = 10%-level, ** = 5%-level, and *** = 1%-level using heteroscedasticity-robust standard errors clustered at the firm-country and year:quarter level.

Panel A. All subsidiaries

	(1)	(2)	(3)	(4)	(5)
CCyB rate (%)	-0.260*	-0.113**	-0.055	-0.073*	-0.086***
	(-1.717)	(-2.591)	(-1.183)	(-1.874)	(-3.014)
FIXED EFFECTS					
Year:quarter	Yes	Yes	Yes	Yes	Yes
Firm	No	Yes	Yes	Yes	Yes
Industry x Year:quarter	No	No	Yes	Yes	Yes
Lender	No	No	No	Yes	Yes
Lender x Year:quarter	No	No	No	No	Yes
Observations	50,111	50,111	50,111	50,111	50,111
Adj. R-squared	0.017	0.792	0.794	0.845	0.842

Panel B. Excluding subsidiaries with other affected subsidiaries in the MNC

	(1)	(2)	(3)	(4)	(5)
CCyB rate (%)	-0.447**	-0.132***	-0.101*	-0.107**	-0.136***
	(-2.694)	(-3.060)	(-2.038)	(-2.708)	(-3.329)
FIXED EFFECTS					
Year:quarter	Yes	Yes	Yes	Yes	Yes
Firm	No	Yes	Yes	Yes	Yes
Industry x Year:quarter	No	No	Yes	Yes	Yes
Lender	No	No	No	Yes	Yes
Lender x Year:quarter	No	No	No	No	Yes
Observations	40,567	40,567	40,567	40,567	40,567
Adj. R-squared	0.012	0.806	0.809	0.848	0.844

Table 3: The Effect of the CCyB on Nonbank-lending

The table shows regression results of the logarithm of nonbank-firm credit on the level of the countercyclical capital buffer (CCyB) in percent and fixed effects, including only subsidiaries. Columns (3) and (4) include only subsidiaries with no other subsidiaries in their MNC subject to a positive CCyB. The sample period is 2013:Q1 to 2019:Q4. The statistical significance of results is indicated by * = 10%-level, ** = 5%-level, and *** = 1%-level using heteroscedasticity-robust standard errors clustered at the firm-country and year:quarter level.

Nonbank Lending

	All subsidiaries		Excluding subsidiaries with other affected subsidiaries in the MNC	
	(1)	(2)	(3)	(4)
CCyB rate (%)	-0.022	-0.053	-0.032	-0.060
	(-0.276)	(-0.703)	(-0.369)	(-0.687)
FIXED EFFECTS				
Time	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes
Industry x Year:quarter	Yes	Yes	Yes	Yes
Lender	Yes	Yes	Yes	Yes
Lender x Year:quarter	No	Yes	No	Yes
Observations	30,774	30,774	25,520	25,520
Adj. R-squared	0.777	0.772	0.790	0.784

Table 4: The Effect of the CCyB on the PD of Borrowers at the Aggregate Level

The table uses data aggregated to the bank-country-year:quarter level and shows regression results of the probability of default of bank borrowers on the level of the countercyclical capital buffer (CCyB) in percent and fixed effects. The sample period is 2013:Q1 to 2019:Q4. The data include all corporate borrowers of banks in Germany which are either a parent company in Germany or its subsidiaries abroad. The statistical significance of results is indicated by * = 10%-level, ** = 5%-level, and *** = 1%-level using heteroscedasticity-robust standard errors clustered at the bank and year:quarter level.

Probability of default of borrowers of a bank in a given country

	Probability of default (%)			
	(1)	(2)	(3)	(4)
CCyB rate (%)	-0.101***	-0.073***	-0.053***	-0.053***
	(-5.870)	(-5.203)	(-4.477)	(-4.445)
FIXED EFFECTS				
Year:quarter	No	Yes	Yes	Yes
Lender	No	No	Yes	Yes
Lender x Year:quarter	No	No	No	Yes
Observations	27,873	27,873	27,873	27,873
Adj. R-squared	0.009	0.046	0.224	0.138

Table 5: The Effect of the CCyB on the PD of Borrowers Within an MNC

The table shows regression results of the probability of default of bank borrowers on the level of the countercyclical capital buffer (CCyB) in percent and fixed effects. The sample period is 2013:Q1 to 2019:Q4. The data include only firms where a bank lends to both the parent and a subsidiary of the same MNC at the same point in time. Parent companies are based in Germany and accordingly have a zero CCyB over the sample period. Subsidiaries are based abroad. The statistical significance of results is indicated by * = 10%-level, ** = 5%-level, and *** = 1%-level using heteroscedasticity-robust standard errors clustered at the firm-country and year:quarter level.

Probability of default of borrowers of a bank within an MNC

	Probability of default (%)					
	Parents & Subsidiaries				Subsidiaries	Parents
	(1)	(2)	(3)	(4)	(5)	(6)
CCyB rate (%)	-0.089***	-0.102***	-0.096***	-0.083***	-0.035**	
	(-4.590)	(-4.530)	(-3.737)	(-4.540)	(-2.174)	
Parent with affected subsidiary						0.068***
						(3.077)
FIXED EFFECTS						
MNC	Yes	Yes	Yes	Yes	Yes	Yes
Year:quarter	Yes	Yes	Yes	Yes	Yes	Yes
Lender	No	Yes	Yes	Yes	Yes	Yes
MNC x Lender	No	No	Yes	Yes	Yes	Yes
Lender x Year:quarter	No	No	No	Yes	Yes	Yes
MNC x Lender x Year:quarter	No	No	No	Yes	Yes	No
Observations	16,480	16,480	16,480	16,480	4,499	7,704
Adj. R-squared	0.525	0.530	0.536	0.600	0.776	0.626

Table 6: The Effect of the CCyB on Internal Debt from the Parent

The table shows regression results of the logarithm of internal debt from the parent, the ratio of internal debt from the parent to total assets, and the ratio of internal debt from the parent to total liabilities on the level of the countercyclical capital buffer (CCyB) in percent and fixed effects, including only subsidiaries. Panel B includes only subsidiaries with no other subsidiaries in their MNC subject to a positive CCyB. The sample period is 2013:Q1 to 2019:Q4. The statistical significance of results is indicated by * = 10%-level, ** = 5%-level, and *** = 1%-level using heteroscedasticity-robust standard errors clustered at the firm-country and year:quarter level.

Panel A. All subsidiaries

	log(internal debt from parent)		internal debt from parent / total assets		internal debt from parent / total liabilities	
	(1)	(2)	(3)	(4)	(5)	(6)
CCyB rate (%)	0.261***	0.312***	0.007*	0.009**	0.017***	0.019***
	(4.464)	(4.472)	(2.019)	(2.400)	(4.517)	(4.745)
FIXED EFFECTS						
Year:quarter	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes
Industry x Year:quarter	No	Yes	No	Yes	No	Yes
Observations	53,050	53,050	53,050	53,050	52,945	52,945
Adj. R-squared	0.805	0.809	0.793	0.797	0.753	0.757

Panel B. Excluding subsidiaries with other affected subsidiaries in the MNC

	log(internal debt from parent)		internal debt from parent / total assets		internal debt from parent / total liabilities	
	(1)	(2)	(3)	(4)	(5)	(6)
CCyB rate (%)	0.280***	0.339***	0.007*	0.009**	0.021***	0.024***
	(4.555)	(3.398)	(1.901)	(2.076)	(5.378)	(4.463)
FIXED EFFECTS						
Year:quarter	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes
Industry x Year:quarter	No	Yes	No	Yes	No	Yes
Observations	46,727	46,727	46,727	46,727	46,630	46,630
Adj. R-squared	0.801	0.806	0.791	0.795	0.747	0.752

Table 7: The Effect of the CCyB on Total Liabilities of Subsidiaries

The table shows regression results of the logarithm of total liabilities, and the ratio of total liabilities to total assets on the level of the countercyclical capital buffer (CCyB) in percent and fixed effects, including only subsidiaries. Columns (3) and (4) include only subsidiaries with no other subsidiaries in their MNC subject to a positive CCyB. The sample period is 2013:Q1 to 2019:Q4. The statistical significance of results is indicated by * = 10%-level, ** = 5%-level, and *** = 1%-level using heteroscedasticity-robust standard errors clustered at the firm-country and year:quarter level.

	All subsidiaries		Subsidiaries, excl. subs. with other affected subs. in the MNC	
	log(liabilities)	liabilities / total assets	log(liabilities)	liabilities / total assets
	(1)	(2)	(3)	(4)
CCyB rate (%)	-0.017	-0.009	-0.021	-0.008
	(-0.421)	(-0.983)	(-0.498)	(-0.919)
FIXED EFFECTS				
Year:quarter	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes
Industry x Year:quarter	Yes	Yes	Yes	Yes
Observations	50,441	53,050	44,398	46,727
Adj. R-squared	0.930	0.897	0.931	0.901

Table 8: Refinancing of the Parent

The table shows regression results of the logarithm of bank-firm credit and nonbank-firm credit on an indicator variable which is one when a subsidiary of the MNC is located in a country with a CCyB and fixed effects, including only parents. The sample period is 2013:Q1 to 2019:Q4. The statistical significance of results is indicated by * = 10%-level, ** = 5%-level, and *** = 1%-level using heteroscedasticity-robust standard errors clustered at the year:quarter level.

	Bank lending		Nonbank lending	
	(1)	(2)	(3)	(4)
Parent with affected subsidiary	0.038**	0.050***	0.113***	0.131***
	(2.325)	(3.329)	(3.513)	(3.567)
FIXED EFFECTS				
Year:quarter	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes
Industry x Year:quarter	Yes	Yes	Yes	Yes
Lender	Yes	Yes	Yes	Yes
Lender x Year:quarter	No	Yes	No	Yes
Observations	137,365	137,365	32,764	32,764
Adj. R-squared	0.491	0.447	0.679	0.652

Table 9: Refinancing of the Parent by Riskiness

The table shows regression results of the logarithm of bank-firm credit and nonbank-firm credit on an indicator variable which is one when a subsidiary of the MNC is located in a country with a CCyB and fixed effects, including only parents. The indicator variable is additionally interacted with the probability of default of the parent in this quarter. The sample period is 2013:Q1 to 2019:Q4. The statistical significance of results is indicated by * = 10%-level, ** = 5%-level, and *** = 1%-level using heteroscedasticity-robust standard errors clustered at the year:quarter level.

	Bank lending		Nonbank lending	
	(1)	(2)	(3)	(4)
Parent with affected subsidiary	0.048***	0.061***	0.144***	0.162***
	(3.157)	(4.335)	(3.827)	(3.729)
Parent with affected subsidiary x PD_{Parent}	-0.022**	-0.028***	-0.044**	-0.043**
	(-2.409)	(-3.244)	(-2.220)	(-2.261)
FIXED EFFECTS & CONTROLS				
Base Effect	Yes	Yes	Yes	Yes
Year:quarter	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes
Industry x Year:quarter	Yes	Yes	Yes	Yes
Lender	Yes	Yes	Yes	Yes
Lender x Year:quarter	No	Yes	No	Yes
Observations	135,471	135,471	31,468	31,468
Adj. R-squared	0.483	0.436	0.660	0.630

Table 10: The Effect of the CCyB on Internal Debt from the Parent by Riskiness

The table shows regression results of the logarithm of internal debt from the parent, the ratio of internal debt from the parent to total assets (total liabilities) on the level of the CCyB in percent and fixed effects, including only subsidiaries. The CCyB is additionally interacted in the odd (even) columns with the probability of default of the subsidiary (parent) in this quarter. Panel B includes only subsidiaries with no other subsidiaries in their MNC subject to a positive CCyB. The sample period is 2013:Q1 to 2019:Q4. The statistical significance of results is indicated by * = 10%-level, ** = 5%-level, and *** = 1%-level using heteroscedasticity-robust standard errors clustered at the firm-country and year:quarter level.

Panel A. All subsidiaries

	log(internal debt from parent)		internal debt from parent / total assets		internal debt from parent / total liabilities	
	(1)	(2)	(3)	(4)	(5)	(6)
CCyB rate (%)	0.427***	0.541***	0.012**	0.017	0.027***	0.030***
	(4.222)	(3.219)	(2.517)	(1.351)	(4.011)	(4.291)
CCyB rate (%) x $PD_{Subsidiary}$	0.024		-0.000		-0.002	
	(1.072)		(-0.222)		(-0.957)	
CCyB rate (%) x PD_{Parent}		-0.205***		-0.009*		-0.010**
		(-4.363)		(-2.021)		(-2.720)
FIXED EFFECTS						
Base Effect	Yes	Yes	Yes	Yes	Yes	Yes
Year:quarter	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes
Industry x Year:quarter	Yes	Yes	Yes	Yes	Yes	Yes
Observations	32,698	20,041	32,698	20,041	32,650	20,023
Adj. R-squared	0.800	0.805	0.792	0.794	0.743	0.733

Panel B. Excluding subsidiaries with other affected subsidiaries in the MNC

	log(internal debt from parent)		internal debt from parent / total assets		internal debt from parent / total liabilities	
	(1)	(2)	(3)	(4)	(5)	(6)
CCyB rate (%)	0.447***	0.698***	0.012**	0.019	0.033***	0.040***
	(3.369)	(3.335)	(2.186)	(1.367)	(5.377)	(3.270)
CCyB rate (%) x $PD_{Subsidiary}$	0.029		-0.000		-0.002	
	(1.185)		(-0.154)		(-1.070)	
CCyB rate (%) x PD_{Parent}		-0.210***		-0.009*		-0.009*
		(-3.980)		(-1.925)		(-1.996)
FIXED EFFECTS						
Base Effect	Yes	Yes	Yes	Yes	Yes	Yes
Year:quarter	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes
Industry x Year:quarter	Yes	Yes	Yes	Yes	Yes	Yes
Observations	29,688	17,587	29,688	17,587	29,640	17,569
Adj. R-squared	0.798	0.807	0.794	0.804	0.739	0.749

Table 11: Robustness - The Effect of the CCyB on Bank Lending including only Early Treated Countries

The table shows regression results of the logarithm of bank-firm credit on the level of the countercyclical capital buffer (CCyB) in percent and fixed effects, including only subsidiaries with no other subsidiaries in their MNC subject to a positive CCyB. The sample period is indicated in the header of the table. The first five columns include the period 2013:Q1 until 2015:Q2, where Norway was the only country, which introduced the CCyB in 2015:Q2. Columns (6) and (7) include the period 2013:Q1 until 2016:Q4, where in addition to Norway only Sweden introduced the CCyB in 2015:Q3. Column (7) excludes all firms located in Sweden. The statistical significance of results is indicated by * = 10%-level, ** = 5%-level, and *** = 1%-level using heteroscedasticity-robust standard errors clustered at the firm-country and year:quarter level.

	Sample Period						
	2013:Q1 to 2015:Q2					2013:Q1 to 2016:Q4	
							excl. Sweden
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CCyB rate (%)	-0.412**	-0.425***	-0.414***	-0.430***	-0.540***	-0.252***	-0.329***
	(-3.220)	(-11.758)	(-5.750)	(-7.085)	(-5.566)	(-3.348)	(-5.904)
FIXED EFFECTS							
Year:quarter	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm	No	Yes	Yes	Yes	Yes	Yes	Yes
Industry x Year:quarter	No	No	Yes	Yes	Yes	Yes	Yes
Lender	No	No	No	Yes	Yes	Yes	Yes
Lender x Year:quarter	No	No	No	No	Yes	Yes	Yes
Observations	14,060	14,060	14,060	14,060	14,060	23,582	22,620
Adj. R-squared	0.000	0.848	0.848	0.885	0.882	0.860	0.861

Appendix

Table A1: List of Sample Countries and their CCyB rates

The table shows the countries of firms in the sample, whether these countries implemented a positive CCyB during 2013 to 2019, the maximum of the CCyB rate during the sample period, and the number of changes of the CCyB rate over this period. Source: ESRB website, authors' compilation.

Sample countries		positive CCyB rate during 2013-2019	max. CCyB rate	# of CCyB rate changes
AT	Austria	no	--	--
BE	Belgium	no	--	--
BG	Bulgaria	yes	0.50%	1
CY	Cyprus	no	--	--
CZ	Czech Republic	yes	1.50%	4
DE	Germany	no	--	--
DK	Denmark	yes	1.00%	2
EE	Estonia	no	--	--
ES	Spain	no	--	--
FI	Finland	no	--	--
FR	France	yes	0.25%	1
GR	Greece	no	--	--
HR	Croatia	no	--	--
HU	Hungary	no	--	--
IE	Ireland	yes	1.00%	1
IS	Iceland	yes	1.75%	3
IT	Italy	no	--	--
LT	Lithuania	yes	1.00%	2
LU	Luxembourg	no	--	--
LV	Latvia	no	--	--
MT	Malta	no	--	--
NL	Netherlands	no	--	--
NO	Norway	yes	2.50%	4
PL	Poland	no	--	--
PT	Portugal	no	--	--
RO	Romania	no	--	--
SE	Sweden	yes	2.50%	4
SI	Slovenia	no	--	--
SK	Slovakia	yes	1.50%	3
UK	United Kingdom	no	--	--

Table A2: Summary Statistics

The table provides descriptive statistics of variables for the sample period 2013 to 2019. Data on bank and nonbank lending is in quarterly frequency, data on firms in annual frequency. All variables are winsorized at the 1st and 99th percentile.

Panel A. Number lenders

Bank	1,075
Nonbank	446
Total	1,521

Panel B. Number borrowers

Subsidiary	3,676
Parent	702
Total	4,378

Panel C. Number borrower-lender relationships

	Bank	Nonbank	Total
Subsidiary	4,439	2,395	6,834
Parent	9,963	2,494	12,457
Total	14,402	4,889	19,291

Panel D. All firms

	Obs.	Mean	SD	p(5)	Median	p(95)
CCyB (%)	500,906	0.0219	0.1777	0.0000	0.0000	0.0000
Credit (thd.)	487,526	5,041	7,864	0.0000	2,000	29,559
PD (%)	436,053	0.7327	1.7809	0.0660	0.2950	2.3087

Panel E. Subsidiaries

	Obs.	Mean	SD	p(5)	Median	p(95)
CCyB (%)	110,926	0.0988	0.3675	0.0000	0.0000	1.0000
Credit (thd.)	97,546	3,397	7,139	0.0000	302	22,077
PD (%)	63,898	0.7160	2.1132	0.0300	0.1820	2.8970
Internal Debt / Total Assets	110,922	0.2122	0.2394	0.0000	0.1239	0.7268
Internal Debt from Parent / Total Assets	110,922	0.0763	0.1658	0.0000	0.0000	0.4821

Panel F. Parents (min. one subsidiary in sample)

	Obs.	Mean	SD	p(5)	Median	p(95)
CCyB (%)	185,554	0.0000	0.0000	0.0000	0.0000	0.0000
Credit (thd.)	185,554	5,847	8,423	8.0000	2,219	31,334
PD (%)	182,090	0.5771	1.4052	0.0824	0.2511	1.7100

Panel G. Variable descriptions

MNC	Multinational corporation, which consists of multiple firms.
Subsidiary	A company outside Germany which is part of an MNC and has a parent in Germany.
Parent	A company in Germany which is part of an MNC and has subsidiaries abroad.
Firm	An entity which is part of an MNC and can be either a parent or a subsidiary.
CCyB	The countercyclical capital buffer which applies to all bank-lending to firms located in the country where the CCyB is effective.
Credit	The amount of lending in € to a firm.
PD	The probability of default of a firm, calculated as the average over the individual PD estimates of all bank lenders to the firm in a given quarter.
Internal Debt	The internal lending between firms within an MNC.

Table A3: The Effect of the CCyB on Internal Debt from other Subsidiaries

The table shows regression results of the logarithm of internal debt from other subsidiaries, the ratio of internal debt from other subsidiaries to total assets, and the ratio of internal debt from other subsidiaries to total liabilities on the level of the countercyclical capital buffer (CCyB) in percent and fixed effects, including only subsidiaries. Panel B includes only subsidiaries with no other subsidiaries in their MNC subject to a positive CCyB. The sample period is 2013:Q1 to 2019:Q4. The statistical significance of results is indicated by * = 10%-level, ** = 5%-level, and *** = 1%-level using heteroscedasticity-robust standard errors clustered at the firm-country and year:quarter level.

Panel A. All subsidiaries

	log(internal debt from subsidiaries)		internal debt from subsidiaries / total assets		internal debt from subsidiaries / total liabilities	
	(1)	(2)	(3)	(4)	(5)	(6)
CCyB rate (%)	-0.026	-0.035	0.001	-0.002	-0.003	-0.004
	(-0.329)	(-0.455)	(0.343)	(-0.564)	(-0.586)	(-0.886)
FIXED EFFECTS						
Year:quarter	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes
Industry x Year:quarter	No	Yes	No	Yes	No	Yes
Observations	53,050	53,050	53,050	53,050	52,945	52,945
Adj. R-squared	0.854	0.856	0.832	0.835	0.765	0.769

Panel B. Excluding subsidiaries with other affected subsidiaries in the MNC

	log(internal debt from subsidiaries)		internal debt from subsidiaries / total assets		internal debt from subsidiaries / total liabilities	
	(1)	(2)	(3)	(4)	(5)	(6)
CCyB rate (%)	-0.013	-0.044	0.001	-0.002	-0.003	-0.005
	(-0.157)	(-0.537)	(0.462)	(-0.487)	(-0.485)	(-0.756)
FIXED EFFECTS						
Year:quarter	Yes	Yes	Yes	Yes	Yes	Yes
Firm	Yes	Yes	Yes	Yes	Yes	Yes
Industry x Year:quarter	No	Yes	No	Yes	No	Yes
Observations	46,727	46,727	46,727	46,727	46,630	46,630
Adj. R-squared	0.850	0.852	0.824	0.827	0.758	0.763

Table A4: Refinancing of the Parent

The table shows regression results of the logarithm of the lending of a subsidiary to the parent on the level of the countercyclical capital buffer (CCyB) in percent and fixed effects, including only subsidiaries with no other subsidiaries in their MNC subject to a positive CCyB. The sample period is 2013:Q1 to 2019:Q4. The statistical significance of results is indicated by * = 10%-level, ** = 5%-level, and *** = 1%-level using heteroscedasticity-robust standard errors clustered at the firm-country and year:quarter level.

	Lending to parent from subsidiary	
	(1)	(2)
CCyB rate (%)	-0.003	-0.003
	(-1.220)	(-1.223)
FIXED EFFECTS		
Year:quarter	Yes	Yes
Firm	Yes	Yes
Industry x Year:quarter	No	Yes
Lender	No	No
Lender x Year:quarter	No	No
Observations	46,727	46,727
Adj. R-squared	0.791	0.800