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The countercyclical capital buffer and the composition of bank lending

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ABSTRACT

Do targeted macroprudential measures impact non-targeted sectors too? We investigate the compositional changes in the supply of credit by Swiss banks, exploiting their differential exposure to the activation in 2013 of the countercyclical capital buffer (CCyB) which targeted banks' exposure to residential mortgages. We find that the additional capital requirements resulting from the activation of the CCyB are associated with higher growth in banks' commercial lending. While banks are lending more to all types of businesses, the new macroprudential policy benefits smaller and riskier businesses the most. However, the interest rates and other costs of obtaining credit for these firms rise as well.

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1. Introduction

In this paper, we examine the effect of the countercyclical capital buffer (CCyB) on the composition of the supply of credit by Swiss banks. In Switzerland, the CCyB was introduced into legislation in June 2012 as a targeted macroprudential policy. Upon its activation in February 2013, it targeted mortgage loans financing domestic residential property and required banks to set aside an additional 1 percent capital buffer against the portfolio of risk-weighted residential mortgages.

The effects of such a tailored macroprudential policy, however, may transcend beyond the targeted sectors or players. Other parts of the economy may be affected via the impact on the supply and resulting cost of credit. Despite the potential importance of such an indirect impact, neither the academic nor the policy literature has so far examined the spillover effects of targeted sectoral capital requirements in detail. In this paper, we fill this gap with an empirical study of both the direct and the indirect effects of the targeted CCyB activation on the composition of bank credit supply.

Our empirical strategy exploits the timing of the CCyB activation and the heterogeneous exposure of Swiss banks to the policy change. Although all Swiss banks were subject to the additional capital

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requirements implied by the CCyB, they were, in fact, affected differently in terms of the resulting additional capital requirements. This is the case because - as we show below - their exposure to the residential mortgage sector varied substantially. We capture this differential exposure by calculating a bank-specific share of residential risk-weighted assets (RWA) in a bank's total assets.

In our analysis, we employ two datasets to examine the effect of sectoral capital requirements on composition of bank lending. First, in an overview of the aggregate effect of the CCyB on the composition of banks' assets based on bank balance sheet data from the Bureau van Dijk's Bankscope database, we document that bank credit supply to the targeted sector responds as intended by the policy. We observe that the banks that are facing higher capital charges reduce the share of residential mortgages in their assets relatively more compared to less exposed banks. At the same time, already at the aggregate level, we observe that residential mortgages are replaced in the banks' portfolios with other types of loans. On balance, the result is that exposure to the CCyB is associated with a decline in the share of residential loan granting, but not with a decline in overall lending. Such a spillover effect, while possibly unintended by policymakers, does not necessarily undermine the rationale for the sectoral capital requirements. Our results reveal the multi-faceted impact of the targeted macroprudential measures that, if taken into account, can improve the resilience and capital allocation in both the targeted and non-targeted sectors.

Further, we perform our main analysis on the Lending Rate Statistics dataset – a credit register collected by the Swiss National Bank (SNB). The data on loan amounts, characteristics, and loan purpose allow us to study the compositional shifts in bank credit supply in response to the CCyB activation in detail. Performing our core analysis at the loan level allows us to control for a variety of factors, including, importantly, the change in credit demand. We additionally investigate the CCyB's impact on interest rates and other loan characteristics. In the analysis, we consider various periods, subsamples of borrowers and banks, and control for a large set of alternative mechanisms.

The loan-level analysis confirms that the CCyB activation, which was intended to curb mortgage lending to private households, also affects lending to corporates. In particular, banks with a higher share of residential RWAs relative to total assets lend more to corporations than banks with a lower share. The size of the effect is highly economically significant: we observe that a one-standard deviation increase in our CCyB exposure measure is associated with a 15-percentage point (pp) increase in a bank's corporate loan volume. Further examination of the compositional impacts reveals that smaller enterprises and riskier firms with lower credit ratings are the biggest beneficiaries of the shift in loan supply. However, larger enterprises see an increase in credit granted to them as well. Apart from some indications of a moderate shift towards construction-related firms, we do not observe any regional or industry compositional effects.

Although the availability of credit for corporate borrowers increases, the costs of obtaining credit increase as well. We observe an economically significant uptick in loan interest rates driven by lending to smaller and riskier borrowers. Another indicator of banks' intensified profit-seeking behavior we uncover is an increase in the one-time commissions that are charged for newly granted corporate loans.

The remainder of the paper is organized as follows. Section 2 discusses the context of the legislative change, the empirical challenges of the study, and the relationship to the literature. Section 3 presents the data. The following three sections 4, 5, and 6 discuss the estimated specifications and the results. Section 4 examines the volume of newly granted and outstanding loans and their characteristics, both at the bank and at the loan level. Section 5 examines the heterogeneity of the effects across firms, industries, and regions. Section 6 studies how a bank's capital position interacts with the CCyB's impact and Section 7 examines the timing of the impact. Section 8 concludes.

2. Background, identification challenges, and literature review

2.1. Background

The countercyclical capital buffer (CCyB) was introduced into Swiss legislation as a targeted macroprudential policy in June 2012. When activated, it requires banks to set aside capital according to a time-varying percentage on their *stock* of *risk*-weighted loans in the targeted sector.

On 13 February 2013, Switzerland's Federal Council decided to activate the CCyB, requiring banks to hold an additional 1 percent equity on loans secured against domestic residential properties. The rate of 1 percent was applicable from 30 September 2013 onwards and was increased to 2 percent on 30 June 2014 (see also Fig. 1).[1] Worth noting is that on 27 March 2020, the Federal Council effectively de-activated the CCyB, thereby reducing bank capital requirements to stimulate bank lending during the COVID-19 pandemic. Hence, the CCyB continues to be an actively used tool in the regulatory toolbox. This means that the CCyB is likely to be re-activated for one or more sectors in the future, at which point the impact of the initial CCyB activation that we document in this paper can help finetuning policy decisions.

In 2013, the CCyB activation had a large aggregate effect on capital requirements, although individual Swiss banks were very differently affected as their residential mortgage exposures differed substantially both in total amounts and, more importantly for our empirical strategy, in relative terms, eg as a percentage of their total assets. This is exemplified in Fig. 2, which shows the CCyB's size as a percentage of total risk-weighted assets (RWAs) at the end of 2014 for 15 large Swiss-domiciled banks. At the high end of the spectrum, the CCyB accounts for 1.22 percent of RWAs for Migros Bank, representing around a seventh of the bank's total regulatory core equity (CET1) requirement. At the low end of the spectrum, the CCyB is almost negligible.

These large pre-existing differences across banks in the relative importance of their residential mortgage lending (as a share of their total business) determine our empirical strategy. If the CCyB activation results in a shift in the structure of bank credit supply, this shift is hypothesized to be relatively more pronounced for banks with a higher proportion of lending to the targeted sector.

2.2. Identification challenges

To address the concern that the shift in bank lending after the CCyB activation could be driven by contemporaneous changes in credit demand, we perform our main empirical analysis on a loan-level dataset of credit granting maintained by the SNB. The data allow us to control for demand shocks with a with-in business estimator (*à la* Khwaja and Mian (2008)) and, thus, disentangle the policy's impact on the supply of bank credit from its impact on demand.

Our empirical investigation takes place in a stable setting where monetary policy was already fully committed to a different goal,[2] ie the

[1] For details see the Swiss National Bank's press releases on 13 February 2013 entitled "Countercyclical capital buffer: proposal of the Swiss National Bank and decision of the Federal Council" and on 23 January 2014 entitled "Swiss National Bank's proposal to increase the countercyclical capital buffer." The former proposal came into effect on 30 September 2013, while the latter came into effect on 30 June 2014.

[2] The SNB in its press release of 6 September 2011 stated that "the current massive overvaluation of the Swiss franc poses an acute threat to the Swiss economy and carries the risk of a deflationary development. The SNB is therefore aiming for a substantial and sustained weakening of the Swiss franc. With immediate effect, it will no longer tolerate a EUR/CHF exchange rate below the minimum rate of CHF 1.20. The SNB will enforce this minimum rate with the utmost determination and is prepared to buy foreign currency in unlimited quantities." The SNB discontinued the minimum exchange rate on 15 January 2015.

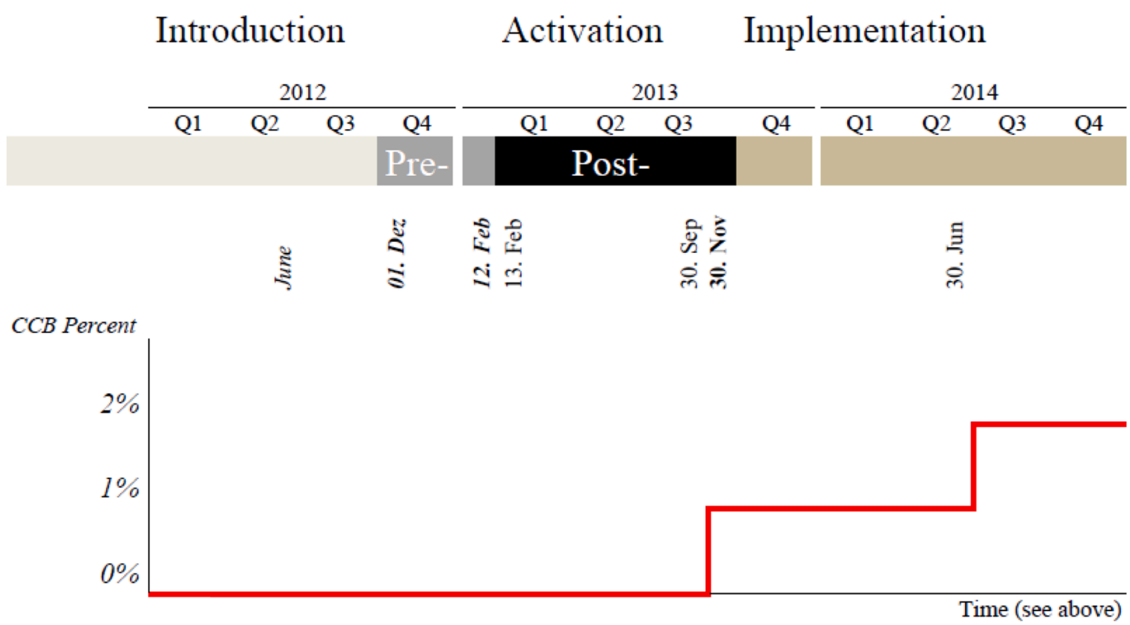

Fig. 1. Timeline of the Introduction, Activation and Implementation of the Countercyclical Capital Buffer in Switzerland. Notes: Switzerland's countercyclical capital buffer (CCyB), a targeted macroprudential policy, was introduced in June 2012 into Swiss legislation. On 13 February 2013, Switzerland's Federal Council decided to activate the CCyB, requiring banks to hold an additional 1 percent equity on loans secured against domestic residential properties. The rate of 1 percent was applicable from 30 September 2013 onwards and was increased to 2 percent on 30 June 2014, where it currently remains. In benchmark estimations the pre-period runs from 1 December 2012 to 12 February 2013 and the post-period from 13 February 2013 to 30 September 2013.

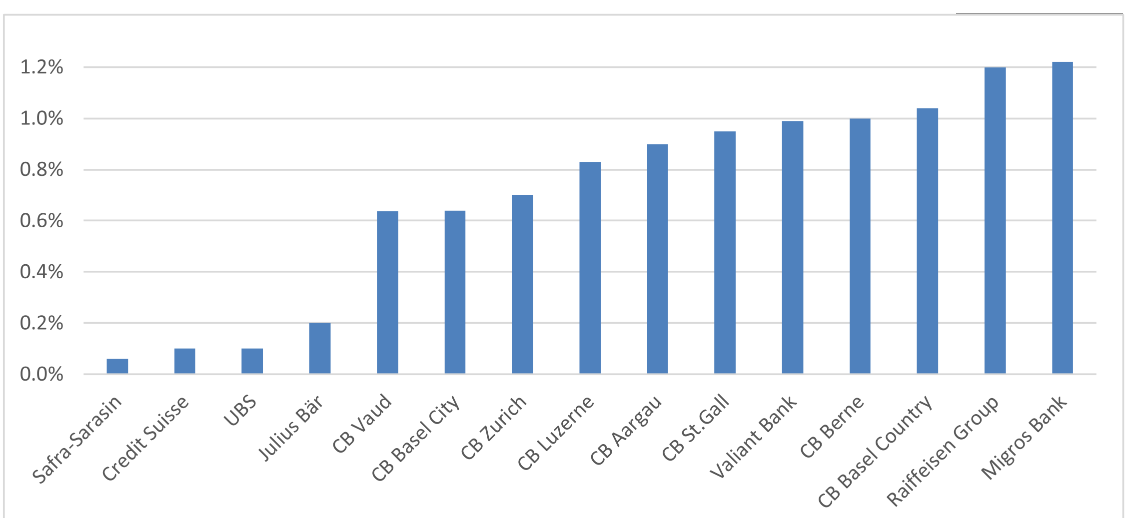

Fig. 2. The size of the Countercyclical Capital Buffer as percentage of total Risk Weighted Assets of 15 large Swiss-domiciled banks (end 2014). Notes: The Countercyclical Capital Buffer as percentage of total Risk Weighted Assets is measured as of end of 2014 and is collected from the bank's Annual Reports or the additional public Basel Pillar III Disclosure Reports. "CB" stands for Cantonal Bank.

maintenance of an exchange rate to promote price stability.[3]

However, the CCyB was not the only policy that was introduced in Switzerland during the period of investigation that could have affected residential and commercial lending. While using banks' heterogeneous exposure to the CCyB activation as an independent variable of interest partly addresses the concern that the documented shift in lending is driven by another concurrent policy innovation, we also perform the estimations for different periods to investigate the timing of the CCyB's impact. We do not observe the effect of interest in the pre-CCyB activation period. We also test whether our results are robust to the inclusion of other macroprudential policies. We include a bank-specific set of dummies for those banks that were subject to the Too-Big-To-Fail legislation. We further control for a bank-specific measure that captures the impact of a permanent increase in the risk-weighing for certain loans that occurred in January 2013 and the effect of which could be

[3] In other countries, the authorities may have imposed countercyclical capital buffers and changed their (conventional) monetary policy setting at the same time (see eg Aiyar, Calomiris and Wieladek (2016)), while in this case this did not occur. In this respect, the Swiss experience is singular and may serve as a unique opportunity to identify the national spillover effects of a targeted macroprudential policy.

correlated with the CCyB. We find that controlling for these additional measures does not alter our conclusions with regard to the CCyB's impact.

Another identification concern that we are facing in our analysis is that banks with different exposure to the CCyB differ also in other characteristics such as their general business model. Apart from controlling for banks' balance sheet characteristics, and in order to alleviate this concern, we estimate the effect of interest within different samples of banks and find similar effect through all the estimations.

2.3. Literature review

The contribution of our paper to the literature is to provide the first evidence of compositional effects of a prominent macroprudential policy. In this respect our paper is markedly different from extant work such as Igan and Kang (2011), Basten and Koch (2015), Jiménez, Ongena, Peydró and Saurina (2017) or Basten (2020), who can and/or do not study any compositional effects in sectors not directly regulated by the policy. Basten and Koch (2015) and Basten (2020), for example, examine the impact of the Swiss CCyB activation within the affected sector, particularly the impact on mortgage pricing.[4] They use data from the Comparis online platform that allow them to uniquely observe multiple offers per mortgage application. They find that capital-constrained and mortgage-specialized banks raise their rates relatively more, that risk-weighting schemes do not strengthen the effect of higher capital requirements, and that both CCyB-affected banks and CCyB-exempt insurers raise mortgage rates, but that insurers raise rates by an additional 8.8 basis points on average.

Jiménez, Ongena, Peydró and Saurina (2017) study the impact of the introduction and subsequent modifications of a related macroprudential policy, ie dynamic provisioning in Spain. While they do provide evidence of some heterogeneity in the impact of the policy change according to banks' and firms' characteristics, their setting does not allow them to study the direct and indirect effects of a targeted macroprudential policy since bank lending to all sectors was concurrently affected with changed provisioning requirements.

Our paper further complements Aiyar, Calomiris and Wieladek (2014) and Favara, Ivanov and Rezende (2021) who study how an increase in banks' capital requirements reduces banks' lending. Both focus on the reallocation of credit between affected and unaffected banks. Aiyar, Calomiris and Wieladek (2014) study bank-level data and find that following tighter capital requirements, regulated banks (ie UK-owned banks and resident foreign subsidiaries) cut back lending, while unregulated banks (ie resident foreign branches) may even increase it. Favara, Ivanov and Rezende (2021) study U.S. corporate loan data and find that additional capital requirements imposed on global systematically important banks (GSIBs) reduce credit to corporate borrowers. They also report that firms switch to non-GSIBs such that the capital surcharges do not have any impact on the firms. In contrast to both papers, rather than studying the "leakage" between banks, we look at compositional effects between affected and unaffected sectors within banks and using bank-firm-level data. As we start from sector-heterogeneous capital requirements, granular data allow us to investigate the reallocation of banks' lending across sectors to document any spillover effects.

While the two above-mentioned papers and our study focus on regulatory-driven re-allocation of credit within one country,[5] there is also an emerging literature on international regulatory arbitrage that manifests itself in credit flows between countries (Houston, Lin and Ma (2012)), 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)).[6] In all these cases – and perhaps not surprisingly – banks lend more, and take on more risk, in countries where regulations are laxer.

Finally, our paper differs in several crucial aspects from Behncke (2020), who similarly studies the effect of the CCyB introduction in Switzerland on bank lending and does not document an increase in commercial credit. First, rather than using quarterly bank-level data for our corporate lending analysis, we use monthly loan-level data. This data granularity allows us to control for credit demand by including business fixed effects into the specifications. Secondly, Behncke (2020) identifies the affected lenders with an indicator variable for banks in the highest quintile by the ratio of the amount of CCyB capital required over banks' excess capital, thus accounting not only for the banks' exposure to the new policy but also for their capital position. Such a treatment dummy assumes that well-capitalized banks do not respond to the CCyB activation. However, extant empirical evidence shows that financial institutions target and observably maintain a capital buffer above the combined requirements level (eg Berger, DeYoung, Flannery, Lee and Öztekin (2008), Bridges, Gregory, Nielsen, Pezzini, Radia and Spaltro (2014)). The assumption may therefore lead to an underestimation of the policy effect on lending. In this paper, we focus on a continuous measure of the banks' exposure to the new policy and, in Section 6, separately analyze its interaction with bank capitalization.

3. Data description

The main analysis in this paper is based on the SNB's Lending Rate Statistics dataset, which includes information on the volume and characteristics of all commercial loans exceeding CHF 50,000 and granted by Swiss banks, to non-financial domestic companies, with loans exceeding CHF 2 billion. The dataset is updated monthly, and the reporting entity is determined by the locational principle, i.e., Swiss branches.

The Lending Rate Statistics include information on a very broad set of loan characteristics. On loan pricing, the data include information on the initial interest rate charged, on whether the rate is fixed or variable, and on the extra commission fees (if any). The data include information on the loan's amount, and on its payout and payback structure. Additional information is provided on the (subjective) risk rating of the individual credit and the firm as entered by the loan officer, whether the loan was collateralized and, if so, what type of collateral was used, and whether the loan was insured and under what conditions. For our purposes, it is also important that the data include information on the loan's

[4] Fischer and Zachmann (2018) assess the differential impact on house prices of self- and bank-financed investment faced with the application of the CCyB. Ferrari, Pirovano and Rovira Kaltwasser (2017) study the impact of a sectoral capital requirement on mortgage spreads in Belgium.

[5] Other related work investigates changes in monetary conditions on bank lending along credit risk (eg Dell'Ariccia, Laeven and Marquez (2014), Jiménez, Ongena, Peydró and Saurina (2014), Ioannidou, Ongena and Peydró (2015)), currency denomination (eg Ongena, Schindele and Vonnák (2021)), or loan type (eg Chakraborty, Goldstein and MacKinlay (2020)), the impact of bank funding shocks on credit re-allocation (eg De Jonghe, Dewachter, Mulier, Ongena and Schepens (2020)), the impact of changes in bank capital requirements on bank equity and asset composition (Gropp, Mosk, Ongena and Wix (2019), Wold and Juelsrud (2020)), lending to firms (eg Mayordomo and Rodríguez-Moreno (2018), De Jonghe, Dewachter and Ongena (2020), Bichsel, Lambertini, Mukherjee and Wunderli (2021)) or lending outside the regulatory perimeter (Irani, Iyer, Meisenzahl and Peydró (2021)), and the impact of the taxation of leverage (Célérier, Kick and Ongena (2020)) or a financial crisis (eg Chodorow-Reich (2014)) on bank lending and the real economy.

[6] See also Buch and Goldberg (2017) and other papers in the special issue of the *International Journal of Central Banking*, for example Auer, Ganarin and Towbin (2017) for the case of Switzerland.

purpose – we know whether the loan was real estate related.

We note that, due to the confidentiality of the credit register data, the dataset does not include unique firm identifiers for all firms. However, it does include information on the characteristics of the borrower such as its industry (79 different two-digit industry codes based on NOGA 2008, the *Nomenclature Générale des Activités économiques* 2008), location by canton (ie 26 distinct categories), size in terms of employment (five different categories), (subjective) rating entered by the loan officer (five different categories), and balance sheet size (six different categories). The combination of these firm characteristics in effect spans up to 308,100 different "business" categories, into which each of the 577,847 different firms that existed in Switzerland in 2013 (of which only a fraction takes out loans over 50,000 CHF) can be slotted.

In Table 1, we present an overview of the loans that were issued during the baseline period we examine (from 2012:07:01 to 2013:11:30). The first four rows focus on the initial interest rate charged.[7] The statistics are respectively reported for a) the entire sample, b) for those loans with a fixed rate of interest, c) for loans with a variable rate with a LIBOR benchmark, and d) for loans that are collateralized. The next three rows summarize the maximum loan size (most loans are at their maximum size when issued), which averages roughly CHF 1.75 million. Loans range in size from CHF 50,000 in the first percentile to CHF 23 million in the 99th percentile.[8] Around 81 percent of the loans are paid out in a lump sum, and 71 percent of the loans have a fixed maturity. Whether a loan has a lump sum payout or is fixed-term does not seem to have a large effect on its amount.

For the 82,310 loans that do have a fixed maturity, the average maturity is over two years (maturity is counted in calendar days, not business days), with the 1st and the 99th percentile ranging from just under a month to 10 years. Of the fixed-term loans, 85 percent are paid back in a single amount at the loan maturity date ("balloon repayment"), whereas the rest are amortized over time. Last, for 17 percent of the loans, banks charge not only an interest rate, but also an upfront fee that averages 1.03 percent of the maximum size of such loans.

In Online Appendix A, we present loan summary statistics by firm size (as measured by number of employees) and by loan type.

Table 2 presents an overview of loan characteristics for all loans issued before the CCyB activation and afterwards. Columns (1) and (2) show the mean and media characteristics of loans issued between 2012:07:01 to 2013:02:12, and Columns (3) and (4) present the same information for the loans issued between 2013:02:13 to 2013:11:30.

We augment the Lending Rate Statistics with bank-level data containing detailed information on all balance sheet items from the SNB's monthly banking statistics, which include detailed monthly information on all balance sheet items of all individual banks domiciled in Switzerland. Further we complement the data with information on the bank's equity, the equity requirements set by the regulator, risk-weighted assets (also those related to residential mortgages) from the publicly available Basel Pillar III disclosure reports that are mandatory for all Swiss banks. From the latter data, we construct our main measure of how a given increase in the CCyB variously affects different banks.

The main independent variable we construct is the CCyB's bank-specific size as a fraction of its total balance sheet. For each individual bank indexed b we therefore calculate the Relative Residential Risk-Weighted Assets ($RRRWA_b$) as:

$$RRRWA_b \equiv \frac{RRWA_b}{Domestic\ Banksize_b}$$

where $RRWA_b$ is the bank-specific amount of Residential Risk-Weighted Assets, and $Domestic\ Banksize_b$ is equal to total Swiss assets of each bank (ie the balance sheet size of the Swiss branches of each banking company). The residential risk-weighted assets comprise mainly the mortgages granted to private households. Calculated in this way, *RRRWA* thus measures the residential risk-weighted assets as a fraction of each bank's balance sheet.

We note that *RRRWA* changes over time as the risk-weighting of selected loans and each bank's portfolio might also change over time.[9] All the estimations below account for these changes of *RRRWA*. Over the course of the entire sample, the median *RRRWA* is around 20 percent, ie risk-weighted assets make up about a fifth of the typical bank's balance sheet size. Further, there is substantial heterogeneity in *RRRWA* in the cross section, with the first percentile of *RRRWA* being equal to 1.5 percent and the 99th percentile equal to 32 percent. For easier interpretation, we standardize *RRRWA*.

4. Changes in the volume and characteristics of bank lending

In this section, we examine how the volume of loans granted and their characteristics change with the CCyB activation on 13 February 2013. We are particularly interested in the response of the volume and various other characteristics of the loans granted to individual borrowers (indexed by f). In our baseline model, we adopt a difference-in-differences approach and examine changes in the issuance of newly granted loans (or other dependent variables of interest). We specifically assess the extent to which individual banks are impacted by the CCyB activation as reflected in subsequent changes in loan issuance.

The main independent variable we construct is the CCyB's bank-specific impact as a fraction of its total balance sheet. For each individual bank indexed b we therefore calculate the Relative Residential Risk-Weighted Assets ($RRRWA_b$) as defined above., , ,

4.1. A first look at the main patterns in the data

To get a first sense of the salient patterns in the data, and before presenting the regression analysis that can properly account for the dynamics of loan demand, we document how overall loan characteristics evolved around the date of the CCyB activation.

Table 3 shows that, with the announcement of a positive CCyB rate, loan origination shifts to banks that are characterized by a high RRRWA. Further, the interest rate charged for the loans by high-*RRRWA* banks increases compared to the one charged by low *RRRWA* banks.

The table presents summary statistics of how the volume of loans and the average interest rate charged differ between banks with an above-median *RRRWA* and banks with below-median *RRRWA* around the initial announcement of a positive CCyB rate on February 13, 2013. Columns (1A) and (1B), respectively, tabulate the share of loans that were issued by such banks before and after 13 February 2013. In Row (i) that share is calculated for five business days before or after the CCyB announcement, while in Row (ii) a three-month window is chosen. Column (2) presents the difference in the interest rates charged by high-*RRRWA* banks and low-*RRRWA* banks.

The picture which emerges from Table 3 is that banks that are

[7] The interest rate is expressed as a percentage and is the rate charged on the date the first loan payout is made (or, in the case of a credit line, on the first date at which a loan payout could be requested). We report the mean rate and the median rate, as well as the first and the 99th percentile. Due to data confidentiality reasons, we cannot report the minimum or the maximum rates.

[8] Note that our data only include loans that exceed CHF 50,000 at the time of granting. Because the data presented here represent monthly averages and loan amortization can start as early as the month of origination, we observe outstanding amounts that are lower than CHF 50,000.

[9] In particular, the risk-weighting for the loan tranche of residential mortgages that exceeds a loan-to-value ratio of 80% was revised in early 2013.

Table 1
Data summary: Loan characteristics of all loans issued during 01.07.2012 to 30.11.2013

	(1) Number of Observations	(2) Mean	(3) Median	(4) 1st Percentile	(5) 99th Percentile
	Initial interest rate (in percent)				
All loans	115,709	2.26	1.70	0.41	7.50
Fixed rate loans only	73,149	1.62	1.45	0.40	4.40
Variable loans with libor benchmark	13,327	1.06	1.00	0.38	2.56
For loans that are collateralized	96,027	1.96	1.51	0.40	6.50
	Loan size (in 1,000 CHF)				
All loans	115,709	1,748.9	400.00	50	23,130
Loans with lump sum payouts	93,664	1,974.5	500.00	50	25,000
Fixed-term loans	82,310	2,196.4	570.00	52	26,130
	Maturity (in calendar days)				
All loans with fixed maturity	82,310	781.11	182	28	3,655
Fixed maturity loans with lump sum payback	70,198	665.00	92	28	3,654
	Loans with commission:				
rate in %	19,774	0.96	1.00	0.76	1.49

Table 2
Data summary: Loan characteristics before and after the CCyB activation

	(1)	(2)	(3)	(4)
	Before CCyB 01.07.2012 - 12.02.2013		After CCyB 13.02.2013 - 30.11.2013	
	Mean	Median	Mean	Median
	Initial interest rate (in percent)			
All loans	2.20	1.60	2.33	1.83
Fixed rate loans only	1.61	1.41	1.66	1.51
Variable loans with libor benchmark	1.07	0.99	1.07	1.00
For loans that are collateralized	1.89	1.47	2.05	1.65
	Loan size (in 1,000 CHF)			
All loans	1,807	450	1,693	385
Loans with lump sum payouts	1,996	500	1,932	498
Fixed-term loans	2,186	600	2,159	500
	Maturity (in calendar days)			
All loans with fixed maturity	790	181	796	185
Fixed maturity loans with lump sum payback	667	92	687	94
Loans with commission: rate in %	0.98	1.00	0.94	1.00

Table 3
Loan granting by high and low-*RRRWA* banks, before and after the CCyB announcement

	(1) **share of loans** issued by high *RRRWA* Banks			(2) **difference IR in basis points** high *RRRWA* - low *RRRWA* Banks		
	(1A) Before 13.2	(1B) On or after 13.02	**(1B)-(1A) Difference**	(2A) Before 13.2	(2B) On or after 13.02	**(2B)-(2A) Difference**
Sample is all new loans issued during:						
(i) one week before or after 13.02:	45.02%	48.05%	**3.02%**	–8.1	–1.6	**6.5**
(ii) 3 months before or after 13.02:	50.24%	51.16%	**0.91%**	–11.4	3.2	**14.6**

Notes: This table presents summary statistics of how the volume of loans and the average interest rate charged differed between banks with high *RRRWA* and banks with low *RRRWA* around the initial announcement of a positive CCyB rate on February 13, 2013. *RRRWA* is as constructed in the main text and high-*RRRWA* is defined as an above-median *RRRWA* rate in the pre-CCyB announcement period. Columns 1A and 1B, respectively, tabulate the share of loans that was issued by such banks before and after February 13, 2013. In row (i) that share is calculated for 5 business days before or after the CCyB-announcement, while in row (ii) a 3-month window is chosen. Column (2) presents the difference in the charged interest rate by high-*RRRWA* banks and low-*RRRWA* banks.

particularly affected by the CCyB not only expand their commercial lending, but also charge a higher interest rate for such loans. In the next section, we establish that this result is not driven by changes in the composition of borrowers and that it is robust to a variety of specifications. We also dig into the cross-section of customers to seek the correct interpretation of this finding.

But before “going down” to loan-level data, we first study the compositional effects at the bank level. We conduct our analysis by examining the response of the composition of loans on banks’ balance sheets in a sample of 94 Swiss Banks for which we can consistently construct one-year lagged balance sheet controls over the period from 2010 to 2014.[10]

Following the activation of the CCyB, banks with a high exposure (ie high level of residential mortgages) react much stronger to the

[10] This bank-level part of our analysis uses standard balance sheet data from Bankscope. To achieve a more comprehensive coverage of Swiss banks we resort to using a 2015-based RRRWA because only 34 (larger) banks did so for 2012. For this set of banks, the correlation coefficient between the 2012 and 2015 measures equals 0.96. For the loan-level exercise (in the subsequent section) which relies on credit register data filed by the larger banks we can use the 2012 measure.

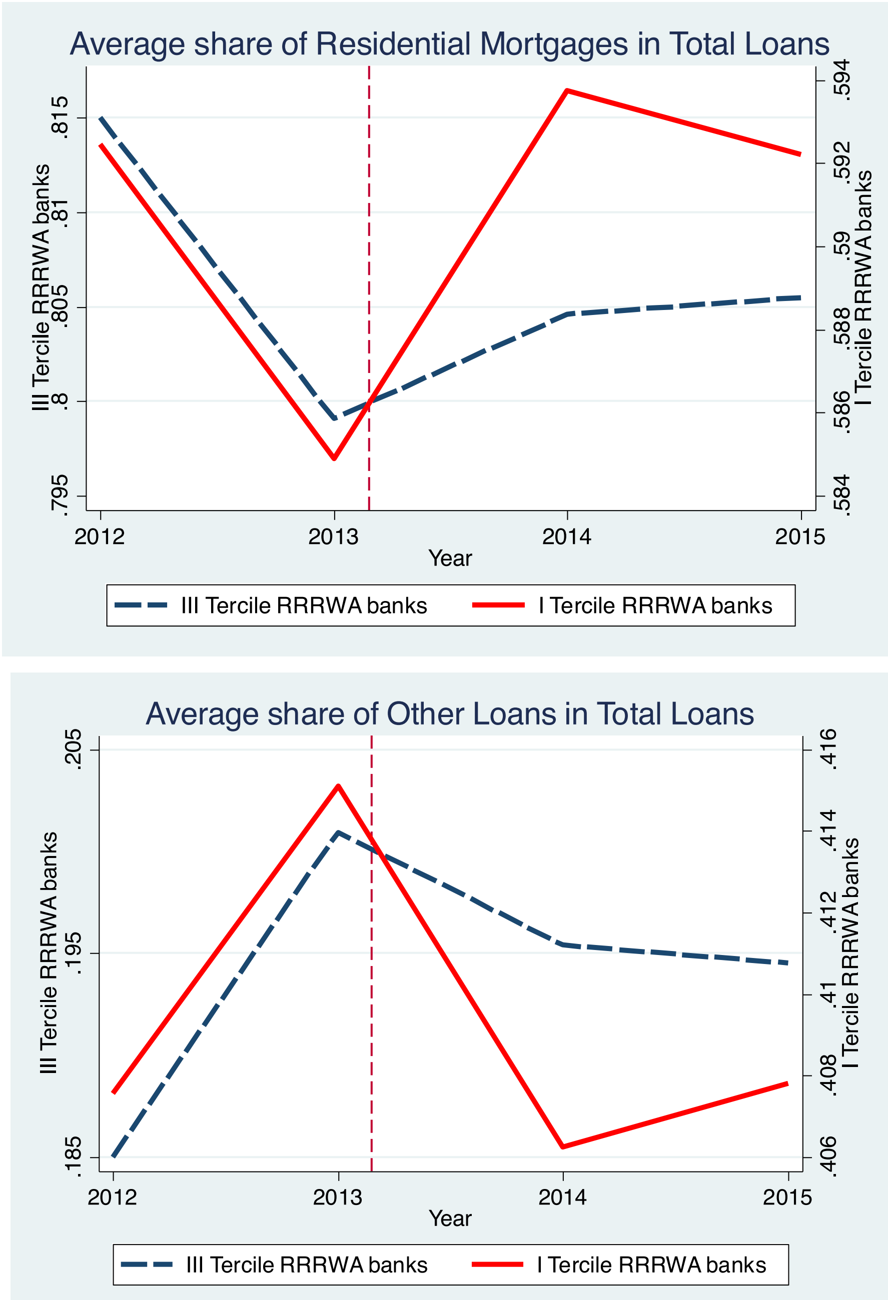

Fig. 3. The dynamic of the average share of the mortgage and non-mortgage loans in total loans of more affected banks and less affected banks. Note: the graphs depict the dynamic over time of the average shares of mortgage and non-mortgage loans in the banks' total loan portfolios for two groups of banks in our sample: the banks in the third tercile by Relative Residential Risk-Weighted Assets (RRRWA), who are relatively more exposed to the CCyB activation, and the banks in the first RRRWA tercile, who are relatively less exposed. The data points represent start of the year values. The dashed red line approximately indicates February 2013.

introduction of the CCyB and rebalance their loan portfolios towards commercial loans more than those banks with only little exposure. Fig. 3 depicts this trend graphically by plotting the average shares of various loan types for more CCyB-exposed banks versus less CCyB-exposed banks.

We next study the change in banks' loan portfolios composition in a panel dataset by estimating a difference-in-differences model where the dependent variables are the shares of different types of bank loans in total assets.

In Columns (1) and (5) of Table 4, the dependent variable is the share of the volume of residential mortgages in the total assets, estimated for each bank annually as follows:

$$\text{Share of Residential Mortgages}_{tb} = \frac{\textit{Residential Mortgages}_{tb}}{\textit{Total Assets}_{tb}} \tag{1}$$

Other dependent variables – the share of loans other than residential mortgages in total assets, share of these other loans in total loans, and share of all loans in total asset – are calculated analogously.

The estimation for Column (1) is then:

$$\text{Share of Residential Mortgages}_{tb} = \alpha_b + \mu_t + \beta Post_t \times RRRWA_b + \gamma X_{bt-1} + \varepsilon_{tb} \tag{2}$$

The model includes bank and year fixed effects as well as an array of bank balance sheet controls lagged by one year (X_{bt-1}) such as banks' size, profitability, leverage, balance sheet liquidity, share of interbank funding, and bank type dummy indicating whether a bank is a cantonal bank or not. The coefficient of interest β captures the change in the composition of banks' assets after the CCyB was activated in early-2013 till the end of 2014 when the available data end.

At first sight, the evidence in Column (1) documents the intended impact of the CCyB: it reduces residential loan-granting more strongly for banks more exposed to the CCyB. The coefficient estimated in

Table 4
The impact of the CCyB on the composition of banks' balance sheet

VARIABLES	(1) Share of Residential Mortgages to TA	(2) Share of Other Loans to TA	(3) Share of Other Loans to Total Loans	(4) Share of All Loans to TA	(5) Share of Residential Mortgages to TA	(6) Share of Other Loans to TA	(7) Share of Other Loans to Total Loans	(8) Share of All Loans to TA
Post x RRRWA	-0.0087*	0.0151***	0.0201***	0.0064				
	[0.005]	[0.005]	[0.007]	[0.004]				
Post x High RRRWA					-0.0207**	0.0253***	0.0312***	0.0046
					[0.009]	[0.008]	[0.011]	[0.005]
Balance sheet controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Post x Bank Type	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank and Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	470	470	470	470	470	470	470	470
R-squared	0.051	0.063	0.066	0.084	0.055	0.063	0.064	0.076

Notes: This table examines at the bank-level how the change in the share of residential mortgage loans in total assets, share of other loans in total assets and share of all loans in total assets was determined by the bank's Relative Residential Risk Weighted Assets (RRRWA) at the end of 2012. RRRWA is standardized with zero mean and unit variance. RRRWA is as constructed as a bank-specific share of residential risk-weighted assets (RWA) in the bank's total assets, and High-RRRWA is defined as an above-median RRRWA rate in the pre-CCyB activation period. The data covers years from 2010 to 2014. The balance sheet controls are lagged one year and include bank size (log of total assets), profitability (return on equity), leverage (equity over total assets), liquidity (liquid assets over total assets), and share of interbank funding (sum of interbank borrowing over total assets). Bank Type is a dummy that indicates whether a bank is cantonal or not. Post is a dummy that indicates period after the CCyB activation (2013-2014). Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Column (1) implies that a one-standard deviation increase in RRRWA is associated with a 0.87 pp reduction in the share of residential mortgages in the banks' total assets. However, in Column (2), we also observe that the share of other loans to total assets of more affected banks simultaneously increases by 1.5 pp. Overall, more affected banks rebalance their loan portfolios towards non-residential mortgage types of loans by 2 pp (Column (3)). At the same time, we do not find any effect of the CCyB activation on the share of all loans to total assets (Column (4)).[11] These observations indicate that the banks more affected by the CCyB rebalance their loan portfolios towards non-residential mortgage types of loans rather than merely cutting residential mortgage lending.

We repeat the analysis employing a dummy variable for above-median RRRWA as an independent variable of interest (Columns (5)-(8) of Table 4). This specification further strengthens our conclusions. In Column (7), we document that the above-median RRRWA group of banks rebalances their loans portfolios towards non-residential mortgage types of loans by 3.1 pp. This means that among the banks in the group of more affected institutions, the average excess increase in other loans constitute 3.1 pp of their total loan portfolios. In our sample, the total volume of loans provided by the above-median RRRWA group of banks in 2012 is CHF 284 billion. Therefore, such a shift in their combined portfolio constitutes an almost CHF 9 billion increase in credit supply for borrowers seeking non-residential mortgage types of loans.

Also, out of the entire sample of Swiss banks available for the period under investigation, we construct a new sub-sample such that the observable characteristics in the groups of more and less affected banks do not exhibit systematic differences.[12] This exercise allows us to alleviate the concern regarding the difference in the treated and control banks' business models. Descriptive statistics by group for this sample is presented in Table 5.

Table 5
Descriptive statistics

Average values, 2012	Below Median RRRWA group of banks	Above Median RRRWA group of banks	The difference,t-stats in brackets
Size	7.8	7.3	0.43
			[1.05]
ROE	5.8	5.3	-0.5
			[-0.93]
Leverage	9.1	8.0	-1.1
			[1.59]
Share of interbank funding	7.7	2.4	5.2
			[1.48]
Liquidity†	4.7	3.9	0.84
			[1.36]

Notes: This table contains average values of banks' balance sheet characteristics by group and their difference. The size is estimated as log of total assets; profitability is the return on equity; leverage estimated as equity over total assets; share of interbank funding is the sum of interbank borrowing over total assets; liquidity is estimated as liquid assets over total assets. † Since the stock of liquid assets on a bank balance sheet at any time is somewhat incidental, we use average liquidity in the pre-2013 period to capture the banks' liquidity management stance

We repeat the estimation of Equation (2) for every dependent variable. The results presented in Table 6 demonstrate a larger impact of the CCyB activation on the composition of banks' balance sheet than in the full sample of banks.

While a bank-level analysis of the impact can be insightful, there may be concerns about attributing changes in bank balance sheet items solely to individual bank decision-making. To put it another way, credit demand or various financial market pressures may affect banks in ways that are correlated with their residential mortgage exposures, in which case the estimates above include both bank supply considerations and many other elements. In the following section, we hence conduct a (bank-firm) loan-level analysis to cleanly separate, at least for corporate credit, bank credit supply from corporate credit demand.

[11] In the earlier versions of this paper and related unreported estimations available upon request, we find that the growth rate and the size of total loans do not respond differentially across banks with different RRRWA. This observation further reinforces the conclusion that the CCyB activation affects merely the composition and not the total amount of bank lending.

[12] We construct the sample for the estimations in Table 6 by removing three banks that are distinctly larger than other banks in the sample and by trimming the sample to the point that ensures equal group outcomes for average balance sheet liquidity.

Table 6
The impact of the CCyB on the composition of banks' balance sheet, reconstructed sample

VARIABLES	(1) Share of Residential Mortgages to TA	(2) Share of Other Loans to TA	(3) Share of Other Loans to Total Loans	(4) Share of All Loans to TA	(5) Share of Residential Mortgages to TA	(6) Share of Other Loans to TA	(7) Share of Other Loans to Total Loans	(8) Share of All Loans to TA
Post x RRRWA	-0.0110*	0.0164***	0.0200**	0.0054				
	[0.006]	[0.006]	[0.009]	[0.005]				
Post x High RRRWA					-0.0290***	0.0285***	0.0372***	-0.0005
					[0.010]	[0.009]	[0.013]	[0.005]
Balance sheet controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Post x Bank Type	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank and Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	385	385	385	385	385	385	385	385
R-squared	0.068	0.067	0.075	0.135	0.077	0.069	0.079	0.128

Notes: This table examines at the bank-level how the change in the share of residential mortgage loans in total assets, share of other loans in total assets and share of all loans in total assets was determined by the bank's Relative Residential Risk Weighted Assets (RRRWA) at the end of 2012. The sample consists of 77 banks such that the observable characteristics in the groups of above-median and below-median RRRWA banks do not exhibit systematic differences. RRRWA is standardized with zero mean and unit variance. RRRWA is as constructed as a bank-specific share of residential risk-weighted assets (RWA) in the bank's total assets, and High-RRRWA is defined as an above-median RRRWA rate in the pre-CCyB activation period. The data covers years from 2010 to 2014. The balance sheet controls are lagged one year and include bank size (log of total assets), profitability (return on equity), leverage (equity over total assets), liquidity (liquid assets over total assets), and share of interbank funding (sum of interbank borrowing over total assets). Bank Type is a dummy that indicates whether a bank is cantonal or not. Post is a dummy that indicates period after the CCyB activation (2013-2014). Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

4.2. Impact on the volume of outstanding loans

4.2.1. Specification

We proceed by estimating the impact on total loan commitments in a difference-in-differences specification comparing loan growth following the CCyB activation of banks strongly affected by the rate hike to those that were not. We estimate a difference-in-differences model of the form:

$$\Delta ln\left(Total\ Commitment\ _{b,f}\right) = \alpha_f + \beta RRRWA_b + \gamma X_{b,f} + \varepsilon_{b,f} \tag{3}$$

where total loan commitment is, at every point in time, equal to the total amount of financing (including credit lines) that is made available by bank b to firm f (hence we take into account not only new loan granting but also the entire maturity and repayment structure of existing loans). Explaining differences between the post and pre period in this way mitigates panel-related concerns of autocorrelation (Bertrand, Duflo and Mullainathan (2004)) and the unequal length of the respective periods.

Table 7 presents the estimates of Equation (3). As a baseline case, we compare average total commitment in the months before the activation of a CCyB rate had been announced to the time including the announcement and actual implementation of the CCyB rate of 1 percent, ie we calculate:

$$\Delta ln\left(Total\ Commitment\ _{b,f}\right) = ln\left(\frac{Total\ Commitment\ _{bf\,b,f,T_2}}{Total\ Commitment\ _{bf\,b,f,T_1}}\right) \tag{4}$$

where T_1 is the time from 2012:07:01-2013:02:12 and T_2 is the time from 2013:02:13-2013:11:30. Further, to make sure that our results are not driven by the response of $RRWA_b$ or $Banksize_b$ to variations in the CCyB rate, we use a pre-determined beginning-of-period values of $RRRWA_b$.

4.2.2. Main estimates

Column (1) in Table 7 presents the estimates from a basic regression of loan growth on *RRRWA*, while in Column (2) we saturate the specification with business-type fixed effects. Those are constructed on the basis of the affiliation of the firm to an industry (79 different two-digit industries), canton (26), size class (5), risk class (5), and balance sheet size class (6).[13] Their combination results in 308,100 business-type fixed effects (=79*26*5*5*6) which reasonably account for credit demand (*à la* Khwaja and Mian (2008)).[14]

In addition to the reasonable adequacy of the business-type fixed effects to capture credit demand, also notice that including individual firm fixed effects would in, the case of Switzerland, lead to a substantial loss of useable observations (and corresponding selection concerns) because relatively few firms in Switzerland employ multiple banks.[15]

Admittedly, it cannot be entirely excluded that subsiding residential mortgage demand by a household could show up as corporate credit demand by a small firm at the affected bank, making credit demand bank-specific and rendering business fixed effects potentially partially impotent.[16] We therefore also study credit granting to large firms (where this is less likely the case), along with other bank characteristics such as proximity to regulatory bank capital (which is less likely correlated with credit demand during normal times), and across corporate sectors (to see if there is residential to corporate mortgage demand shifting). None of these channels are a main driver of the changes in credit.

We note that in Table 7, the number of observations is 3,814, over a magnitude fewer than the number of loans granted during this period (115,709, see Table 1). The reason is that banks grant multiple credits to

[13] Strict confidentiality concerns surrounding the credit register prevent access to a unique firm identifier.

[14] Degryse, De Jonghe, Jakovljevic, Mulier and Schepens (2019) make a comprehensive case that the use of business or firm fixed effects in many situations will result in similar estimates.

[15] See Ongena and Smith (2000), Neuberger, Räthke and Schacht (2006), Qian and Strahan (2007), and Neuberger, Pedergnana and Räthke-Döppner (2008) De Jonghe, Dewachter, Mulier, Ongena and Schepens (2020). for example employ a similar saturation strategy for Belgian small firms that, like Swiss firms, often maintain a single bank relationship.

[16] See also eg Paravisini, Rappoport and Schnabl (2020) or Altavilla, Boucinha, Holton and Ongena (2021).

Table 7
The impact of the activation of the countercyclical capital buffer on total loan commitment and new loan issuance

Model description	(1) w/o business FE	(2) Baseline w/ business FE	(3) Pre-announcement effect	(4) Winsorized*RRRWA*	(5) Winsorized dep. var	(6) Change in*RRRWA*	(7) Bank size	(8) Cantonal bank dummy	(9) *RRRWA* incl. foreign assets	(10) Change in newly granted loans
Dependent variable	Δln(Total Commitment)									**Δln(New Loan Volume)**
Difference period	*12:07:01-13:02:12 – 13:02:13-13:11:30*		*2012:H1 - 2012:H2*	*2012:07:01-2013:02:12 - 2013:02:13-2013:11:30*						
Bank Relative Residential Risk Weighted Assets (*RRRWA*)	0.03***	0.14***	–0.01	0.14***	0.09***	0.13***	0.13***	0.19***		0.22***
	[0.01]	[0.02]	[0.03]	[0.02]	[0.01]	[0.02]	[0.02]	[0.02]		[0.03]
Change in *RRRWA*						–12.40***				
						[4.36]				
Ln(Bank Balance Sheet Size)							0.21***			
							[0.03]			
Cantonal Bank y/n								0.06***		
								[0.02]		
Alternative *RRRWA*, using Domestic Size									0.15***	
									[0.02]	
Business Fixed Effects	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Individual Bank After Designation as TBTF y/n	No	No	No	No	No	No	No	No	No	Yes
Observations	3,814	3,814	3,033	3,809	3,594	3,814	3,814	3,814	3,814	3,159
R-squared	0.002	0.444	0.540	0.444	0.495	0.447	0.461	0.448	0.445	0.406

Notes: This table examines how the change in the volume in total commitment or of newly granted loans is determined by the bank's Relative Residential Risk Weighted Assets (*RRRWA*). In Columns (1) to (9), the dependent variable is the percentage change in the volume of total commitment (all outstanding loans-accrued repayment + credit lines) from 2012:07:01-2013:02:12 compared to 2013:02:13-2013:11:30. In (10), the dependent variable is the percentage change in the volume of newly granted loans over the same period. For the construction of *RRRWA* see the main text. The falsification exercise in (3) repeats the specification presented in (2) using the change in the half year before and after the first CCyB-announcement (2012:H1 to 2012:H2) as dependent variable. (4) excludes observations in which *RRRWA* is more than two standard deviations above or below the mean and (5) excludes observations in which the dependent variable is more than two standard deviations above or below the mean. (6) adds the change in average *RRRWA* from 2012:07:01-2013:02:12 to 2013:02:13-2013:11:30 as dependent variable. (7) adds as control the logarithm of the bank's balance sheet size, (8) adds dummies equal to 1 for cantonal banks, and (9) constructs a different measure of *RRRWA* that also takes into foreign domestic business when normalizing (see main text). All specifications except (1) absorb business fixed effects, thus limiting the variation in the data to businesses with multiple bank relations. For better comparison, also the sample in (1) is limited to this sample. Businesses are defined to belong to an industry (79 categories), canton (26), size class (5), risk class (5), and balance sheet size class (5). "Yes" indicates that the set of characteristics or fixed effects is included in the specification. "No" indicates that the set of characteristics or fixed effects is not included. Standard errors in brackets. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

individual firms, which we need to aggregate to obtain the level of total commitment. Further, the number of observations is cut by a factor of two as we adopt a difference-in-differences model.[17]

The estimated coefficient on *RRRWA* in Column (2) equals 0.14***.[18] The positive sign on this estimated coefficient suggests that, after the CCyB activation, banks with higher *RRRWA* increase new lending to firms more (compared to the pre-activation period) than banks with lower *RRRWA*. This is consistent with a compositional effect. The estimated coefficient is also economically relevant. Since we standardized *RRRWA* prior to estimation, this coefficient suggests that *ceteris paribus* a bank in the 75th percentile of the *RRRWA* range increases lending to firms by 18 log-points or almost 20 pp more than a bank in the 25th percentile.[19]

In sum, we find that the CCyB activation spurs corporate lending by banks with higher *RRRWA* more than it does at banks with lower*RRRWA*, and that such differential growth rates.

4.2.3. Robustness

We next examine the robustness of this first main finding. It is conceivable that our main measure of the CCyB's impact is correlated with bank-specific trends in loan growth that have little or nothing to do with the CCyB itself. Column (3) therefore contains an important falsification exercise which documents that *RRRWA* was uncorrelated to

[17] Note that a data requirement for estimating the difference-in-differences specification of Khwaja and Mian (2008), we require that the same bank-business relationship is granted a credit in both the pre- and the post-activation period. Further, due to the presence of fixed effects, only businesses with multiple banking relations are included in the sample. For our sample, these data requirements exclude only around 25% of the observations, and it further holds that the characteristics of the credits in the sample and those that are dropped are very similar within each period. This is documented in Table A2 in the Online Appendix A.

[18] *** Significant at 1%, ** significant at 5%, and * significant at 10%. For convenience we will also indicate the significance levels of the estimates that are mentioned further in the text.

[19] The 25th to 75th percentile range equals two times 0.67, the standard deviation which by construction is set equal to 1 (= 0.14 * 2 * 0.67 * 1 = 0.18). Measured in absolute terms, the 25th percentile of relative risk-weighted assets (not standardized) is 2.3%, while the 75th percentile is equal to 24.9%. This difference of 22.6% in risk-weighted assets as a fraction of the balance sheet is associated with a 0.18 ln points difference in the growth of newly issued loans.

growth in the period before the CCyB announcement.

Indeed, in Column (3), we re-estimate Equation (3), evaluating the change in average commitment from 2012:01:01-2012:06:30 to 2012:07:01-2012:12:31, and find that the *RRRWA* has no effect on loan growth during that period.

The fact that our empirical strategy has no power during a time when no CCyB rate was announced constitutes an important finding. The reason is that, in addition to the Federal Council's announcement of the legislation for the CCyB, FINMA announced a revision to banks' self-regulation guidelines that increased the risk-weighting for loan tranches exceeding 80 percent of the property's value. Fortunately, for our analysis, the latter came into effect already on 1 July 2012, i.e., over half a year before the activation of the CCyB. We find no evidence for a change in bank's loan granting around the beginning of July 2012.[20]

Thus, it is in the announcement of the CCyB activation rather than the introduction of the legal framework that we identify the measure's impact. If we had found that our bank-specific variables – tailored to pick up the CCyB's impact but nevertheless potentially correlated with other bank characteristics that are affected by these additional measures – it would be less clear that we had identified the impact of the CCyB alone.

We next examine whether outliers in either *RRRWA* or in loan growth could be behind our results. In Column (4), we exclude those loans issued by banks with *RRRWA* two or more standard deviations above or below the mean of this variable, and in (5) we winsorize by the dependent variable.

Column (6) starts by controlling for changes in risk-weighted assets (RWA) during the time of observation; that is, we compare the average RWA from 2012:07:01-2013:02:12 to the average for 2013:02:13-2013:11:30. The reason we control for this change is that the underlying formulas for the calculation of RWA have been changed. This change was announced during June 2012, but actually implemented in January 2013, which is very close to the first announcement of the CCyB rate. Controlling for such changes of RWA that are induced by other legislation has no impact on the estimated coefficients.

Column (7) instead controls for bank size, measured as the natural logarithm of the bank's balance sheet. The results suggest not only a similar effect for *RRRWA* but also a positive loading on bank size, suggesting that the CCyB may also have encouraged larger banks to lend more. Column (8) similarly controls for bank ownership by including a dummy for cantonal banks that are owned and guaranteed by the state. The estimate for *RRRWA* remains positive, while the estimate on the dummy suggests that cantonal banks increase their supply of credit by less after the CCyB activation than other banks do.

Column (9) presents a robustness test in which we construct an alternative measure for the *RRRWA*. In this alternative measure, we normalize *RRRWA* by the size of the global domestic balance sheet rather than the domestic one:

$$\overline{RRRWA}_b = \frac{RRWA_b}{International\ Banksize_b} \tag{5}$$

The estimate of the coefficient on this rescaled $\overline{RRRWA}_b$ measure is very close to the baseline estimate.

Finally, in Column (10), we examine how the change in newly granted loans is determined by the CCyB activation across banks with different *RRRWA*. To do so, we compute at every point in time the change in the total amount of financing (including credit lines) that is made available by bank *b* to firm *f* (hence we take into account not only new lending but also the entire maturity and repayment structure of existing loans). Then we estimate a specification of the form:

$$\Delta ln\left(New\ Loan\ Volume_{b,f}\right) = \alpha_f + \widehat{\beta} RRWA_b + \widehat{\gamma} X_{b,f} + \varepsilon_{b,f} \tag{6}$$

where:

$$\Delta ln\left(New\ Loan\ Volume_{b,f}\right) = ln\left(\frac{New\ Loan\ Volume_{b,f,T_2}}{New\ Loan\ Volume_{b,f,T_1}}\right) \tag{7}$$

where T_1 is the time from 2012:07:01-2013:02:12 and T_2 is the time from 2013:02:13-2013:11:30. We again restrict the sample to firms that have relationships with more than one bank at both points in time.

While the RRRWA coefficient in the baseline regression (Column 2) is 0.14***, in Column 10, where the dependent variable is the change in the volume of newly originated loans, the coefficient is 0.22***. If we interpret these log-change coefficients in percentage points, the estimations indicate that a one-standard deviation in RRRWA is associated with an almost 25 pp increase in the volume of new corporate loans. Therefore, as one would expect, the effect of the CCyB on bank lending is immediately visible in the flow of newly originated loans, while the total volume of corporate loans responses with a delay – its coefficient indicates a 15-pp increase over the same period.

4.3. Impact on loan characteristics

4.3.1. Changes in the cost of credit

Table 8 investigates the impact of the introduction of the CCyB on loan characteristics, ie the loan interest rate and commissions (our main focus), and also the loan rating and sector.

We follow the line-up of the estimations in Equation (3), but we now feature changes in loan characteristics as the dependent variable. We commence by constructing the change in the average interest rate charged by bank *b* to firm *f*:

$$\Delta IR_{b,f} = \overline{IR}_{b,f,T_2} - \overline{IR}_{b,f,T_1} \tag{7}$$

Columns (1) to (6) in Table 8 use this newly constructed $\Delta IR_{b,f}$ as the dependent variable, ie we estimate:

$$\Delta IR_{b,f} \ = \alpha_f + \widehat{\beta} RRRWA_b + \widehat{\gamma} X_{b,f} + \varepsilon_{b,f} \tag{8}$$

As in Table 7, in Column (1) in Table 8 we estimate this model first without business-type fixed effects and in Column (2) we add the business-type fixed effects. The estimated coefficient in the latter specification (again our benchmark specification) equals 0.18*** implying that, after versus before the CCyB activation, the rate charged by banks at the 25th and the 75th percentile of *RRRWA*, respectively, diverge by 0.24% (=0.18*(0.67+0.67)). Given that the average charged interest rate in the sample is low, ie the unweighted average interest rate equals 2.4 percent; this difference is again economically relevant.

Next, we document that there is no such relation in the control period (see Column (3)) and subject our finding to a number of robustness exercises. For example, in Column (4) we again control for the change in *RRRWA* during the period of observation to address whether the measured coefficients convolute the CCyB's impact with that of the change in the loan-to-value ratio. We find that this is not the case.

Further, in Column (5), we add the set of bank controls featured before in Table 7, ie the bank balance sheet size, the cantonal bank dummy and the set of fixed effects for each bank after designation as TBTF. We find that the CCyB activation has a marked positive effect on the charged interest rate also in this specification.

In Column (6), we add loan-specific controls, ie whether a loan is Libor-denominated, whether a loan is collateralized, what the quality of the collateral is, and the loan's risk class. First and foremost, the estimated coefficient on the *RRRWA* remains similar and equal to 0.16; hence, the differential changes in the loan rate between banks are not explained by the changing characteristics of the loans that are granted.

In Column (7) in Table 8, we introduce a new dependent variable, which is the average change in the fraction of loans that were subject to a commission to assess whether higher interest rates were accompanied by corresponding changes in commissions. The dependent variable in

[20] See Danthine (2012) and FINMA (2012) for a discussion of these measures and their goals.

Table 8
The impact of the activation of the countercyclical capital buffer on the characteristics of new loans from 2012:07:01-2013:02:12 compared to 2013:02:13-2013:11:30

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Model description	w/o business FE	Baseline w/ business FE	Pre-announcement effect	Change in RRRWA	Bank Characteristics	Loan Characteristics	Extra commission	Libor rate	Loan risk class	New construction loans	Maturity
Dependent variable: %D in	**Average interest rate**						**Commis-sion y/n**	**Libor y/n**	**Risk Class [0,1]**	**Real Estate y/n**	**Days (ln)**
		Bank Relative Residential Risk Weighted Assets									
(*RRRWA*)	0.03	0.18***	–0.11	0.17***	0.67***	0.16***	0.08***	0.04**	0.00	0.04***	0.09**
	[0.03]	[0.04]	[0.09]	[0.05]	[0.14]	[0.04]	[0.02]	[0.02]	[0.02]	[0.01]	[0.04]
Change in *RRRWA*				–7.20							
				[14.26]							
%D Libor y/n						–0.19**					
						[0.09]					
%D Collateralized y/n						–0.68***					
						[0.15]					
D Collateral Quality						0.21***					
						[0.03]					
D Risk Class [0,1]						2.35***					
						[0.57]					
Ln(Balance Sheet Size)					–0.02						
					[0.07]						
Cantonal Bank y/n					0.59***						
					[0.14]						
Business Fixed Effects	No	Yes	Yes	Yes	Yes	Yes	Cant. & Size	Cant. & Size	Cant. & Size	Cant. & Size	Yes
Individual Bank After Designation as TBTF y/n	No	No	No	Yes	Yes	No	No	No	No	No	No
Observations	4,121	4,121	2,844	4,121	4,121	4,121	4,013	4,118	1,821	4,070	3,113
R-squared	0.000	0.474	0.571	0.474	0.480	0.497					0.565

Notes: this table examines how the respective dependent variable is affected by the bank's Relative Residential Risk Weighted Assets (*RRRWA*). In Columns (1) to (6), the dependent variable is the percentage point change from 2012:07:01-2013:02:12 to 2013:02:13-2013:11:30 in the average interest rate charged by bank b to firm f. In (7), (8), and (10), the dependent variable, respectively, is the change in the probability that a loan has a commission, is libor-denominated, is related to new construction. In (9), the dependent variable is the percentage point change in the average risk class (normalized to the range [0,1], 1=highest risk). In (11), the dependent variable is the change in the logarithm of average maturity. For the construction of *RRRWA* see main text. (4) adds the change in the average *RRRWA* from 2012:07:01-2013:02:12 compared to 2013:02:13-2013:11:30 as dependent variable. (5) adds the logarithm of the bank's balance sheet, a dummy equal to 1 for cantonal banks, and dummies for TBTF regulation (TBTF coefficients are not reported). (6) controls for changes in the fraction of libor-denominated loans, in the fraction of collateralized loans, in the loan risk class index, and in an index of collateral quality (if applicable). All specifications except (1) absorb business fixed effects, thus limiting the variation in the data to businesses with multiple bank relations. For better comparison, also the sample in (1) is limited to this sample. Businesses are defined to belong to an industry (79 categories), canton (26), size class (5), risk class (5), and balance sheet size class (5). "Yes" indicates that the set of characteristics or fixed effects is included. "Canton & Size" indicates that singular fixed effects for canton and size are included. "No" indicates that the set of characteristics or fixed effects is not included. Standard errors in brackets. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

(7) is thus equal to:

$$\Delta Commision_{b,f} = \overline{Commission}_{b,f,T_2} - \overline{Commission}_{b,f,T_1} \tag{9}$$

where $Commission_l$ is a dummy which is equal to one if a loan comes with a commission and is equal to zero otherwise. We then estimate:

$$\Delta\ Commision_{b,f} \ = \alpha_f + \widehat{\beta} RRRWA_b + \widehat{\gamma} X_{b,f} + \varepsilon_{b,f} \tag{10}$$

Since the change in the fraction of loans with commissions must lie in the interval [-1,1], we estimate a General Linear Model (GLM), assuming that the dependent variable has a Binominal distribution.[21]

The estimated coefficient on *RRRWA* equals 0.08***, implying that around the CCyB activation, the proportion of the loans that are charged commissions by banks at the 25th and the 75th percentile of *RRRWA*, respectively, diverges by 11 pp (=0.08*(0.67+0.67)). This is a very substantial economic effect, given that on average only 17% of the loans in our sample attract additional commissions.

In sum, banks not only increase the interest rate charged on the newly granted loans, but they are also much more likely to charge upfront commissions at the time of loan issuance.[22]

4.3.2. Changes in other loan characteristics

Tables 7 and 8 so far document that both the amount and cost of corporate lending by banks increase substantially for higher-*RRRWA* banks following the CCyB. This is not consistent with a simple expansion of credit supply by these banks. Thus, we next investigate how the other characteristics of the newly granted loans evolve. In the remainder of Table 8, we examine whether the CCyB activation spurs banks to opt for floating rather than fixed rates, whether it affects the (subjective) credit risk assessment of these newly issued loans, and whether it shifts the composition of loans towards real estate-related activity.

For the former two loan characteristics, we follow the procedure for the construction of $\Delta Commision_{b,f}$ in Equation (9) and construct measures of the change of the fraction in Libor-denomination for use in Column (8) and the change in the risk-class for Column (9).

We find that the CCyB activation also makes loans more likely to be tied to the Libor benchmark rather than to a fixed rate, but there is no effect on the subjective risk perception of the issued credits.[23] The former effect is also sizeable. The proportion of the loans that were Libor-benchmarked by banks at the 25th and the 75th percentile of *RRRWA*, respectively, diverge by 5.4 pp (=0.04*(0.67+0.67)).

In Column (10) of Table 8, we examine a new dependent variable, the change in the fraction of loans that were related to planned and ongoing construction activity (ie so-called “Baukredit”). The estimates suggest that the CCyB also causes a moderate shift towards real-estate related loans in the commercial sector. As the CCyB applies only to residential mortgages, it may hence incentivize banks to grant mortgages to firms. And indeed, the CCyB increases the fraction of new construction loans. The ratio of the loans to construction by banks at the 25th and the 75th percentile of *RRRWA*, respectively, diverges around the CCyB introduction by 5.4 pp (=0.04*(0.67+0.67). The last loan characteristic we examine is maturity: in Column (11), the dependent variable is the log of maturity. We find that the CCyB introduction leads to a modest increase in maturity.

In sum, banks with higher *RRRWA* respond to the CCyB activation by increasing the availability, price, risk and maturity of credit, and by shifting lending towards commercial real estate activities.

5. Heterogeneity of the effects

In this section, we examine the heterogeneity of the CCyB’s impact on bank credit supply across firms differing in size, credit rating, sector, and location. We find that more affected banks tend to lend more to smaller and riskier borrowers while increasing the cost of borrowing for them at the same time.

We estimate the Equations (3) and (8) for different subsamples and examine whether the coefficients of interest are heterogeneous across firms. Table 9 presents the estimated effect on new loan growth (in Panel A) and loan interest rate (in Panel B). Table B1 in Online Appendix B establishes the corresponding interaction regressions that can inform us about the statistical significance of these differences across firm groups.[24]

The subsample in Column (1) of Table 9 includes all firms with fewer than 10 employees, Column (2) includes firms with 10 or more employees but not more than 49, and the subsample in Column (3) includes the remaining large firms. We find that loan growth is more strongly affected by *RRRWA* in the sample of small firms than in the sample of large firms. Moreover, the maturity of loans for small business is positively affected as well (see Online Appendix Table B2). These effects are, however, accompanied by an increase in the interest rate charged to small firms.

Overall, our results indicate that heterogeneous capital requirements tilt bank credit supply towards small business in non-targeted sectors. These findings provide insight into how access to credit for small firms can be facilitated through an increase in the availability of longer maturity loans or reducing their need for posting costly collateral. In this respect our results complement Chodorow-Reich, Darmouni, Luck and Plosser (2021) who find that, in order to maintain higher degree of lender discretion, U.S. banks provide small firms with short-term credit lines, which restricts the borrowers’ access to funds in distress. Moreover, they report that less than 5% of the small business credit lines are unsecured, while the majority of large business does not post collateral for credit lines. Consistent with these findings, Luck and Santos (2021) demonstrate that posting collateral substantially reduces the cost of credit for small firms, but not for large ones.

The subsample in Column (4) includes only firms that are active in construction sectors,[25] while Column (5) contains the remainder of the sample. Overall, we find that bank *RRRWA* has a somewhat stronger effect on loan growth for firms that are active in the construction industry than for other firms. However, we do see an opposite differential

[21] The GLM specification with the Poisson assumption is appropriate for modeling percentage distributions, and we hence rescale the change in the fraction of loans that can take values from -1 to 1 such that the support equals [0,1] by adding one and dividing by two. We then double the resulting coefficients and standard errors, so that the interpretations of the coefficients remain intuitive. The GLM estimation does not allow us to include the set of all possible business fixed effects. We thus include fixed effects by industry, canton, and size, but not the combinations of these sets of fixed effects.

[22] Auer and Ongena (2016) provide a plausible explanation for this higher commercial loan growth at a higher cost. In their illustrative theoretical framework, entrepreneurs obtain both private and commercial credit from their relationship bank. Because of the presence in the model of private benefits that accrue to entrepreneurs borrowing privately, but which are inaccessible to banks in the case of bankruptcy, private and commercial credit are perfect substitutes for entrepreneurs but not for banks. An increase in equity requirements on private lending by banks will then spur banks to lend commercially, but they will charge a higher price to do so. Moreover, and entirely consistent with our empirical estimates, both positive volume and cost effects will be stronger for banks that are granting relatively more private loans.

[23] This change in the perceived risk class must be interpreted with care in any case, as it reflects a subjective judgment by a loan officer who might simply be entering a higher loan risk class in the database to justify a higher interest rate. We address this concern below by classifying firms by their ex-ante risk rating (our dataset includes information on the risk class both of each loan and each firm) to assess whether those that were considered to be riskier ex-ante received more credit.

[24] In Online Appendix B, we present additional results on the heterogeneity of the effect on loan maturity and in the sample of non-mortgage commercial loans.

[25] Sectors 41, 42, 43, and 71 in the NOGA 2008 classification system.

Table 9
Heterogeneous effects on new loan issuance across firms, industries, and regions

	Subsample	(1) Small firms Emp<10	(2) Medium size 9<Emp<50	(3) Large firms Emp>49	(4) Construction related	(5) Not construction related	(6) Real estate hot spot	(7) No real estate hot spot	(8) High Rating (A- to AAA)	(9) No/ Lower Rating
Panel A	**Dependent variable**					**Δln(Total Commitment)**				
	Bank Relative Residential Risk Weighted Assets (*RRRWA*)	0.24***	0.12***	0.08**	0.17***	0.14***	0.17***	0.12***	-0.05	0.15***
		[0.04]	[0.02]	[0.03]	[0.05]	[0.02]	[0.03]	[0.02]	[0.08]	[0.02]
	Business Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Observations	596	2,280	938	583	3,231	1,643	2,171	961	2,853
	R-squared	0.447	0.435	0.461	0.436	0.446	0.431	0.460	0.446	0.444
Panel B	**Dependent variable**					**Percentage point change in the average interest rate**				
	Bank Relative Residential Risk Weighted Assets (*RRRWA*)	0.24*	0.22***	0.11	0.09	0.20***	0.11	0.22***	-0.43	0.19***
		[0.13]	[0.06]	[0.08]	[0.11]	[0.05]	[0.08]	[0.05]	[0.38]	[0.05]
	Business Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Observations	449	1,955	1,717	644	3,477	1,609	2,512	379	3,742
	R-squared	0.526	0.448	0.484	0.417	0.484	0.472	0.475	0.592	0.466

Notes: This table examines whether the relation between the growth of newly granted loans (Panel A) or the change in the average asked interest rate (Panel B) and the bank's Relative Residential Risk Weighted Assets (*RRRWA*) is heterogeneous across firms. In all specifications, the dependent variable is either the percentage change in the volume of newly granted loans or the percentage change in the average interest rate from 2012:07:01-2013:02:12 and 2013:02:13-2013:11:30. All specifications absorb business fixed effects thus limiting the variation in the data to businesses with multiple bank relations present. Businesses are defined to belong to an industry (79 categories), canton (26), size class (5), risk class (5), and balance sheet size class (5). "Yes" indicates that the set of characteristics or fixed effects is included. In (1), the sample includes only firms with less than 10 employees, in (2) firms with fewer than 50 but more than 10 employees are included and in (3), firms with 50 or more employees are included. In (4), only firms that are active a construction related sector are included (sectors 41, 42, 43, and 71 in the NOGA 2008 classification system) and (5) includes the remained of the sample. (6) includes firms located in the cantons Basel City, Basel Land, Geneva, Lucerne, Vaud, Wallis, Schwyz, Zug and Zurich. (7) includes the remaining cantons. (8) includes those firms with a high credit rating in late 2011, defined as either a Standard and Poor's rating of A- and higher, or a Moody's rating of A3 of higher. (9) Includes the remaining firms (also those without a rating). Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

effect with regards to the average interest rate and neither difference is statistically significant (see Online Appendix Table B1). Overall, this analysis suggests that the impact is not credit demand-related (substituting residential for company mortgage demand) but rather coming from the credit supply side where the bank reallocates across its non-CCyB affected areas of lending.

Table 10
Equity, regulatory requirements, *RRRWA* and new loan issuance

Model description	(1) Only high CET/ REQ dummy	(2) Controlling for high CET/REQ dummy	(3) Interaction*RRRWA** high CET/ REQ dummy	(4) Only CET/REQ	(5) Controlling for CET/REQ	(6) Interaction *RRRWA**CET/REQ
Dependent variable			**Δln(Total Commitment)**			
Bank Relative Residential Risk Weighted Assets (*RRRWA*)		0.14***	0.16***		0.14***	0.11***
		[0.02]	[0.02]		[0.02]	[0.02]
High Tier 1 Core Equity (CET) / Required Core Equity (REQ)	0.02	-0.02	0.02			
	[0.03]	[0.03]	[0.03]			
*RRRWA** High CET/REQ			-0.18***			
			[0.04]			
Tier 1 Core Equity (CET) / Required Core Equity (REQ)				0.02	0.02	-0.01
				[0.04]	[0.04]	[0.04]
*RRRWA** CET/REQ						-0.17**
						[0.07]
Business Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,814	3,814	3,814	3,814	3,814	3,814
R-squared	0.426	0.445	0.449	0.426	0.445	0.446

Notes: This table examines how the change in total commitment is affected by the bank's Relative Residential Risk Weighted Assets (*RRRWA*), by the bank's tier 1 core equity (CET) compared to the required core equity ratio (REQ), and by the interaction of *RRRWA* and CET/REQ. In all specifications, the dependent variable is the percentage point change from 2012:07:01-2013:02:12 to 2013:02:13-2013:11:30 in loan growth by bank b to firm f. All columns except (1) and (4) include *RRRWA* as dependent variable. (1) and (2) adds a dummy equal to 1 for bank-firm relations above the median CET/REQ, and (3) further adds the interaction of this dummy with *RRRWA*. (4) includes the CET/REQ directly instead of a dummy, and (6) includes the interaction of the CET/REQ with *RRRWA*. Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

Table 11
Equity, regulatory requirements, *RRRWA* and interest rates

Model description	(1) Only high CET/REQ dummy	(2) Controlling for high CET/REQ dummy	(3) Interaction *RRRWA** high CET/REQ dummy	(4) Only CET/REQ	(5) Controlling for CET/REQ	(6) Interaction *RRRWA** CET/REQ
Dependent variable	**The percentage point change in the average interest rate**					
Bank Relative Residential Risk Weighted Assets (*RRRWA*)		0.12***	0.08		0.19***	0.22***
		[0.04]	[0.05]		[0.04]	[0.05]
High Tier 1 Core Equity (CET) / Required Core Equity (REQ)	–0.55***	–0.51***	–0.48***			
	[0.07]	[0.07]	[0.07]			
*RRRWA** High CET/REQ			0.11			
			[0.07]			
Tier 1 Core Equity (CET) / Required Core Equity (REQ)				–0.43***	–0.45***	–0.90***
				[0.14]	[0.14]	[0.21]
*RRRWA** CET/REQ						0.72***
						[0.26]
Business Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4,121	4,121	4,121	4,121	4,121	4,121
R-squared	0.484	0.485	0.486	0.472	0.476	0.478

Notes: This table examines how loan growth is affected by the bank's Relative Residential Risk Weighted Assets (*RRRWA*), by the bank's tier 1 core equity (CET) compared to the required core equity ratio (REQ), and by the interaction of *RRRWA* and CET/REQ. In all columns, the dependent variable is the percentage point change from 2012:07:01-2013:02:12 to 2013:02:13-2013:11:30 in the average interest rate charged by bank b to firm f. All specifications except (1) and (4) include *RRRWA* as dependent variable. (1) and (2) adds a dummy equal to 1 for bank-firm relations above the median CET/REQ, and (3) further adds the interaction of this dummy with *RRRWA*. (4) includes the CET/REQ directly instead of a dummy, and (6) includes the interaction of the CET/REQ with *RRRWA*. Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

In Column (6), we focus on a subsample of firms headquartered in a "real estate hot spot", ie the cantons of Basel City, Basel Land, Geneva, Lucerne, Vaud, Valais, Schwyz, Zug, and Zurich, while in Column (7) all other cantons are included.[26] We find that *RRRWA* has, at most, a somewhat stronger effect on loan growth in cantons with real estate hot spots as compared with cantons without hot spots. However, we again see an opposite differential effect with regard to the average interest rate and the differences are again not statistically significant (Online Appendix Table B1). This constitutes an important finding since it documents that no regional compositional effects can be identified.

The last two Columns split the sample by credit rating, showing that the increased lending is concentrated in the set of more risky firms, as is the increase in the interest rates charged. The sample of Column (8) includes firms whose 2012 credit ranking was either A- or higher from Standard and Poor's, or A3 or higher from Moody's. The sample of Column (9) includes firms with a lower ranking or none.

6. Equity, capital requirement, and *RRRWA*

What is the impact of a bank's equity compared to the level of capital that is required by the regulator on lending and the interest rate charged during the time of observation? Further, are there any interactions between the bank's equity and its exposure to the CCyB through its residential mortgage business (eg Brei and Gambacorta (2016))?

We show that the previously established results regarding the impact of *RRRWA* on loan growth and the average interest rate charged are unaltered when also controlling for the proximity of a bank's equity to regulatory capital. Further, on its own, proximity to regulatory capital has no effect on new lending volume but is associated with lower interest rates. That is, during the time of observation, those banks with comparatively ample equity reduce their interest rates.

Moreover, we point out an interesting interaction between *RRRWA* and proximity to regulatory capital around the CCyB activation. We find that *RRRWA* has stronger effects on loan growth, yet weaker effects on the interest rate charged for banks that have lower levels of equity compared to the regulatory requirement. A rationalization of this result is that banks with a high *RRRWA* have a stronger incentive to grant more commercial loans when the CCyB is activated. Further, in the high *RRRWA* group, banks with less equity have more room to increase lending where the CCyB does not "bite." We document these findings in Tables 10 and 11. In Table 10, the dependent variable is the change in total commitment around the CCyB activation, and the table examines how this change is affected by the bank's *RRRWA*, by the bank's Tier 1 Core Equity (CET1) compared to the required core equity ratio (REQ), and by the interaction of and CET/REQ. A large excess over regulatory requirements has no impact on loan growth. Column (1) includes a dummy labeled High CET/REQ that is equal to one if the bank's CET/REQ is above the median for all banks in the sample, and zero otherwise. Column (2) adds this dummy to our baseline specification including *RRRWA*.

However, there is some indication that the impact of *RRRWA* is weaker for banks with a larger excess over regulatory requirements. Column (3) adds the interaction of *RRRWA* with the large excess over regulatory requirements dummy. The latter is positive, indicating that the covariation of loan growth and *RRRWA* is lower (in absolute value) among the group of banks with high equity.

These results are similar when we control for CET/REQ directly. In (4) we add this variable, in (5), we add it to the baseline specification including *RRRWA* and in (6) we add the interaction of *RRRWA* with CET/REQ.

In Table 11, we present the same specifications as in Table 10, but with the change in the average interest rate around the CCyB activation as the dependent variable. Banks with a greater excess over regulatory capital do lower their interest rates around that time (see (2) and (4)), but this does not alter our results regarding the positive impact of *RRRWA*on the interest rate charged (see Columns (4) and (5)). Again, there is evidence that the interaction of *RRRWA* and excess capital over regulatory requirements is positive (see Columns (3) and (6)), ie that the impact of *RRRWA* on the interest rate charged is more pronounced in the group of banks with ample equity. In sum, Tables 10 and 11 suggest that banks with high *RRRWA* and low equity increase lending more and at a

[26] To determine whether a canton was a real estate hot spot, we rely on the "UBS Swiss Real Estate Bubble Index," which indicates the risk of a real estate bubble forming on the Swiss housing market. We are using the 2013:Q1 issue of this index. This quarter is after our main sample period and hence we attribute foresight to loan officers that make lending decisions.

Table 12
Timing of the effects

	(1)	(2)	(3)	(4)	(5)	(6)
Model description	Difference-in-differences	Regressions with Business * Year-Month Fixed Effects				Poisson regression
Dependent variable	**Δln(Total Commitment)**	**Loan specific interest rate**		**Ln(Maturity)**	**Libor y/n**	**Libor y/n**
Actual Bank Specific Countercyclical Capital Buffers (CCyB)	0.22***	0.69**	0.49*	2.45***	−0.44***	0.05
	[0.03]	[0.32]	[0.26]	[0.38]	[0.08]	[0.11]
Announced Bank Specific Countercyclical Capital Buffers (CCyB)			0.94**	4.40***	−0.37***	−0.52***
			[0.46]	[0.60]	[0.09]	[0.17]
Business Fixed Effects	Yes	No	No	No	No	Yes
Year:Month Fixed Effects	No	No	No	No	No	Yes
Business * Year:Month Fixed Effects	No	Yes	Yes	Yes	Yes	No
Observations	3,522	402,017	402,017	299,952	402,017	402,017
R-squared	0.463	0.610	0.610	0.625	0.377	–

Notes: Column (1) in this table examines how the change in the volume of total commitment from 2012:07:01-2013:02:12 compared to 2013:02:13-2014:09:30 is determined by the bank Relative Residential Risk Weighted Assets (*RRRWA*). This specification includes business fixed effects and *RRRWA* as the only independent variable. In Columns (2) to (6), the sample includes all individual loans issued from the start of 2010 to the end of the sample period, and the dependent variable is a loan characteristic, i.e., interest rate in (2) and (3), the logarithm of maturity in (4), and Libor denomination or not in (5) and (6). The variable Actual Bank Specific Countercyclical Capital Buffers (CCyB) is equal to *RRRWA* times the applicable actual CCyB rate at each point in time. The variable Announced Bank Specific CCyB is equal to *RRRWA* times the announced minus the applicable CCyB rate at each point in time. Columns (2) to (5) estimate regressions that absorb business – year-month fixed effects, thus limiting the variation in the data to businesses and year-month combinations with multiple bank relations present. Businesses are defined to belong to an industry (79 categories), canton (26), size class (5), risk class (5), and balance sheet size class (5). "Yes" indicates that the set of characteristics or fixed effects is included. "No" indicates that the set of characteristics or fixed effects is not included. The reported standard errors are clustered at the level of the business. Column (6) estimates a Poisson model that also includes year-month fixed effects (but not business * year-month fixed effects). Standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

lower interest rate (than other banks) in areas not affected by the CCyB surcharges.

7. Timing of the impact: Announcement or activation effects?

So far, we have evaluated the impact of the CCyB activation on loan growth from 2012:07-2013:02 to 2013:03-2013:11. In this section, we first examine a longer time horizon, and we then go to a panel estimation in which we pick up the finer over-time variation of the announced and actually implemented CCyB rates.

For the impact on loan volume growth, we find that the CCyB long-run impact is somewhat larger than the impact over a shorter horizon. Column (1) of Table 12 reproduces the baseline specification presented in Column (2) of Table 7, but we compare the average total commitment before the CCyB rate is announced (as before: 2012:07:01-2013:02:12) to average total commitment from 2013:02:13-2014:09:30. We find that the change in total commitment is somewhat larger than when including only a shorter time period. This is hardly surprising given that the second period now also includes the second hike of the CCyB rate: during January of 2014, the CCyB rate is announced to equal 2% effective of June 2014.

To distinguish the impact of the two announcement and two effective dates on the properties of charged interest rates, we next go to a different form of estimation allowing us to more finely disentangle the importance of activation and implemented effects. Instead of looking at a simple difference in differences, we can also look at the entire sample of individual loans and examine how the interest rate charged evolves with the announced and implemented CCyB rates. We construct the variables:

$$CCB\ Actual_{b,t} = CCB\ Actual\ Rate_t * RRRWA_b \tag{11}$$

$$CCBAnnounced_{b,t} = (CCBAnnouncedRate_t - CCBActualRate_t) * RRRWA_b \tag{12}$$

where *CCB Actual Rate*$_t$ is the rate that is applicable to *RRRWA* (0, 1% or 2%) at each point in time and *CCB Announced Rate*$_t$ is the rate that is announced. *CCB Announced*$_{b,t}$ is thus picking up the variation in interest rates during periods when a CCyB rate is announced, but not yet implemented. For example, the rate of 1% was announced on 13 February 2013, but took effect only after 30 September of that year. From Column (2) onwards, Table 12 presents estimations of the form:

$$Interest\ Rate_{b,f,l,t} = \alpha_{f,t} + \widehat{\beta} CCB\ Actual_{b,t} + \widehat{\beta} CCB\ Announced_{b,t} + \varepsilon_{b,f,l,t} \tag{13}$$

This equation is estimated for the sample of individual loans. To maintain the spirit of the estimations presented hitherto that follow Khwaja and Mian (2008) and utilize the variation across multiple banks serving the same customer, Columns (2) to (5) of Table 12 control for business-time fixed effects, thus also absorbing all aggregate over-time variation, and they further cluster fixed effects around businesses (business-type fixed effects are subsumed in the business-time fixed effects). Our estimations thus filter out not only all aggregate trends and fluctuations brought about by other regulatory changes during the period of observation, but even such fluctuations at the business level.

Column (2) only includes the actual rate and estimates a coefficient of 0.69** for *CCB Actual*$_{b,t}$, implying that, if the CCyB rate is increased by 1 pp, the interest rate charged by a bank with *RRRWA* of 0.5 increases by 0.34 pp (=0.69*0.5*1).

We next add *CCB Announced*$_{b,t}$ to the specification in Column (2), documenting that the activation effect is actually stronger than the implementation effect.

In Columns (4) and (5), we also document that the announcement effect is dominant for (the log of) loan maturity and for whether a loan is Libor-denominated. We note that the absorption regression in Column (5) does not produce the correct standard errors due to the non-normality of the dependent variable, and we thus estimate a Poisson specification in Column (6). We cannot include the firm-time fixed effects in the latter specification, and we thus also report specification in Column (5). In sum, we find that the announcement effect is stronger than the implementation effect for all three examined loan characteristics.

8. Conclusion

We examine the compositional effects of Switzerland's countercyclical capital buffer (CCyB), a specific targeted macroprudential policy. The impact of its activation was substantial, although it varied considerably across Swiss banks, reflecting the substantial difference in their mortgage exposures, both in total amounts and (more importantly for our application) in relative terms, e.g., as a percentage of total assets.

Our empirical strategy naturally employs the CCyB activation, its timing, and its variation across banks in terms of the resulting capital requirements, to identify the potential impact on lending behavior in other credit categories. The credit register data from the SNB let us account for credit demand through saturation with business-time-level fixed effects. Thus, we identify if and how the CCyB activation spills over in altering the *supply* of bank credit to sectors other than those directly affected by the capital surcharge.

We find that the CCyB activation and implementation lead to both an increase in the amount and the cost of lending to corporations, and especially to small firms and somewhat to those active in commercial real estate (for non-mortgage credit).

A targeted macroprudential policy to squeeze lending in one place leads to an expansion of lending in another adjacent place. Such spillovers may not be unexpected or even suboptimal from the policymaker's perspective, but it seems to be an inevitable part of designing a targeted policy. Our estimates suggest that an expansion in lending in other areas than those targeted indeed took place in Switzerland.

While our empirical identification strategy allows us to estimate the compositional effects, some questions remain. Our current data do not allow us to indicate where precisely the effect may originate: Are the loan officers or branch managers somehow incentivized to keep on lending, or do our findings derive from changes in the pattern of loan applications? Need the funds that are raised be lent out? Are banks forced to compete for market share in those adjacent lending areas? Our work has nothing to say about these questions and we leave therefore them for future research.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.jfi.2022.100965.

References

Aiyar, S., Calomiris, C.W., Wieladek, T., 2014. Does Macro-Pru Leak? Evidence from a UK Policy Experiment. J. Money Credit Bank. 46, 181–214.

Aiyar, S., Calomiris, C.W., Wieladek, T., 2016. How Does Credit Supply Respond to Monetary Policy and Bank Minimum Capital Requirements? Eur. Econ. Rev. 82, 142–165.

Altavilla, C., Boucinha, M., Holton, S., Ongena, S., 2021. Credit Supply and Demand in Unconventional Times. J. Money Credit Bank. 53, 2071–2098.

Auer, R., Ongena, S., 2016. The Countercyclical Capital Buffer and the Composition of Bank Lending, Bank for International Settlements, Basel, Working Paper 593.

Auer, S., Ganarin, M., Towbin, P., 2017. International Banking and Cross-Border Effects of Regulation: Lessons from Switzerland. Int. J. Central Bank. 13, 65–93.

Basten, C., 2020. Higher Bank Capital Requirements and Mortgage Pricing: Evidence from the Countercyclical Capital Buffer. Rev. Finance. 24, 453–495.

Basten, C., Koch, C., 2015. Higher Bank Capital Requirements and Mortgage Pricing: Evidence from the Countercyclical Capital Buffer, Bank for International Settlements, Basel, Working Paper 511.

Behncke, S., 2020. Effects of Macroprudential Policies on Bank Lending and Credit Risks, Swiss National Bank, Bern, Working Paper 6.

Berger, A.N., DeYoung, R., Flannery, M.J., Lee, D., Öztekin, Ö., 2008. How Do Large Banking Organizations Manage Their Capital Ratios? J. Financ. Serv. Res. 34, 123–149.

Bertrand, M., Duflo, E., Mullainathan, S., 2004. How Much Should We Trust Differences-in-Differences Estimates? Q. J. Econ. 119, 249–275.

Bichsel, R., Lambertini, L., Mukherjee, A., Wunderli, D., 2021. The Pass-through of Bank Capital Requirements to Corporate Lending Spreads. J. Financ. Stabil. Forthcoming.

Brei, M., Gambacorta, L., 2016. Are Bank Capital Ratios Pro-cyclical? New Evid. Perspect. Econ. Policy. 31, 357–403.

Bridges, J., Gregory, D., Nielsen, M., Pezzini, S., Radia, A., Spaltro, M., 2014. The Impact of Capital Requirements on Bank Lending, Bank of England, London, Working Paper 486.

Buch, C.M., Goldberg, L.S., 2017. Cross-border Prudential Policy Spillovers: How Much? How Important? Evidence from the International Banking Research Network. Int. J. Central Bank. 13, 505–558.

Célérier, C., Kick, T., Ongena, S., 2020. Taxing Bank Leverage, University of Toronto, Toronto ON, Mimeo.

Chakraborty, I., Goldstein, I., MacKinlay, A., 2020. Monetary Stimulus and Bank Lending. J. Financ. Econ. 136, 189–218.

Chodorow-Reich, G., 2014. The Employment Effects of Credit Market Disruptions: Firm-level Evidence from the 2008-09 Financial Crisis. Q. J. Econ. 129, 1–59.

Chodorow-Reich, G., Darmouni, O., Luck, S., Plosser, M., 2021. Bank liquidity provision across the firm size distribution. J. Financ. Econ. Forthcoming.

Danthine, J.-P., 2012. Taming the Financial Cycle, 30th SUERF Colloquium, Zurich, Speech 5 September 2012.

De Jonghe, O., Dewachter, H., Mulier, K., Ongena, S., Schepens, G., 2020. Some borrowers are more equal than others: bank funding shocks and credit reallocation. Rev. Finance 24, 1–43.

De Jonghe, O., Dewachter, H., Ongena, S., 2020. Bank capital (requirements) and credit supply: evidence from pillar 2 decisions. J. Corp. Finance 60. Forthcoming.

Degryse, H., De Jonghe, O., Jakovljevic, S., Mulier, K., Schepens, G., 2019. Identifying credit supply shocks with bank-firm data: methods and applications. J. Financ. Intermed. Forthcoming.

Dell'Ariccia, G., Laeven, L., Marquez, R., 2014. Real interest rates, leverage, and bank risk-taking. J. Econom. Theory 149, 65–99.

Favara, G., Ivanov, I., Rezende, M., 2021. GSIB surcharges and bank lending: evidence from US corporate loan data. J. Financ. Econ. Forthcoming.

Ferrari, S., Pirovano, M., Rovira Kaltwasser, P., 2017. The Impact of Sectoral Macroprudential Capital Requirements on Mortgage Lending: Evidence from the Belgian Risk Weight Add-on, University Library of Munich, Germany, MPRA Paper.

FINMA, 2012. Mortgage Financing: FINMA Recognises New Minimum Standards, FINMA, Bern, News.

Fischer, A.M., Zachmann, L., 2018. The Effect of Self-financed Investors on Local House Prices, Swiss National Bank, Zurich, Mimeo.

Gropp, R., Mosk, T.C., Ongena, S., Wix, C., 2019. Bank Response to Higher Capital Requirements: Evidence from a Quasi-Natural Experiment. Rev. Financial Studies 32, 266–299.

Houston, J.F., Lin, C., Ma, Y.U.E., 2012. Regulatory Arbitrage and International Bank Flows. J. Finance 67, 1845–1895.

Igan, D., Kang, H., 2011. Do Loan-to-Value and Debt-to-Income Limits Work? Evidence from Korea, International Monetary Fund, Washington DC, Working Paper 297.

Ioannidou, V.P., Ongena, S., Peydró, J.-L., 2015. Monetary Policy, Risk-Taking and Pricing: Evidence from a Quasi-Natural Experiment. Rev. Finance 19, 95–144.

Irani, R.M., Iyer, R., Meisenzahl, R.R., Peydró, J.-L., 2021. The Rise of Shadow Banking: Evidence from Capital Regulation. Rev. Financial Studies 34, 2181–2235.

Jiménez, G., Ongena, S., Peydró, J.-L., Saurina, J., 2014. Hazardous times for monetary policy: what do twenty-three million bank loans say about the effects of monetary policy on credit risk-taking? Econometrica 82, 463–505.

Jiménez, G., Ongena, S., Peydró, J.-L., Saurina, J., 2017. Macroprudential policy, countercyclical bank capital buffers and credit supply: evidence from the spanish dynamic provisioning experiments. J. Polit. Econ. 125, 2126–2177.

Khwaja, A.I., Mian, A., 2008. Tracing the Impact of Bank Liquidity Shocks: Evidence from an Emerging Market. Am. Econ. Rev. 98, 1413–1442.

Luck, S., Santos, J.A.C., 2021. The Valuation of Collateral in Bank Lending, Federal Reserve Bank of New York, New York NY, Mimeo.

Mayordomo, S., Rodríguez-Moreno, M., 2018. Did the Bank Capital Relief Induced by the Supporting Factor Enhance SME Lending? J. Financ. Intermed. 36, 45–57.

McCann, F., O'Toole, C., 2019. Cross-Border Macroprudential Policy Spillovers and Bank Risk-Taking. Int. J. Central Bank. 15, 267–311.

Neuberger, D., Pedergnana, M., Räthke-Döppner, S., 2008. Concentration of Banking Relationships in Switzerland: The Result of Firm Structure or Banking Market Structure. J. Financ. Serv. Res. 33, 101–126.

Neuberger, D., Räthke, S., Schacht, C., 2006. The number of bank relationships of SMEs: a disaggregated analysis for the swiss loan market. Econ. Notes 35, 1–36.

Ongena, S., Popov, A.A., Udell, G.F., 2013. When the cat's away the mice will play": does regulation at home affect bank risk-taking abroad? J. Financ. Econ. 108, 727–750.

Ongena, S., Schindele, I., Vonnák, D., 2021. In lands of foreign currency credit, bank lending channels run through? J. Int. Econ. Forthcoming.

Ongena, S., Smith, D.C., 2000. What determines the number of bank relationships? cross-country evidence. J. Financ. Intermed. 9, 26–56.

Paravisini, D., Rappoport, V., Schnabl, P., 2020. Specialization in Bank Lending: Evidence from Exporting Firms. National Bureau for Economic Research, Cambridge MA. Discussion Paper 21800.

Qian, J., Strahan, P.E., 2007. How Law and Institutions Shape Financial Contracts: The Case of Bank Loans. J. Finance 62, 2803–2834.

Temesváry, J., 2018. The Role of Regulatory Arbitrage in U.S. Banks' International Lending Flows: Bank-level Evidence. Econ. Inq. 56, 2077–2098.

Wold, E.G., Juelsrud, R.E., 2020. Risk-weighted Capital Requirements and Portfolio Rebalancing. J. Financ. Intermed. Forthcoming.