The Pass-through of Bank Capital Requirements to Corporate Lending Spreads*

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Abstract

We study the impact of higher bank capital requirements on corporate lending spreads using granular bank- and loan-level data. Our empirical strategy employs the heterogeneity in capital requirements across banks and time of implementation in Switzerland. We find that changes in the capital deviation from the regulatory minimum affect lending spreads asymmetrically. In response to a reduction in the capital deviation, banks with deficits with respect to their risk-weighted capital requirement raise spreads relative to banks with surpluses and de-leverage. Banks respond to higher requirements by raising spreads and, for deficit banks, by cutting lending.

JEL codes: E44, G21, G28
Keywords: bank capital requirements; lending spreads; bank regulation

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1 Introduction

Bank capital requirements have been tightened following the global financial crisis. While increasing minimum capital requirements has the advantage of making financial institutions more resilient, it may adversely affect borrowing costs and lending volumes. This paper studies how changes in bank capital requirements in Switzerland affect lending spreads.

Identifying the effects of higher capital requirements on bank pricing policies is challenging for a number of reasons. The analysis should include significant variation, over time but especially across banks, in capital regulation. Lack of cross-sectional variation makes it difficult to disentangle the effect of capital regulation from that of aggregate conditions. The changes in regulation should be exogenous with respect to the bank's risk taking and balance sheet and the econometrician must be able to control for demand.

In this paper, we identify the impact of changing capital requirements on lending rates, utilizing a variety of regulatory policies that were exogenous to banks' risk-taking policies and balance sheets but had heterogeneous effects across different banks. Using bank- and loan-level supervisory data for banks operating in Switzerland, we analyze the impact of several large capital regulatory changes, which we label "regulatory events". These include the introduction of international standards such as Basel II and Basel III, targeted capital requirements for systemically important banks (SIBs) in Switzerland (too-big-to-fail) as well as regulatory policies specific to small- and medium-sized financial institutions (end of the Cantonal Bank Rebate and Pillar 2). Other regulatory changes, such as the introduction of the minimum leverage ratio requirement for the two big banks UBS and Credit Suisse during the financial crisis or the activation of the sectoral countercyclical capital buffer (CCyB), are not exogenous and therefore are not considered as "regulatory events." The advantage of focusing on Switzerland is that international as well as Swiss-specific regulatory changes were implemented at different times and affected different groups of banks, leading to substantial time-series and cross-sectional variation in capital requirements.

For each bank, period and capital requirement, we construct a capital deviation variable as the difference between the actual capital ratio and its regulatory target. All changes in minimum capital ratios in our sample period specify a date when the new regulation comes into force and a phase-in period at the end of which the bank is expected to be fully compliant. We calculate the required capital ratio in two ways: phase-in and look-through. The look-through required capital ratio is the new requirement the bank should satisfy by the end of the phase-in period. The phase-in required capital ratio is the linear interpolation between the old and the new requirement. Suppose that, in period t, new regulation raises the required capital ratio from 8 to 12 percentage points with a phase-in period of 8 quarters. The look-through required capital ratio is equal to 0.12 starting from period t; the phase-in required capital ratio is equal to 8 percent in period t and it increases by 0.5 percent every following quarter until it reaches 12 percent in $t + 8$. A bank has a capital surplus if its actual capital ratio is above its regulatory target; it has a capital shortfall or deficit otherwise.[1]

A bank with capital above requirement does not need to take any immediate capital action from the regulatory standpoint; on the other hand, a bank with capital below the required level needs to improve its capital position. Pressure to do so may come from the market, for example via an increase in funding costs, or to avoid intervention by the supervisory authority. To reduce its capital deficit, a bank can change its lending policies either by raising spreads in an effort to increase retained earnings, or by cutting lending; if the shortfall concerns the risk-weighted capital ratio, the bank can reduce its risk exposure or increase it and gamble for resurrection. In general, we expect loan pricing to be differentially impacted by capital surpluses and deficits.

Our main results can be summarized as follows. First, we find an asymmetric relation between banks' risk-weighted regulatory capital situation and lending spreads. The relationship is positive and economically small for banks with a capital surplus compared to requirements but negative and economically significant for banks with a capital deficit. A 1 percentage point increase in capital surpluses leads to a 2 to 3 basis points (bps) higher lending spread for such banks. This estimated effect suggests that banks pass through to borrowers the cost of holding additional capital. For these banks, a 1 percentage point worsening of their capital deficits (say from -2 to -3 percent) leads to an increase in lending spreads of about 20 bps. This negative relation between capital deviation and lending spreads indicates that a deterioration of banks' regulatory capital shortfall due, for example, to a tightening of requirements, leads to higher

[1]Notice that the phase-in required capital ratio we calculate in the paper may not coincide with the legally binding phase-in capital requirement used by the Swiss National Bank or the Swiss Financial Market Supervisory Authority FINMA.

lending spreads. For these banks, the rise in spreads is accompanied by a reduction in lending growth concentrated in the risky segment. This is consistent with deficit banks improving their capital position by raising lending rates and increasing retained earnings.

Second, results based on the two global systemically important banks (G-SIBs) show that the relation between capital surplus and lending spreads is also negative when focusing on the leverage ratio (rather than risk-weighted) capital metric. The big banks reduce spreads and raise lending volumes when the leverage ratio is above its target. On the other hand, they lower spreads when their leverage ratio surplus improves; this effect is driven by a shift toward safer loans and it is consistent with these banks using the available regulatory space and expanding their lending volume.

Third, we find that a tightening of capital requirements is accompanied by an increase in lending spreads by the banks subjected to such tightening around the implementation period. This effect is independent of the banks' capital deviations relative to the regulatory target.

Our results suggest that a tightening of regulation is accompanied by a temporary tightening of borrowing conditions around the implementation period. This mainly affects firms borrowing from deficit banks, i.e. banks facing a capital shortfall. The mechanism that emerges from the analysis is one of raising rates and cutting lending, particularly in the riskier segment. Hence, regulation is accompanied by a temporary tightening of borrowing conditions that is more severe if more banks have capital deficits. From the policy perspective, our results speak to the importance of phase-in periods.

The empirical impact of capital shocks on bank lending has been an area of active research. One approach to address the identification issues alluded earlier is to utilize a 'natural experiment' and the seminal contribution in this area is Peek and Rosengren (1997). They estimate the impact of a capital shock under Basel I to Japanese banks on lending by bank branches in the United States. They find that a 1 percentage point reduction in the parent banks' capital ratio led to a 6 percent decline in loans extended by the U.S. branches. Gropp, Mosk, Ongena and Wix (2018) use the exogenous variation in the bank selection rule of the 2011 EBA capital exercise to analyze the balance sheet adjustment of banks subject to a change in capital requirement. Jiménez, Ongena, Peydró and Saurina (2017) utilize credit-register loan-level data and exploit the time-varying heterogeneity in dynamic provisioning requirements in Spain; Aiyar, Calomiris and Wieladek (2014) and Francis and Osborne (2009) exploit bank-specific capital requirements set by regulatory institutions in the United Kingdom, but lack firm- and loan-level data and focus on total lending volume at the bank level. De Jonghe, Dewachter and Ongena (2016) use bank-specific capital requirements in Belgium matched with corporate credit register data that conveys information on the total quantity of credit granted to every firm. Our contribution to this literature is twofold. First, we use the cross-section and time-series heterogeneity in the variation of capital requirements across Swiss banks. Second, our variable of interest is the capital deviation from target and we document an asymmetric response to a capital requirement change depending on whether the bank has a capital surplus or a deficit. Third, our analysis covers both risk-weighted capital ratio and leverage ratio requirements.

The rest of paper is structured as follows. Section 2 describes the capital regulation changes used in our study. Section 3 describes the data and presents descriptive evidence. Section 4 presents the results for the risk-weighted capital ratio deviation and section 5 for the leverage ratio deviation. Section 6 analyzes the mechanism; section 7 studies the role regulatory events and reports a number of robustness exercises. Section 8 concludes.

2 Capital Regulation Events in Switzerland

Banks in Switzerland are subject to regulatory capital requirements. These requirements stipulate that a bank's capital must exceed a certain proportion of its risk-weighted and, during our sample period for systemically important institutions, unweighted assets. Furthermore, banks have to report their regulatory capital ratios. These ratios play a key role for the assessment of the banks' capital adequacy and are used both by authorities and market participants. The regulatory framework in place is based on the international standards. However, Swiss specificities apply both regarding design and severity.

In Switzerland, new regulation or changes in existing regulation are proposed by the relevant authority,[2] which opens a consultation with affected financial institutions that typically lasts a few months. After the consultation period a new/amended regulation, possibly different from the one originally proposed, is officially adopted by means of issuing official documents that state the date in which the new requirement enters into force and the phase-in period, namely

[2]FINMA and/or the Ministry of Finance can propose new regulation; a decision is then taken by Federal Council, or Parliament or FINMA, depending on the kind of regulation.

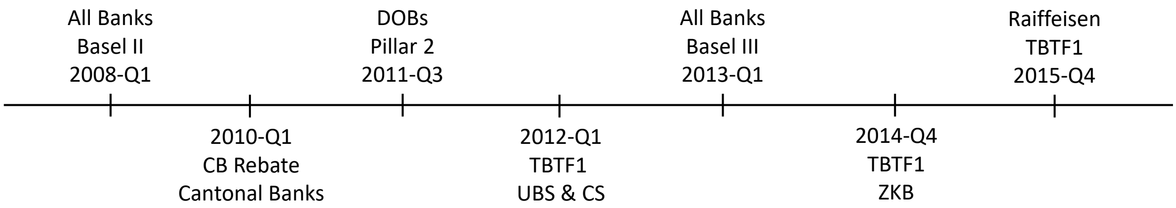


Figure 1: Swiss Regulatory Events

the deadline by which affected banks must be fully compliant.

Figure 1 illustrates the time line for the regulatory events considered in our study; for each event, we report: a) the implementation date, namely the date in which the new regulation came into force; b) the regulation; c) the banks affected. In chronological order, the regulatory events considered are: Basel II, the end of the Cantonal Bank Rebate (CB Rebate), Pillar 2, Too-Big-To-Fail 1 (TBTF1), and Basel III.

Basel II Basel II was implemented in Switzerland in the first quarter of 2008 and applied to all banks in our sample; the quantitative threshold for risk-weighted capital was set at 8 percent plus a buffer requirement of 1.6 percent (Swiss finish) to a total of 9.6 percent.

CB Rebate Cantonal banks are commercial banks operating mainly within the geographical area of their canton (state) and in which cantonal governments hold significant stakes. Most cantonal banks enjoyed a reduction in required capital, called the Cantonal Bank Rebate, thanks to exhaustive guarantee by cantonal governments. This preferential treatment was removed in the first quarter of 2010, leading to a substantial increase in their capital requirements.

Pillar 2 In 2011-Q3 FINMA replaced the standard buffer required by all institutions, i.e. the 1.6 percent Swiss finish of Basel II, with Pillar 2 requirements for banks in category 2 to 5; these requirements take into account the overall risk of individual financial institutions and de-facto resulted in heightened minimum capital requirements for domestically oriented banks, namely for all banks except UBS and Credit Suisse (CS).

TBTF1 In 2012-Q1 additional capital requirements applying to banks considered systemically important from a domestic perspective, UBS and CS, were introduced in Switzerland. These were part of a reform program, which we refer to as TBTF1, aimed at addressing the too-big-to-fail issue in Switzerland. As a consequence, their quality adjusted going-concern capital requirements (capital to cover losses from current operating activities) were increased and gone-concern requirements (capital instruments to enable a restructuring or orderly resolution) were introduced, which resulted in a tightening of required risk-weighted and unweighted capital ratios. In 2014-Q4 the Cantonal Bank of Zürich (ZKB) was designated systemically important from a domestic perspective and therefore became subject to TBTF1 regulation; likewise for Raiffeisen in 2015-Q4.

Basel III In 2013-Q1, the Basel III revised capital standards were introduced. This led to a further tightening of the capital requirements, mainly through tighter quality requirements and an increase of risk-weighting for exposure to derivatives and counter-party risk in particular for the big banks.

In our empirical analysis, we create an indicator variable for each regulatory event described above. This indicator variable is equal to one only for the affected banks in the implementation period, the four quarters before and the four quarters after it, and zero otherwise. For example, the indicator variable for TBTF1 is equal to one between 2011-Q1 and 2013-Q1 for UBS and Credit Suisse, between 2013-Q4 and 2015-Q4 for ZKB, and between 2014-Q4 and 2016-Q4 for Raiffeisen. We activate the indicator four quarters before implementation because these regulatory changes were anticipated: the beginning of the consultation period happened on average four to five quarters before the change came into force. The regulation indicator is also set equal to one for four quarters after implementation because these regulatory events provided phase-in periods of at least one calendar year.

Some regulatory changes that took place in our sample period are not treated as "events" in our analysis. In the fourth quarter of 2008, following the public rescue of Switzerland's biggest bank UBS in the wake of the global financial crisis, the two big banks' risk-weighted buffer requirements were increased and FINMA, the Swiss supervisory authority, newly subjected them to a minimum leverage ratio requirement of 3 percent. Unlike other events, these regulatory changes were implemented without pre-announcement and/or consultation and explicitly in response to (and in the middle of) the financial crisis. In our analysis, these requirement changes are fully accounted for in the required capital ratios but they are not treated as events because they were unanticipated and possibly not exogenous to global financial conditions. The introduction of the revised international standards governing the capital requirements for market risks, referred to as Basel 2.5, in 2011-Q1 left the minimum capital ratios unchanged for the two big banks, UBS and Credit Suisse, but potentially raised their risk-weighted assets. We do not have such detailed information and therefore do not treat Basel 2.5 as a regulatory event. In January 2013 the sectoral countercyclical capital buffer (CCyB) targeted at mortgage loans financing residential property was activated and set at a level of 1 percent; it was further increased to 2 percent in January 2014. The sectoral CCyB differs from all other regulatory events considered because, by making residential mortgages more expensive than commercial lending in risk-weighted terms, it encouraged substitution towards commercial lending, as documented by Auer and Ongena (2016). For this reason, the required risk-weighted capital ratios used in our study include the CCyB but we do not treat it as a regulatory event. We cannot include a major modification of too-big-to-fail regulation for SIBs, referred to as too-big-to-fail 2, in our events because it occurred at the end of our sample period.

The extent of cross-section, time-series heterogeneity in requirements among Swiss financial institutions can be seen in Figure 2, which graphs the time series of the required total capital over risk-weighted assets for all banks during our sample period.

3 Data and Descriptive Evidence

For our analysis, we utilize multiple confidential datasets of the Swiss National Bank (SNB) and the Swiss Financial Market Supervisory Authority (FINMA). The loan-level data is obtained from the lending rate statistics (KREDZ). Every new loan arrangement (excluding residential mortgages) is reported at a monthly frequency by all banks whose total yearly lending to domestic non-financial corporations exceeds CHF 2 billion. A new loan arrangement is either a new loan granted or an old loan to which significant changes have been made (e.g. change in maturity or pricing).[3] This new dataset is one of the strengths of our study as it allows us to use new credit granted as opposed to the existing stock of loans which is commonly used in

[3]For loans with multiples tranches, each tranche is reported separately.

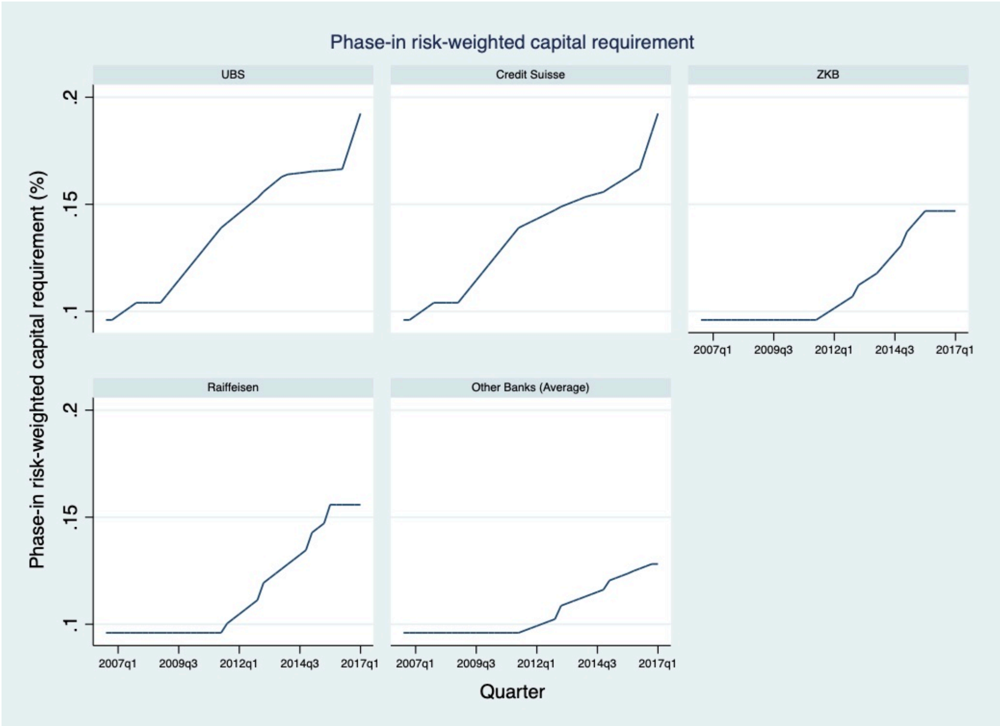


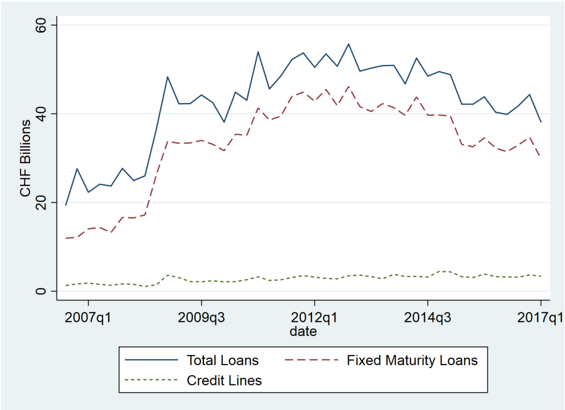
Figure 2: Required Total Capital to Risk-weighted Assets

banking studies.[4] Loans can be of two types in our dataset: fixed maturity and credit lines. Fixed maturity loans represent almost 90 percent of quarterly total loan volume as reported in our dataset. We summarize loan characteristics in Appendix A. Figure 3a reports the quarterly volume of new loan arrangements. Figure 3b is is the average loan spread weighted by loan size, where the spread is the interest rate charged on the loan over the 3-month Swiss Franc (CHF henceforth) Libor. Table 11 in Appendix A reports the loan types and their frequency over the entire sample and up to 2008-Q4.

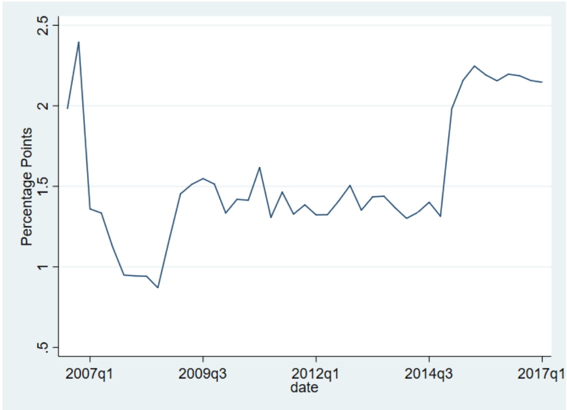
Almost half of all new loans to firms are secured by real estate and the relative frequency of loan types did not change substantially after the financial crisis. Almost 80 percent of all loans are collateralized and/or guaranteed, as reported in Table 12 in Appendix A. 1 percent of all loans in our dataset are issued by a syndicate of banks.

Other loan characteristics in KREDZ includes the size, maturity, type, and type of collateral (if any). It includes firm location (canton), the industry in which the firm operates, an identifier for firm size, and a combined firm- and loan-risk indicator. However, it does not include an

[4]A few shortcomings of using the loan stock for analysis are that it can be influenced by write-offs, changes in reporting, and exchange-rate changes.



(a) Loan Volume



(b) Average Loan Spread[6]

Figure 3: Loan Characteristics

unique firm identifier. Firms in our sample are classiffied into 6 size categories based on total assets. The cutoffs are CHF 1 Million, CHF 5 Million, CHF 25 Million, CHF 100 Million and greater than CHF 100 Million. The remaining category includes observations for which size was reported as unclassiffied (see Table 13, Appendix A). We assign an indicator variable taking values between 1 and 5 for the size categories and 0 for the unclassiffied, respectively. We label the composite indicator of firm-loan riskiness, Probability of Default (PD) class. This is categorized into five classes ranging from low (1) to high (5) and a sixth class for unclassiffied observations (see Table 14, Appendix A). We match this dataset with supervisory data on capital requirements, capital and bank characteristics.[5] Our matched panel dataset includes data from 2006-Q3 to 2017-Q1.

We have 20 loan-granting banks in our sample; they are listed in Appendix B and they represent over 80 percent of total assets of the Swiss banking sector.[7] All banks in our sample are subject to regulation for their risk-weighted capital ratios; systemically important institutions are additionally subject to leverage ratio regulation. Regarding risk-weighted regulation, our study focuses on the ratio of total capital to risk-weighted assets (TC/RWAs), which represents the most comprehensive risk-weighted capital adequacy ratio; the leverage ratio (LR) is defined as the ratio of total capital to unweighted assets. Total capital consists of Tier 1 capital plus

[5] Banks report at the parent level and/or at the highest level of consolidation (group). We use the highest level of consolidation for our analysis because capital requirements are imposed at the highest level of consolidation.

[6] Weighted by loan size.

[7] Our sample does not include foreign-controlled banks, branches of foreign banks and private banks. We consider six different bank characteristics: total assets, cash/assets, debt/assets, return on assets, risk-weighted assets/assets and the relevant capital surplus(es).

potentially loss-absorbing debt instruments and unweighted assets are broadly defined as a banks' total balance sheet assets and relevant off-balance sheet positions. Table 1 presents the variables used in our regressions and their summary statistics.

Table 1: Summary Statistics

Variable	**Units**	**N**	**Mean**	**SD**	**5^{th} pct**	**Median**	**95^{th} pct**
Panel A: Loan characteristics							
Loan Spread	%	1220724	2.5	1.9	0.5	1.9	6.6
Loan Maturity	Years	762402	2.2	2.8	0.1	1.0	8.0
Loan Amount	CHF Mill	1220724	1.5	6.0	0.1	0.4	5.5
Single-Issuer Loan	Indicator[1]	1220724	See Appendix A (Table 11)				
Probability of Default Class	0-5[2]	1220724	See Appendix A (Table 14)				
Loan Type	Indicator	961776	See Appendix A (Table 11)				
Loan Collateral Type	Indicator	961776	See Appendix A (Table 12)				
Panel B: Firm characteristics							
Firm Size	Indicator	1220724	See Appendix A (Table 13)				
Firm Location	Indicator	1220724	26 cantons & Liechtenstein				
Firm Industry	Indicator	1220724	38 industries (NOGA 2008 codes)				
Panel C: Bank capital deviation ratios							
			Phase-in target, including buffer				
Total Capital/RWAs deviation	%	1220724	5.3	2.9	1.1	5.1	9.5
Total Capital/Assets deviation	%	1220724	5.9	2.6	1.5	6.6	9.6
			Look-through target, including buffer				
Total Capital/RWAs deviation	%	1220724	3.9	3.3	-1.4	3.8	9.2
Total Capital/Assets deviation	%	1220724	5.4	3.1	-0.1	7.0	9.6
Panel D: Bank characteristics							
Bank Assets	CHF Bill	1220724	447	577	14.2	155.0	1460
Cash/Assets	%	1220724	4.4	4.3	0.3	3.0	12.8
Debt[3]/Assets	%	1220724	15.6	4.9	8.8	14.9	24.6
Return on Assets	%	1220724	0.3	0.3	-0.1	0.3	0.8
Risk-weighted Assets/Assets	%	1220724	40	10	20	40	60

This table reports the summary statistics for the sample period 2006-Q3 - 2017-Q1.

[1] indicator = 0 if syndicated loan

[2] 0: undefined, 1: low, ..., 5: high

[3] Excluding deposits

Figure 4 reports actual TC/RWAs and LR, calculated as an average weighted by bank assets;[8] one can clearly see the worsening of risk-weighted capital positions during the global financial crisis as well as the increase in both ratios thereafter. In Figure 5 we report the density of capital deviations for our two capital measures; panels (a) and (b) pertain to phase-in targets whereas panels (c) and (d) pertain to look-through targets. For the risk-weighted deviation,

[8]The LR is measured as average of all banks, not only of systemically important banks.

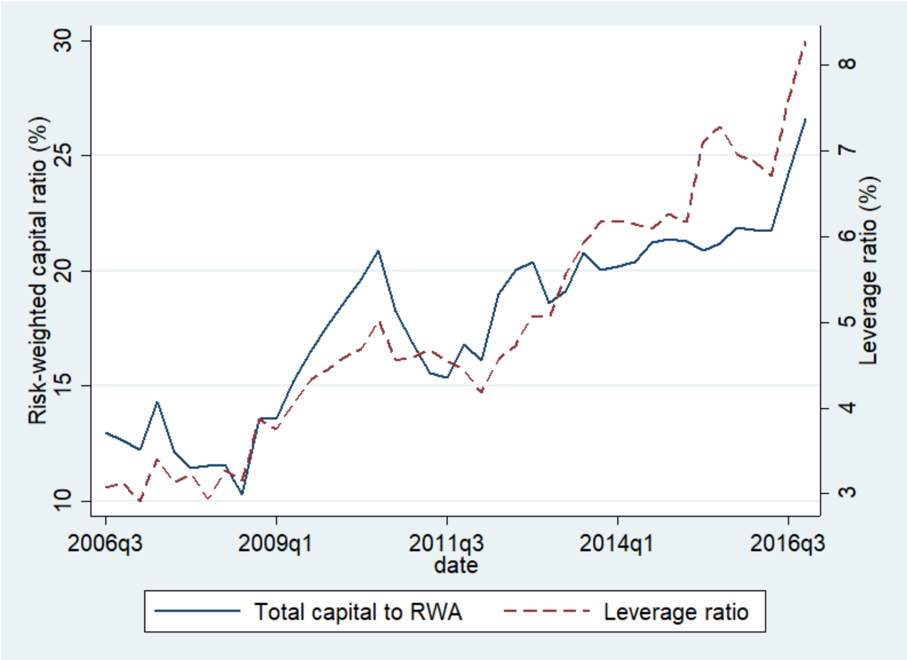
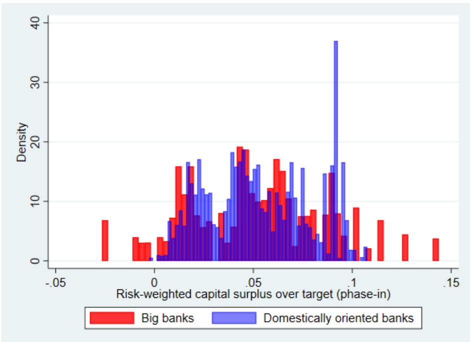


Figure 4: Capital Ratios

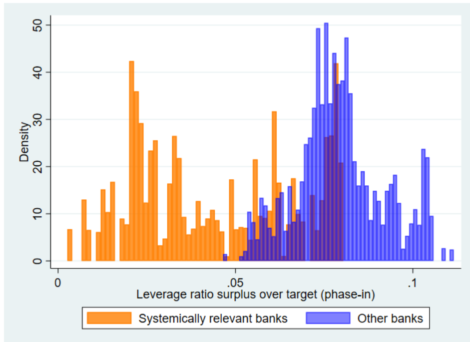
we show separately the densities of the two big banks and of all other banks that we refer to as domestically oriented banks (DOBs); for the leverage ratio deviation, we report separately the density of SIBs, which are subject to the leverage ratio requirement, and the density of all other banks, which are not subject to such regulation in our sample period.[9] For non-systemically important financial institutions, the leverage ratio deviation is calculated assuming a leverage ratio target of zero. Conditional on a capital measure, look-through deviations are lower than their phase-in counterpart; this confirms that our sample period captures the process of adjustment undertaken by Swiss banks to their new and higher required capital ratios. The distributions of capital deviations of large financial institutions, big and systemically important, have higher standard deviations than those of other banks. The leverage ratio deviation distributions, phase-in and look-through, clearly display a bimodal distribution where observations around the left mode almost entirely belong to SIBs. Notice that the distance between the two modes is larger than the average leverage ratio requirement for SIBs in our sample period. The distribution of look-through risk-weighted capital deviations is also bimodal, with the lower mode belonging to the big banks. This evidence alludes to important differences in

[9]As noted earlier, two domestically oriented banks (ZKB and Raiffeisen) were designed as SIBs in 2014Q4 and 2015Q4, respectively, and became subject to leverage ratio regulation.

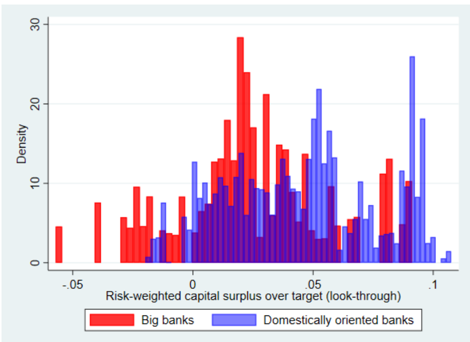
the way small and large financial institutions operate, with the latter being more leveraged and holding riskier assets but smaller capital buffers, as pointed out by Rime (2001). Negative deviations are non-negligible and they almost entirely concern the big banks. Risk-weighted total capital shortfalls of big banks represent 1.7 and 5.6 percent of all observations for the phase-in and look-through definitions, respectively; the corresponding percentages for the leverage ratio shortfalls of systemically important banks are 0 and 5.1. These capital deficits speak to the effort undertaken by the large Swiss financial institutions to raise their capital ratios during our sample period.



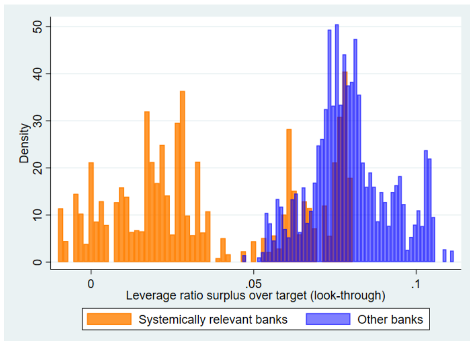
(a) **Total Capital/RWAs Deviation (PI)**



(b) **Leverage Ratio Deviation (PI)**



(c) **Total Capital/RWAs Deviation (LT)**



(d) **Leverage Ratio Deviation (LT)**

Figure 5: Capital Deviation Density

4 Risk-weighted Capital Deviation from Target

To understand the relationship between loan pricing and bank capital deviation from its target, we estimate loan-level regressions of the following type:

$$\begin{aligned}\text{Loan Spread}_{i,j,t} =& \alpha\,\text{Deviation}_{i,t-1} + \gamma\,\text{Bank}_{i,t-1} + \phi\,\text{Firm-Loan}_{j,t} \\ &+ \varphi\,\text{Neg Rate}_t + \beta\,\text{Yield}_t + \mu_i + \nu_t + \epsilon_{i,j,t}.\end{aligned} \tag{1}$$

Loan $\text{Spread}_{i,j,t}$ measures the spread between the interest rate charged for loan j by bank i at time t and the 3-month CHF Libor rate at time t. $\text{Deviation}_{i,t-1}$ is a capital deviation variable for bank i at time $t-1$. For each bank and period, we calculate the capital deviation variables as described in section 1. These are listed in Table 2 alongwith the regulatory event indicator variables used in the regressions. $\text{Bank}_{i,t-1}$ is a vector of bank-specific characteristics, namely

Table 2: Capital Deviation Variables

Name	Value
PI/LT Deviation	Phase-in/look-through TC/RWAs deviation
I(PI/LT Deviation)	1 if the Phase-in/look-through TC/RWAs deviation is positive, 0 otherwise
PI/LT Surplus	Phase-in/look-through TC/RWAs deviation if positive, 0 otherwise
PI/LT Deficit	Phase-in/look-through TC/RWAs deviation if negative, 0 otherwise
I(LR Deviation)	1 if the look-through LR deviation is positive, 0 otherwise
LR Deviation	look-through LR deviation
LR Surplus	look-through LR deviation if positive, 0 otherwise
LR Deficit	look-through LR deviation if negative, 0 otherwise
I(Basel II)	1 for all banks between quarter 2007-Q1 and 2009-Q1, 0 otherwise
I(CB Rebate)	1 for cantonal banks between quarter 2009-Q1 and 2011-Q1, 0 otherwise
I(Pillar 2)	1 for all banks except UBS and Credit Suisse between quarter 2010-Q3 and 2013-Q3, 0 otherwise
I(Basel III)	1 for all banks between quarter 2012-Q1 and 2014-Q1, 0 otherwise
I(TBTF1)	1 for UBS and Credit Suisee between quarter 2011-Q1 and 2013-Q1, for ZKB between 2013-Q4 and 2015-Q4, for Raiffeisen between quarter 2014-Q4 and 2016-Q4, 0 otherwise

size (log of total assets), liquidity (cash/assets ratio), debt (medium term notes and bonds over assets), ROA (net income divided by assets). Note that all bank controls, including the capital surplus, are lagged by one period to avoid simultaneity bias. The vector $\text{Firm-Loan}_{j,t}$ includes controls for firm size, industry, location, loan amount, loan type, loan maturity, collateral type and PD class. To distinguish between fixed maturity loans and credit lines, we include the indicator variable Fixed Maturity$_{i,j,t}$, which takes a value equal to 1 if the loan has a fixed maturity and 0 otherwise. Neg Rate$_t$ is an indicator variable that takes the value of 1 starting in 2015-Q1, when the SNB moved the target range for its policy rate, the 3-month CHF Libor, into negative territory. Yield$_t$ is the slope of the yield curve as proxied by the difference between the 10-year and 3-month yields on Swiss Confederation bonds. Bank fixed effects, μ_i, control for any unobserved systematic heterogeneity at the bank level and time fixed effects, ν_t, control for macroeconomic conditions and/or demand effects common to all banks at a given point in time.

Our main interest in the effect of Deviation$_{i,t-1}$ on Loan Spread; most specifications will include two deviation measures, surplus and deficit, to capture the differential pricing responses to positive and negative capital deviations. In equation (1), α measures the basis point change in the spread caused by a one percentage point increase in the bank's capital deviation measure.

4.1 Phase-in

We first analyze the impact on lending spreads of deviation of the risk-weighted capital ratio from its phase-in target level; the estimation is presented in Table 3. In column (1) we use the capital deviation, PI Deviation, and the indicator variable I(PI Deviation). Banks with phase-in surpluses charge on average lower loan spreads relative to banks with phase-in deficits, as suggested by the negative coefficient on the surplus indicator. At the same time, a one percentage increase in capital surplus is associated with a 2.50 bps increase in lending spreads. Both effects are statistically significant. The positive estimated effect on the phase-in surplus can be interpreted as the cost of holding additional capital and it is in line, although on the lower side, with the range of values (between 5 and 19 bps) reported by Basel Committee on Banking Supervision (2016) and Dagher, Dell'Ariccia, Laeven, Ratnovski and Tong (2016), which estimate the relationship between lending spreads and capital ratios. The negative coefficient on the surplus indicator, however, indicates a difference in pricing behavior between banks with a capital surplus and those with a capital deficit.

In column (2) of Table 3, we explicitly allow for loan spreads to respond differently to phase-in capital surpluses and deficits. The estimated coefficient on PI surplus is 2.3, which is close to the coefficient estimated in column (1); on the other hand, we estimate a coefficient of -

21.45 on PI deficit. A reduction of one percent in a phase-in deficit, i.e. if the deficit falls from -1 percent to -2 percent, is accompanied by a 21.45 bps increase in lending spreads. The results of column (2) suggest that, when capital is above its phase-in target, an increase in the surplus is accompanied by a small but significant increase in lending spreads, which can be interpreted as the bank passing on to customers the cost of higher capital. When capital is below its phase-in target, however, a further reduction in capital and therefore a larger deficit leads to an economically large and significant raise in spreads. Three distinct mechanisms are consistent with the finding of Table 3. The first is that banks with capital deficits experience an increase in funding costs, as they are perceived as riskier and more likely to default. In a monopolistic competitive setting, an increase in the marginal cost may lead to an increase in price. The second mechanism is that banks with capital shortfalls temporarily increase their intermediation margin to boost retained earnings and close their capital gaps. It is well known that banks resist raising equity when their capital buffers are low, which typically happens when equity prices are also low. In fact, the empirical evidence suggests that banks typically improve their capital position by increasing retained earnings. This interpretation is also consistent with the analysis of a capital quality shock in Gerali, Neri, Sessa and Signoretti (2010). A third mechanism may stem from risk taking: undercapitalized banks have less skin in the game and may accordingly lend to riskier firms in an effort to gamble for resurrection. In this case, higher spreads simply reflect higher risk. Our regressions include all loan characteristics, including the probability of default, which should capture the effect of increased risk taking on lending spreads.[10]

Next we investigate whether there are differences in the loan pricing response to capital deviations by large (SIBs) and other smaller banks. In column (3) of Table 3 we repeat the estimation of column (1) but also include the interaction between the phase-in deviation and the SIB indicator, i.e. an indicator variable that takes value of 1 if the banks is systemically important and 0 otherwise. The estimated coefficient on the interaction term is not significant and the coefficients on PI deviation and I(PI deviation) are almost unchanged. In column (4), we include the surplus and deficit variables and allow for their interaction with the SIB indicator. We find that the response to the phase-in surplus is in line with the estimates of

[10]Our findings are robust to using multi-way fixed effects and the results are tabulated in Appendix C.1

Table 3: Phase-in deviation

	(1)	(2)	(3)	(4)
PI deviation	2.50***		2.18***	
	(4.42)		(4.26)	
I(PI deviation)	-0.51***		-0.54***	
	(-2.70)		(-2.98)	
PI surplus		2.30***		2.08***
		(3.92)		(4.01)
PI deficit		-21.45**		-86.59***
		(-2.16)		(-7.75)
PI deviation*I(SIB)			1.15	
			(1.50)	
PI surplus*I(SIB)				0.80
				(1.13)
PI deficit*I(SIB)				64.52***
				(4.20)
Log(Assets)	0.34**	0.35***	0.37***	0.37***
	(2.63)	(2.83)	(2.71)	(2.85)
Cash/assets	-1.22***	-1.20***	-1.29***	-1.26***
	(-3.22)	(-3.26)	(-3.26)	(-3.30)
Debt/Assets	0.91**	0.99**	0.97**	1.03**
	(2.25)	(2.40)	(2.41)	(2.51)
Return on assets	6.23	5.31	5.72	4.94
	(1.64)	(1.27)	(1.47)	(1.16)
Loan Level Controls	Y	Y	Y	Y
Firm Level Controls	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
Observations	1220724	1220724	1220724	1220724
R^2	0.776	0.775	0.776	0.775

This Table reports in columns (1)-(4) estimates from an ordinary least squares regression model. The dependent variable is the loan spread. Phase-in deviation is each banks' risk-weighted capital in relation to its phase-in requirement. I(PI deviation) is an indicator variable equal to one when a bank has a positive level of surplus and zero otherwise. PI surplus is the positive level of surplus and PI deficit is the negative level of surplus. I(SIB) is an indicator variable equal to one during the period a bank is designated to be systemically important. The definition of loan- and firm-level controls can be found in Appendix A. A constant is always included but left unreported. Standard errors are clustered by quarter. t statistics in parentheses, * p<0.1, ** p<0.05, *** p<0.01

column (2) and there is no significant difference between SIBs and the rest of the banks (the interaction of PI surplus with the SIB indicator is not significant); on the other hand, small banks raise loan spreads substantially more (86.59 bps) than SIBs (86.59-64.52=22.07 bps) in response to phase-in deficits.

Looking at bank controls, log bank assets enters positively, thereby suggesting that bigger banks charge higher spreads. This is consistent with the presence of monopolistic competition in the corporate loan sector. We also find a positive relationship between debt and lending spreads; the cash/assets ratio, on the other hand, enters negatively. This effect could be driven by the fact that liquid banks face lower funding costs and reduce lending rates relative to banks with low liquidity. Return on assets does not affect lending spreads. The effects of bank controls is fairly stable in all our regressions and, for brevity, we omit reporting them henceforth.

We do not report our loan and firm controls for brevity; however, they enter our regressions with the expected signs. Fixed maturity loans are characterized by lower interest rates relative to credit lines; larger loans are also cheaper. Uncollateralized loans are charged higher interest rates; among the different types of collateral, loans backed by real estate or land are priced at a premium. Riskier loans, i.e. belonging to higher PD classes, have higher spreads. Syndicated loans represent only 3 percent of our loans and they are cheaper than single-issuer loans. The slope of the yield curve, as proxied by the difference between the 10-year and 3-month yields on Swiss Confederation bonds, positively affects lending spreads in all specifications. Given the maturity transformation activity performed by banks, this positive estimate reflects the higher cost of hedging the interest rate exposure when the yield curve becomes steeper.

As a robustness check, we re-run our risk-weighted phase-in capital deviation but use interacted fixed effects to control for loan demand. These regressions include: a) firm cluster times bank fixed effects to proxy for the same bank lending to the same group of firms; b) firm cluster times quarter fixed effects to control for loan demand. The results are reported in Table 15 in Appendix C.1 and are in line with our baseline results discussed above.

4.2 Look-through

Next we analyze the relationship between lending spreads and look-through risk-weighted capital deviations and Table 4 reports our results. As for the phase-in deviations reported in Table

Table 4: Look-through deviation

	(1)	(2)	(3)	(4)
Look-through (LT) deviation	2.02***		1.64***	
	(3.58)		(3.26)	
I(LT deviation)	-0.07		-0.09*	
	(-1.38)		(-1.78)	
LT surplus		1.72***		1.24**
		(3.21)		(2.60)
LT deficit		-2.17		-73.65***
		(-0.39)		(-5.65)
LT surplus*I(SIB)			1.37	
			(1.67)	
LT surplus*I(SIB)				1.48*
				(1.81)
LT deficit*I(SIB)				71.06***
				(5.35)
Bank Level Controls	Y	Y	Y	Y
Loan Level Controls	Y	Y	Y	Y
Firm Level Controls	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
Observations	1220724	1220724	1220724	1220724
R^2	0.775	0.775	0.775	0.775

This Table reports in columns (1)-(4) estimates from an ordinary least squares regression model. The dependent variable is the loan spread. Look-through deviation is each banks' risk-weighted capital in relation to its look-through requirement. I(LT deviation) is an indicator variable equal to one when a bank has a positive level of surplus and zero otherwise. LT surplus is the positive level of surplus and LT deficit is the negative level of surplus. I(SIB) is an indicator variable equal to one during the period a bank is designated to be systemically important. Bank Level controls include the logarithm of total assets, cash/assets, debt/assets, and return on assets. The definition of loan- and firm-level controls can be found in Appendix A. A constant is always included but left unreported. Standard errors are clustered by quarter. t statistics in parentheses, * $p<0.1$, ** $p<0.05$, *** $p<0.01$

3, we find a small, positive effect of look-through deviations on lending spreads; however, there is no significant difference between the average spread charged by banks with surpluses and deficits in column (1) but a small one in column (3). Interestingly, the findings in column (4) suggest that SIBs, display a similar response to deficits (-73.65+71.06=-2.59) and surpluses

(1.24+1.48=2.72), while smaller banks raise their spreads much more in response to deficits (-73.65 versus 1.24).

To summarize, we find a stronger response to phase-in capital deviations relative to look-through ones. This is particularly the case for capital deficits, the response to which is weaker for non-SIBs. Overall the empirical evidence suggests that Swiss banks raise their lending rates relative to peers in response to a short-term, i.e. phase-in, capital deficit; the evidence for long-term, i.e. look-through, gaps is weaker.

5 Leverage Ratio Deviation from Target

In Switzerland, leverage ratio (TC/Assets) requirements were first implemented in 2008-Q4 and affected only the two big banks, UBS and Credit Suisse. Later on, ZKB (2014-Q4) and Raiffeisen (2015-Q4) were designated systemically important from a domestic perspective and became subject to leverage ratio regulation. Our analysis is therefore limited to these four institutions and to the time period when they were affected by leverage ratio regulation. Since there are no leverage ratio phase-in deficits in our sample, we restrict our attention to look-through leverage ratio deviations. When we analyze leverage ratio deviations, we include the lag of the RWA density among the regressors to capture the bank's response to its risk exposure.

There is no evidence that leverage ratio look-through deviations have impacted loan pricing in a significant manner, as all coefficients in Table 5, including the RWA density, lack statistical significance.

There are important differences among the four financial institutions in the SIB group. UBS and Credit Suisse (big banks henceforth) are G-SIBs and their total assets are several multiples that of ZKB and Raiffeisen. Because of their size and systemic importance, the big banks have been subjected to leverage ratio requirements since the breakout of the global financial crisis. For these reasons, we investigate whether look-through leverage ratio deviations have affected loan pricing for the two big banks.

Table 6 confirms that the big banks respond to deviations of the leverage ratio from its look-through target; hence, the lack of significance of the results in Table 5 is driven by the heterogeneity in the SIB group. The estimated coefficients in column (1) of Table 6 indicate that a one percentage point increase in the leverage ratio deviation leads to a -3.71 bps reduction in

Table 5: Look-through leverage ratio deviation

	(1)	(2)	(3)	(4)
Leverage ratio (LR) deviation	0.17		-0.06	
	(0.15)		(-0.05)	
I(LR deviation)	0.02		-0.00	
	(0.40)		(-0.02)	
LR surplus		0.28		-0.00
		(0.23)		(-0.00)
LR deficit		3.86		1.56
		(0.51)		(0.22)
RWA density			1.53	1.50
			(1.60)	(1.56)
Bank Level Controls	Y	Y	Y	Y
Loan Level Controls	Y	Y	Y	Y
Firm Level Controls	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
Observations	387453	387453	387453	387453
R^2	0.836	0.836	0.836	0.836

This Table reports in columns (1)-(4) estimates from an ordinary least squares regression model for a subset of banks (UBS, Credit Suisse, ZKB, and Raiffeisen) for whom the leverage ratio was imposed by the regulators. The dependent variable is the loan spread. Leverage ratio surplus is each banks' un-weighted capital ratio in relation to its look-through requirement. I(LR deviation) is an indicator variable equal to one when a bank has a positive level of surplus and zero otherwise. LR surplus is the positive level of surplus and LR deficit is the negative level of surplus. RWA density is the ratio of risk-weighted assets to asset ratio. Bank Level controls include the logarithm of total assets, cash/assets, debt/assets, and return on assets. The definition of loan- and firm-level controls can be found in Appendix A. A constant is always included but left unreported. Standard errors are clustered by quarter. t statistics in parentheses, * $p<0.1$, ** $p<0.05$, *** $p<0.01$

lending spreads. Since the specification in column (1) forces the relation between spreads and capital deviation to be the same for surpluses and deficits, this implies an increase in lending spreads in response to a worsening of the leverage ratio deficit. These results are consistent with banks reducing rates and increasing lending volumes in response to an improvement of their leverage ratio deviation from target. Column (3) shows that an increase in the lagged RWA density raises lending spreads and that the estimated response to a deviation falls to -5 bps. The effect of the RWA density suggests de-leveraging via an increase in lending rates and/or risk taking, i.e. the bank makes riskier and therefore more expensive loans. The lower coefficient on the LR deviation in column (3) relative to column (1) suggests that the mechanism at play here may come from banks with high lagged RWA density and negative capital deviations and banks with low RWA density and positive capital deviations. This intuition is further confirmed by the results in column (2), where we do not find significant effects for the leverage ratio surplus and deficit by themselves, while in column (4) the surplus and the RWA density are significant. The big banks reduce spreads and raise lending volumes when the leverage ratio is above its target; on the other hand, the big banks do the opposite, ie. they raise spreads and cut lending, when they have high RWA density.

Table 6: Look-through leverage ratio deviation - Big banks

	(1)	(2)	(3)	(4)
LR deviation	-3.71*		-5.00**	
	(-1.86)		(-2.69)	
I(LR deviation)	0.02		-0.00	
	(0.72)		(-0.02)	
LR surplus		-3.43		-5.70**
		(-1.37)		(-2.55)
LR deficit		-1.66		-8.10
		(-0.24)		(-1.48)
RWA density			1.47**	1.56**
			(2.38)	(2.52)
Bank-Level controls	Y	Y	Y	Y
Loan-Level controls	Y	Y	Y	Y
Firm-Level controls	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
Observations	303775	303775	303775	303775
R^2	0.868	0.868	0.868	0.868

This Table reports in columns (1)-(4) estimates from an ordinary least squares regression model for a subset of banks (UBS and Credit Suisse) for whom the leverage ratio was imposed by the regulators starting 2009q1. The dependent variable is the loan spread. Leverage ratio surplus is each banks' un-weighted capital ratio in relation to its look-through requirement. I(LR deviation) is an indicator variable equal to one when a bank has a positive level of surplus and zero otherwise. LR surplus is the positive level of surplus and LR deficit is the negative level of surplus. RWA density is the ratio of risk-weighted assets to asset ratio. Bank-Level controls include the logarithm of total assets, cash/assets, debt/assets, and return on assets. All bank-level variables are lagged by one period. The definition of loan- and firm-level controls can be found in Appendix A. A constant is always included but left unreported. Standard errors are clustered by quarter. *t*-statistics in parentheses. Significance levels: * $p<0.1$, ** $p<0.05$, *** $p<0.01$

6 Inspecting the Mechanism

We further investigate the mechanism behind our results by looking at the impact of capital deviations on loan growth. Up to now, our unit of observation has been a single loan. Because our loan-level data does not include a unique firm identifier, we do not observe the evolution of each unique bank-firm relationship and therefore how changes in the bank capital surplus and deficit affect the amount of credit extended to the same firm. To address this question, we can form firm clusters based on industry, location, balance-sheet size indicator, and risk-of-default class, along the lines of Khwaja and Mian (2008), and aggregate loans at the cluster level for each bank to obtain a meaningful measure of credit volume.

In Table 7, the unit of observation is a firm cluster-bank-quarter. The dependent variable is the change in log loan volume of a firm cluster-bank relation in a given quarter. I(safe) is an indicator variable equal to one for risk (probability-of-default class) corresponding to a credit rating of A- and higher based on the mapping of Standard and Poor's rating grades to default probabilities by Basel Committee on Banking Supervision (2015); I(big) is an indicator variable equal to one for UBS and Credit Suisse, and zero otherwise.

Column (1) and (2) of Table 7 report results for the phase-in surplus and deficit of the risk-weighted capital ratio. Banks with phase-in deficits significantly cut lending in response to a worsening of the capital gap. The interaction of the phase-in deficit with the safe indicator in column (2) indicates that the cut in lending is concentrated on the riskier loans. More precisely, a one percentage point worsening in the deficit, i.e. if the deficit goes from -1 to -2 percent, lending growth across the board falls by 15.05 percent while the growth of safe loans increases by 19.20 percent suggesting that banks with deficits reduce risk-taking.

Columns (3) to (5) concern specifications run only on the SIBs and they show that the leverage ratio surplus, the deficit and the RWA density fail to significantly affect loan growth. There is no significant re-balancing toward safer loans and these results are unchanged when we focus only on the two big banks.

In Table 8, the unit of observation is again a firm cluster-bank-quarter but the dependent variable is the average spread of the loans granted in a firm cluster-bank relation in a given quarter. The results in columns (1) and (2) are for the risk-weighted phase-in surplus and deficit, while those in columns (3) to (5) are for the leverage ratio surplus and deficit and

Table 7: Loan growth

	(1) (All)	(2) (All)	(3) (Big banks)	(4) (Big banks)	(5) (Big banks)
PI surplus	-0.82	-0.86			
	(-1.11)	(-1.14)			
PI deficit	13.93***	15.05***			
	(5.22)	(5.4)			
PI surplus*I(safe)		0.87			
		(0.52)			
PI deficit*I(safe)		-19.20**			
		(-2.06)			
LR surplus			3.12	3.19	3.49
			(0.49)	(0.50)	(0.55)
LR deficit			-0.52	-0.96	0.05
			(-0.02)	(-0.04)	(0.00)
RWA density			-0.25	-0.30	-0.20
			(-0.06)	(-0.07)	(-0.04)
RWA density*I(safe)			1.04	1.81	1.09
			(0.39)	(0.44)	(0.27)
LR surplus*I(safe)				-4.19	-68.75
				(-0.38)	(-1.64)
LR deficit*I(safe)				-3.57	-0.14
				(-0.09)	(-0.00)
LR surplus*I(safe)*I(big)					68.92
					(1.60)
Firm-cluster-Bank FE	Y	Y	Y	Y	Y
Firm-cluster-Time FE	Y	Y	Y	Y	Y
Observations	49611	49611	5562	5562	5562
R^2	0.468	0.468	0.548	0.548	0.548

Columns (1)-(5) present the results of a modified version of the Khwaja and Mian (2008) bank lending channel regression. The unit of observation is a firm cluster-bank-quarter. The dependent variable is the change in log loan volume of a firm cluster-bank relation in a given quarter where firm clusters are formed based on industry, loacation (canton), balance sheet size indicator, and risk(PD class). PI surplus is the positive level of surplus and PI deficit is the negative level of surplus. LR surplus is the positive level of surplus and LR deficit is the negative level of surplus. I(safe) is an indicator variable equal to one with risk (PD class) corresponding to a credit rating of A- and higher based on the mapping of Standard and Poor's rating grades to default probabilities by Basel Committee on Banking Supervision (2015). I(big) is an indicator variable equal to one for UBS and Credit Suisse, and zero otherwise. RWA density is the ratio of risk-weighted assets to asset ratio. Bank-Level controls include the logarithm of total assets, cash/assets, debt/assets, and return on assets. All bank-level variables are lagged by one period. The definition of loan level and firm controls can be found in Appendix A. A constant is always included but left unreported. Standard errors are clustered by quarter. t-statistics in parentheses. Significance levels: * p<0.1, ** p<0.05, *** p<0.01

therefore limited to the SIBs.

The results in column (1) and (2) are mixed. We found above that banks with deficit cut risky lending but slightly increase safe lending. When we look at spreads, we find that banks with phase-in surpluses raise the spreads charged to safe firms. This effect could be driven by the competition for safe loans from deficit banks. The results for the SIBs, namely column (3) to (5), show that banks with leverage ratio deficits charge significantly larger spreads relative to their surplus counterparts. When we control for the risk of the firm cluster as well as the RWA density (column (4)), we see that deficit banks charge higher spreads across all risk classes in response to a worsening of the leverage ratio deficit; on the other hand, banks with a leverage ratio surplus have a muted response to an increase in the surplus. This muted response by surplus banks, however, is the result of a reduction in spreads for safe firms and therefore an increase in spreads for the riskier firms. This result, however, is entirely driven by the big banks, as shown in column (5); the other SIBs raise lending spreads for safe firms when the surplus is increased. High (lagged) RWA density is also associated with an increase in spreads for safe firms. Our results here are consistent with the findings in Table 6 that shows that big banks reduce spreads when in surplus in terms of the leverage ratio. Here we show that the reduction in rates is concentrated on the safe firms. We speculated this policy by the big banks is in an effort to expand credit volume when they are in leverage ratio surplus, since they have regulatory space to do so. The loan growth results in column (5) of Table 7 would be consistent with this interpretation but are not statistically significant.

Table 8: Average spread

	(1) (All)	(2) (All)	(3) (Big banks)	(4) (Big banks)	(5) (Big banks)
PI surplus	1.27*	1.19*			
	(1.85)	(1.70)			
PI deficit	-3.72	-3.39			
	(-0.68)	(-0.57)			
PI surplus*I(safe)		1.44**			
		(2.24)			
PI deficit*I(safe)		-4.33			
		(-0.59)			
LR surplus			3.83	4.47	3.95
			(1.42)	(1.68)	(1.47)
LR deficit			-29.07**	-31.79**	-34.77**
			(-2.20)	(-2.21)	(-2.38)
RWA density			-1.81	-2.16	-2.18
			(-0.99)	(-1.16)	(-1.15)
RWA density*I(safe)			0.75	5.34***	6.75***
			(0.33)	(3.26)	(3.76)
LR surplus*I(safe)				-22.48***	8.29**
				(-4.15)	(2.43)
LR deficit*I(safe)				-14.89	-22.59
				(-0.78)	(-1.16)
LR surplus*I(safe)*I(big)					-41.85***
					(-6.77)
Firm-cluster-Bank FE	Y	Y	Y	Y	Y
Firm-cluster-Time FE	Y	Y	Y	Y	Y
Observations	81674	81674	8277	8277	8277
R^2	0.806	0.806	0.809	0.809	0.810

Columns (1)-(5) present the results of a modified version of the Khwaja and Mian (2008) bank lending channel regression. The unit of observation is a firm cluster-bank-quarter. The dependent variable is average spread charged to a firm cluster by a bank in a given quarter where firm clusters are formed based on industry, loacation (canton), balance sheet size indicator, and risk(PD class). PI surplus is the positive level of surplus and PI deficit is the negative level of surplus. LR surplus is the positive level of surplus and LR deficit is the negative level of surplus. I(safe) is an indicator variable equal to one with risk (PD class) corresponding to a credit rating of A- and higher based on the mapping of Standard and Poor's rating grades to default probabilities by Basel Committee on Banking Supervision (2015). I(big) is an indicator variable equal to one for UBS and Credit Suisse, and zero otherwise. RWA density is the ratio of risk-weighted assets to asset ratio. Bank-Level controls include the logarithm of total assets, cash/assets, debt/assets, and return on assets. All bank-level variables are lagged by one period. The definition of loan level and firm controls can be found in Appendix A. A constant is always included but left unreported. Standard errors are clustered by quarter. *t*-statistics in parentheses. Significance levels: * p<0.1, ** p<0.05, *** p<0.01

7 Regulatory Changes and Robustness

7.1 Regulatory Changes

The variation in capital deviations stems either from changes in the bank capital or from changes in capital regulation that move the relevant target. While changes in bank equity are the consequence of aggregate economic conditions or bank-specific shocks and policies, the regulatory events considered in our study are arguably exogenous to lending opportunities. Our strategy is to use the regulatory events described in section 2 as exogenous variation to the capital deviation measure of banks to estimate the impact of capital surplus and deficit on loan pricing. Since most countries lack the necessary variation of capital requirements across banks and over time, previous research has not relied on this source of identification. An exception is Francis and Osborne (2009), who exploit bank-specific capital requirements set by regulatory institutions in the United Kingdom, but lack firm- and loan-level data and focus on lending volume. Another exception is De Jonghe et al. (2016), who use bank-specific capital requirements in Belgium matched with corporate credit register data that conveys information on the total quantity of credit granted to every firm. Unlike De Jonghe et al. (2016), we focus on loan pricing rather than volume.

Our regressions are run at the loan level and the dependent variable is the loan spread. We include as regressors the phase-in surplus, phase-in deficit, an indicator variable for each regulatory event that is equal to one for the four quarters before and after the implementation date, and the interaction between our capital deviation measure and the regulatory event indicator. A positive estimate for the coefficient of a regulatory indicator means that the increase in capital requirement leads to an increase in lending spreads. The coefficient on the interaction term measures the marginal effect on lending spreads of a one percentage point higher lagged capital deviation during a regulatory change. If the estimated coefficient is negative, it implies that, among financial institutions subjected to the same increase in requirements, banks with higher capital deviations charge lower spreads.

Table 9 summarizes our results. In column (1), the phase-in surplus is positive and significant and it captures the pass-through of holding additional capital above target for all banks and periods. The deficit by itself is no longer significant (relative to the results in Table 3) because

Table 9: Regulatory interactions with risk-weighted PI deviation

	(1)	(2)
PI surplus	3.95***	3.58***
	(5.88)	(5.39)
PI deficit	0.19	-3.39
	(0.04)	(-0.62)
PI surplus*I(SIB)		0.98
		(1.34)
PI deficit*I(SIB)		
I(Basel II)	0.08	0.08
	(1.29)	(1.22)
I(CB rebate)	0.29***	0.28***
	(4.72)	(4.86)
I(Pillar 2)	0.21***	0.18**
	(3.14)	(2.55)
I(Basel III)	0.39***	0.37***
	(8.86)	(8.34)
I(TBTF1)	0.13**	0.12**
	(2.67)	(2.50)
PI surplus*I(Basel II)	-5.02***	-4.93***
	(-3.77)	(-3.65)
PI deficit*I(Basel II)	-15.18	-12.11
	(-1.52)	(-1.22)
PI surplus*I(CB rebate)	-4.33***	-4.24***
	(-4.79)	(-4.85)
PI deficit*I(CB rebate)		
PI surplus*I(Pillar 2)	-0.29	0.05
	(-0.37)	(0.07)

Table 9: Continued

	(1)	(2)
PI deficit*I(Pillar 2)	-85.65***	-81.35***
	(-3.79)	(-3.63)
PI surplus*I(Basel III)	-2.25***	-2.15***
	(-3.46)	(-3.29)
PI deficit*I(Basel III)		
PI surplus*I(TBTF1)	-2.99***	-3.13***
	(-3.29)	(-3.47)
PI deficit*I(TBTF1)		
Bank-Level controls	Y	Y
Loan-Level controls	Y	Y
Firm-Level controls	Y	Y
Industry FE	Y	Y
Bank FE	Y	Y
Time FE	Y	Y
Observations	1220724	1220724
R^2	0.777	0.777

This Table reports in columns (1)-(2) estimates from an ordinary least squares regression model. The dependent variable is the loan spread. PI surplus is the positive level of surplus and PI deficit is the negative level of surplus. I(SIB) is an indicator variable equal to one during the period a bank is designated to be systemically important. I(Basel II), I(CB rebate), I(Pillar 2), and I(Basel III) are indicator variables equal to one in quarters 2007-Q1 to 2009-Q1, 2009-Q1-2011-Q1, 2010-Q3 to 2012-Q3, and 2012-Q1 to 2014-Q1 respectively and zero otherwise. I(TBTF1) is an indicator variable equal to one for UBS and Credit Suisse in quarters 2011-Q1 to 2013-Q1, for ZKB in quarters 2013-Q4 to 2015-Q4, and Raiffeisen in quarters 2014-Q4 to 2016-Q4, and zero otherwise. Bank-Level controls include the logarithm of total assets, cash/assets, debt/assets, and return on assets. All bank-level variables are lagged by one period. The definition of loan- and firm-level controls can be found in Appendix A. A constant is always included but left unreported. Standard errors are clustered by quarter. *t*-statistics in parentheses. Significance levels: * p<0.1, ** p<0.05, *** p<0.01

the interactions with the regulatory events estimate these effects in a more precise manner. This suggests that the transmission of deficits to borrowing costs is at work primarily during regulatory changes. All regulatory event indicator variables, with the exception of Basel II, are positive and significant. This confirms that a bank subjected to a tightening of capital requirements charges higher lending spreads around that event relative to normal times. Notice that this effect is independent of the bank's capital position. The interactions of the phase-in surplus with the regulatory indicator variables are negative and significant, with the exception of Pillar 2 which is not significant. This indicates that, among the banks affected by a specific regulation, financial institutions with higher (lagged) capital surplus charge significantly lower lending spreads. All regulatory events in our study represent an increase in minimum requirements that, all else equal, lowers a bank capital deviation/surplus/deficit. According to column (1), outside regulatory events, a one percentage point increase in the phase-in surplus leads to a 3.95 bps increase in lending spreads; in the eight quarters around the Cantonal Bank Rebate event, a one percentage point increase in the surplus of cantonal banks caused a 3.95-4.33=-0.38 bps change in lending spreads for cantonal banks with a capital surplus. A similar interpretation applies to Basel II, Basel III, and TBTF1, whose interaction terms are negative and significant. Around the Pillar 2 implementation period, a one percentage point worsening in the deficit of institutions subject to Pillar 2 regulation led to a 85.65 bps increase in lending spreads for such institutions. In column (2) we find no evidence of a differential response by SIBs. Notice that some deficit interactions with the regulatory event indicator variable drop out because there are no deficits for the relevant banks and periods.

To sum up, we confirm that banks respond asymmetrically to changes in their capital deviation from target depending on whether they are in surplus or deficit territory. Our identification here relies on the exogenous variation in bank surplus and deficit stemming from regulatory changes. Banks raise lending spreads when their capital surplus is reduced by tighter regulation while they normally, i.e. outside regulatory changes, reduce lending spreads. Banks also raise lending rates, but more aggressively so, if the new regulation worsens their capital deficit.

In Table 10 we look at the leverage ratio deviation around the single relevant regulatory event in our sample period, the first implementation of too-big-to-fail (TBTF1). Column (1) considers the two big banks while column (2) extends the analysis to all SIBs. We do not consider leverage ratio surplus and deficit interactions with the regulatory indicator because our deficit reference category has too few observations for consistent estimation. We find evidence, for both the big banks and all SIBs, that a reduction in the leverage ratio deviation from target around the time of TBTF1 implementation leads to a significant increase in lending spreads.

Table 10: Regulatory interactions with LR deviation

	(1)	(2)
LR surplus	3.54	2.53
	(-1.57)	(1.53)
LR deficit	-0.86	9.87
	(-0.14)	(1.23)
		(2.74)
I(TBTF1)	-0.02	0.04
	(-0.12)	(0.88)
LR deviation*I(TBTF1)	-5.41***	-2.85*
	(-3.51)	(-1.77)
Bank-Level controls	Y	Y
Loan-Level controls	Y	Y
Firm-Level controls	Y	Y
Industry FE	Y	Y
Bank FE	Y	Y
Time FE	Y	Y
Observations	303775	387453
R^2	0.868	0.836

This Table reports in columns (1)-(2) estimates from an ordinary least squares regression model. Column (1) considers the two big banks - UBS and Credit Suisse. Column (2) incorporates ZKB and Raiffeisen once they were designated as systemically important in addition to the two big banks. The dependent variable is the loan spread. LR deviation is the level of leverage ratio deviation from the look-through target. I(TBTF1) is an indicator variable equal to one for UBS and Credit Suisse in quarters 2011-Q1 to 2013-Q1, for ZKB in quarters 2013-Q4 to 2015-Q4, and Raiffeisen in quarters 2014-Q4 to 2016-Q4, and zero otherwise. Bank-Level controls include the logarithm of total assets, cash/assets, debt/assets, and return on assets. All bank-level variables are lagged by one period. The definition of loan- and firm-level controls can be found in Appendix A. A constant is always included but left unreported. Standard errors are clustered by quarter. *t*-statistics in parentheses. Significance levels: * $p<0.1$, ** $p<0.05$, *** $p<0.01$

7.2 Robustness

We run a number of robustness exercises. First, we estimate how loan terms other than the spread, namely loan amount and maturity, are affected by changes in capital deviation; our analysis is at the loan level. The results are reported in Table 18 in Appendix C.2. In columns (1) and (2), the dependent variable is the logarithm of the loan amount. Our estimations indicate that an increase in the risk-weighted phase-in deviation is accompanied by a reduction in the amount granted at the individual loan level. When we consider surplus and deficit separately in column (2), we find that the loan amount responds negatively to both surpluses and deficits, although the effect for deficits is larger. In columns (3) and (4), the dependent variable is the logarithm of loan maturity. The positive and statistically significant coefficient on I(PI deviation) in column (3) indicates that surplus banks, on average, extend loans with longer maturity than deficit banks. This finding is strengthened in column (4) where we consider surplus and deficit separately. The positive coefficient on PI deficit indicates that deficit banks reduce loan maturity by 6.76% in response to a 1 percentage point worsening of the deficit.

The global financial crisis is part of our sample period and it strongly affected the two largest Swiss banks, UBS and Credit Suisse, due to their global nature. In particular, in October 2008 UBS received a capital injection of CHF 6 billion from the Swiss Confederation and it transferred USD 38.7 billion worth of illiquid assets to a stabilization fund mostly owned by the SNB. Both UBS and Credit Suisse suffered large losses and raised capital during this period. To ensure that our results are not uniquely driven by the global financial crisis, we run two specifications. We create an indicator for the global financial crisis that takes the value of 1 for the period 2008-Q1 to 2009-Q2 and re-estimate our specification with the risk-weighted phase-in surplus and deficit. The results are reported in Table 19 in Appendix C.3. Introducing the crisis indicator does not affect any of our earlier results. Column (1) shows that the effect of the phase-in surplus and deficit on lending spreads is unchanged relative to Table 3 and the crisis indicator is not significant. The interactions of the crisis indicator with the phase-in surplus and deficits are added in column (2) and are both negative and significant with point estimates of -4 and -21.61, respectively. During the global financial crisis, a one percentage higher positive surplus was accompanied by a 4 bps reduction in lending spreads; however, a one percentage lower deficit is accompanied by a 21.61 bps increase in lending spreads. Interestingly, the phase-in deficit is not significant in column (2) and its effect is now captured by the interaction with the crisis indicator, which suggests that the response to phase-in deficits was particularly at work during the financial crisis.

8 Conclusions

In this paper, we show that the response of banks to capital deviations is asymmetric and depends on whether they are in surplus or deficit relative to the regulatory target. This finding holds both in terms of the phase-in and look-through risk-weighted requirements. Using a confidential dataset on new credit granted matched with supervisory data on bank balance sheets, we find a small but statistically significant impact of holding a capital surplus. The impact of a deficit on spreads is much larger. This increase in spreads charged by deficit banks is accompanied by a decrease in riskier lending. Our analysis further finds a heterogenous response between the two large, internationally active Swiss banks (UBS and CS) and systemically important domestically focused banks (ZKB and Raiffeisen). The two large banks, in response to a positive leverage ratio surplus, reduce spreads driven by a shift to safer loans. On the other hand, two domestically focused banks do not respond to leverage ratio surplus. However, they increase their spreads when in a deficit which is consistent with the mechanism of increasing the intermediation margin to boost retained earnings and in turn increase their capital levels. Moreover, we find that lending rates of Swiss banks subject to new and higher capital requirements are higher in the four quarters before and after the introduction of the regulation relative to banks not affected by new requirements. A reduction in surplus driven by tighter regulation results in banks increasing their lending spreads. Banks also raise lending rates, and more aggressively so, if the new regulation worsens their capital deficit.

We contribute to the literature by documenting that banks with a capital shortfall with respect to the regulatory target charge higher spreads for their loans. In other words, banks respond differently to higher capital ratios or tighter requirements, depending on whether they are in capital surplus or deficit compared to their regulatory target. Our results, therefore, speak strongly to the importance of phase-in periods, as banks raise lending rates when their capital falls below their phase-in targets.

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Appendix

A Loan and firm characteristics

Table 11: Loan Type[a]

Variable	N	Frequency	Frequency ≤ 2008-Q4	% of Total Loan Value
Mortgage to Firm[b]	561,586	46.00	46.57	23.1
Fixed Advance (Investment Loan)	348,101	28.52	19.4	63.5
Overdraft Facility	250,750	20.54	29.62	7.1
Construction Loan	25,608	2.10	3.2	3.2
Loan / Fixed advance (Investment Loan)	12,704	1.04	0.6	1.4
Miscellaneous Loans	8,212	0.67	0.04	0.4
Rollover Loan	5,889	0.48	0.09	1.0
Loan (Investment Loan)	5,741	0.47	0.73	0.2
Fixed-rate Construction Mortgage	1,221	0.10	0.01	0.2
Seasonal Loan	913	0.07	0.06	0.12

[a]: Around 97% of the loans in the sample are single-issuer loans.

[b]: Secured by real estate

Table 12: Collateral Type

Variable	N	Frequency	Cumulative
Real estate or land	877,137	71.85	71.85
No collateral	222,420	18.22	90.07
Securities	46,862	3.84	93.91
Guarantee	37,524	3.07	96.99
Other collateral	28,817	2.36	99.35
Cession	5,128	0.42	99.77
Pledge on register or goods	2,836	0.23	100.00

Table 13: Firm Size Distribution

Firm Size	indicator	N	Frequency	Cumulative
<1	1	606,035	49.65	49.65
1-5	2	205,326	16.82	66.47
6-25	3	143,767	11.78	78.24
26-100	4	97,227	7.96	86.21
>100	5	38,444	3.15	89.36
Unclassified	6	129,926	10.64	100.00

in CHF Millions

Table 14: Probability of Default Class Distribution

PD class	Probability of default	N	Frequency	Cumulative
1	$\leq$ 0.05	36,866	3.02	3.02
2	>0.05 and $\leq$ 0.11	60,721	4.97	7.99
3	>0.11 and $\leq$ 0.50	270,669	22.17	30.16
4	>0.50 and $\leq$ 2.6	542,619	44.45	74.61
5	>2.6	185,745	15.22	89.83
Unclassified		124,105	10.17	100.00

B Banks names

AKB:	Aargau Cantonal Bank (Aargauische Kantonalbank)
BCF:	Fribourg Cantonal Bank (Banque Cantonale de Fribourg)
Bank Cler:	Bank Cler (Bank Coop before 2017Q2)
BCGE:	Geneva Cantonal Bank (Banque Cantonale de Geneve)
BCVS:	Valais Cantonal Bank (Banque Cantonale du Valais)
BCV:	Vaud Cantonal Bank (Banque Cantonale Vaudoise)
BLKB:	Basel-Landschaft Cantonal Bank (Basellandschaftliche Kantonalbank)
BSKB:	Basel-Stadt Cantonal Bank (Basler Kantonalbank)
BEKB:	Bern Cantonal Bank (Berner Kantonalbank)
CS:	Credit Suisse
GKB:	Grisons Cantonal Bank (Graubündner Kantonalbank)
LUKB:	Lucerne Cantonal Bank (Luzerner Kantonalbank)
Migros Bank:	Migros Bank
NAB:	New Aargau Bank (Neue Argaauer Bank)
RG:	Raiffeisen Group Switzerland (Raiffeisen Gruppe (Schweiz))
SGKB:	St. Gallen Cantonal Bank (St. Galler Kantonalbank)
TKB:	Thurgau Cantonal Bank (Thurgauer Kantonalbank)
UBS:	UBS
VAL:	Valiant Bank
ZKB:	Zurich Cantonal Bank (Zuercher Kantonalbank)

C Robustness

C.1 Interacted Fixed Effects

Table 15: Interacted Fixed Effects

	(1)	(2)	(3)	(4)
PI deviation	2.30***		1.72***	
	(4.89)		(4.36)	
I(PI deviation)	-0.36***		-0.40***	
	(-2.45)		(-2.84)	
PI surplus		2.09***		1.66***
		(4.52)		(4.42)
PI deficit		-14.52***		-52.68**
		(-2.19)		(-2.04)
PI deviation*I(SIB)			1.48**	
			(2.30)	
PI surplus*I(SIB)				1.07
				(1.65)
PI deficit*I(SIB)				37.29
				(1.39)
Bank-Level controls	Y	Y	Y	Y
Firm-cluster-Bank FE	Y	Y	Y	Y
Firm-cluster-Time FE	Y	Y	Y	Y
Observations	1133249	1133249	1133249	1133249
R^2	0.849	0.849	0.849	0.849

This table reports in columns (1)-(4) estimates from an ordinary least squares regression model with interacted fixed effects. The dependent variable is the loan spread. Phase-in deviation is each banks' risk-weighted capital in relation to its phase-in requirement. I(PI deviation) is an indicator variable equal to one when a bank has a positive level of surplus and zero otherwise. PI surplus is the positive level of surplus and PI deficit is the negative level of surplus. I(SIB) is an indicator variable equal to one during the period a bank is designated to be systemically important. All bank-level variables are lagged by one period. All bank-level variables are lagged by one period. The definition of loan- and firm-level controls can be found in Appendix A. A constant is always included but left unreported. Standard errors are clustered by quarter. *t*-statistics are reported in parentheses. Significance levels: * p<0.1, ** p<0.05, *** p<0.01

Table 16: Regulatory interactions with risk-weighted surplus

	(1)	(2)
PI surplus	3.76***	3.42***
	(7.93)	(7.47)
PI deficit	-2.31	-4.23
	(-0.63)	(-1.15)
PI surplus*I(SIB)		0.76
		(1.32)
PI deficit*I(SIB)		
I(Basel II)	0.06	0.07
	(1.34)	(1.38)
I(CB rebate)	0.26***	0.25***
	(4.19)	(4.31)
I(Pillar 2)	0.27***	0.25***
	(4.64)	(3.81)
I(Basel III)		
I(TBTF1)	0.12***	0.12***
	(4.10)	(3.75)
PI surplus*I(Basel II)	-3.59***	-3.64***
	(-2.94)	(-2.99)
PI deficit*I(Basel II)	-7.49	-5.93
	(-1.00)	(-0.80)
PI surplus*I(CB rebate)	-2.64***	-2.55***
	(-3.44)	(-3.39)
PI deficit*I(CB rebate)		
PI surplus*I(Pillar 2)	-1.68***	-1.43**
	(-2.81)	(-2.32)

Table 16: Continued

	(1)	(2)
PI deficit*I(Pillar 2)	-39.43	-36.70
	(-1.38)	(-1.28)
PI surplus*I(Basel III)	-1.95***	-1.88***
	(-3.15)	(-3.01)
PI deficit*I(Basel III)		
PI surplus*I(TBTF1)	-3.13***	-3.26***
	(-4.26)	(-4.34)
PI deficit*I(TBTF1)		
Bank-Level controls	Y	Y
Firm-cluster-Bank FE	Y	Y
Firm-cluster-Time FE	Y	Y
Observations	1133249	1133249
R^2	0.849	0.849

This table reports in columns (1)-(2) estimates from an ordinary least squares regression model with interacted fixed effects. The dependent variable is the loan spread. PI surplus is the positive level of surplus and PI deficit is the negative level of surplus. I(SIB) is an indicator variable equal to one during the period a bank is designated to be systemically important. I(Basel II), I(CB rebate), I(Pillar 2), and I(Basel III) are indicator variables equal to one in quarters 2007-Q1 to 2009-Q1, 2009-Q1-2011-Q1, 2010-Q3 to 2012-Q3, and 2012-Q1 to 2014-Q1 respectively and zero otherwise. I(TBTF1) is an indicator variable equal to one for UBS and Credit Suisse in quarters 2011-Q1 to 2013-Q1, for ZKB in quarters 2013-Q4 to 2015-Q4, and Raiffeisen in quarters 2014-Q4 to 2016-Q4, and zero otherwise. Bank-Level controls include the logarithm of total assets, cash/assets, debt/assets, and return on assets. All bank-level variables are lagged by one period. The definition of loan- and firm-level controls can be found in Appendix A. A constant is always included but left unreported. Standard errors are clustered by quarter. t-statistics in parentheses. Significance levels: * $p<0.1$, ** $p<0.05$, *** $p<0.01$

Table 17: Regulatory interactions with leverage ratio surplus

	(1) (Big banks)	(2) (SIBs)
LR surplus	-3.66	0.29
	(-0.73)	(0.15)
LR deficit	-15.10	-6.49
	(-1.48)	(-0.65)
I(TBTF1)		0.07
		(1.27)
LR deviation*I(TBTF1)	-0.85	0.15
	(-0.36)	(0.08)
Bank-Level controls	Y	Y
Firm-cluster-Bank FE	Y	Y
Firm-cluster-Time FE	Y	Y
Observations	303775	387453
R^2	0.868	0.836

This table reports in columns (1)-(2) estimates from an ordinary least squares regression model with interacted fixed effects. Column (1) considers the two big banks - UBS and Credit Suisse. Column (2) incorporates ZKB and Raiffiesen once they were designated as systemically important in addition to the two big banks. The dependent variable is the loan spread. LR surplus is the positive level of surplus and LR deficit is the negative level of surplus. I(TBTF1) is an indicator variable equal to one for UBS and Credit Suisse in quarters 2011-Q1 to 2013-Q1, for ZKB in quarters 2013-Q4 to 2015-Q4, and Raiffeisen in quarters 2014-Q4 to 2016-Q4, and zero otherwise. Bank-Level controls include the logarithm of total assets, cash/assets, debt/assets, and return on assets. All bank-level variables are lagged by one period. The definition of loan- and firm-level controls can be found in Appendix A. A constant is always included but left unreported. Standard errors are clustered by quarter. *t*-statistics in parentheses. Significance levels: * $p<0.1$, ** $p<0.05$, *** $p<0.01$

C.2 Loan Amount and Maturity

Table 18: Loan amount and maturity

	(1) log(loan amount)	(2) log(loan amount))	(3) log(maturity)	(4) log(maturity)
PI deviation	-1.86***		0.11	
	(-8.97)		(0.32)	
I(PI deviation)	0.07		0.13*	
	(1.67)		(2.01)	
PI surplus		-1.89***		0.17
		(-8.96)		(0.51)
PI deficit		3.78*		6.76***
		(1.83)		(3.06)
Bank-Level controls	Y	Y	Y	Y
Loan-Level controls	Y	Y	Y	Y
Firm-Level controls	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y
Time FE	Y	Y	Y	Y
Observations	1220724	1220724	762401	762401
R^2	0.439	0.439	0.655	0.655

This table reports in columns (1)-(4) estimates from an ordinary least squares regression model. In columns (1) and (2), the dependent variable is the logarithm of the loan amount and in (3) and (4), the logarithm of loan maturity. Phase-in deviation is each banks' risk-weighted capital in relation to its phase-in requirement. I(PI deviation) is an indicator variable equal to one when a bank has a positive level of surplus and zero otherwise. PI surplus is the positive level of surplus and PI deficit is the negative level of surplus. Bank-Level controls include the logarithm of total assets, cash/assets, debt/assets, and return on assets. All bank-level variables are lagged by one period. The definition of loan- and firm-level controls can be found in Appendix A. A constant is always included but left unreported. Standard errors are clustered by quarter. *t*-statistics in parentheses. Significance levels: * p<0.1, ** p<0.05, *** p<0.01

C.3 Global Financial Crisis

Table 19: Crisis interactions

	(1)	(2)
PI surplus	2.30***	2.97***
	(3.92)	(5.19)
PI deficit	-21.45**	4.23
	(-2.16)	(0.66)
I(crisis)	-0.17	0.06
	(-0.66)	(0.24)
PI surplus*I(crisis)		-4.00***
		(-3.45)
PI deficit*I(crisis)		-21.61**
		(-2.18)
Bank-Level controls	Y	Y
Loan-Level controls	Y	Y
Firm-Level controls	Y	Y
Industry FE	Y	Y
Bank FE	Y	Y
Time FE	Y	Y
Observations	1220724	1220724
R^2	0.775	0.776

This Table reports in columns (1)-(2) estimates from an ordinary least squares regression model. The dependent variable is the loan spread. PI surplus is the positive level of surplus and PI deficit is the negative level of surplus. I(crisis) is an indicator variable equal to one in quarters 2008-Q1 to 2009-Q2, and zero otherwise. Bank-Level controls include the logarithm of total assets, cash/assets, debt/assets, and return on assets. All bank-level variables are lagged by one period. The definition of loan- and firm-level controls can be found in Appendix A. A constant is always included but left unreported. Standard errors are clustered by quarter. *t*-statistics in parentheses. Significance levels: * p<0.1, ** p<0.05, *** p<0.01