Capital Floors, the Revised SA and the Cost of Loans in Switzerland

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Abstract

The Basel Committee has recently announced plans to revise the Standardised Approach (SA) to bank capital for credit risk and to employ the revised SA as a floor for bank capital based on internal models. Some aspects of the proposals remain unclear but it is likely that the new approaches will have a major impact on the overall level of capital and its distribution across banks and asset classes.

This paper examines the effects of the proposed changes in capital rules on the Swiss loan market. Using primarily public information, we estimate the effects on the capital of individual Swiss banks broken down by asset class. We infer what this is likely to imply for lending rates in the Swiss market.

We find that the proposed Basel rule changes would significantly boost capital for corporate and commercial mortgage exposures while capital for residential mortgages could actually fall for SA banks. This pattern of effects across asset classes is at variance with the lessons of the recent financial crisis which was triggered by the collapse of the US residential mortgage market. It is also inconsistent with current policy concerns in Switzerland where regulators have publicly expressed concern about possible overheating in the residential mortgage market.

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EXECUTIVE SUMMARY

This paper analyses the impact on the Swiss loan market of the changes in capital rules proposed by the Basel Committee in two recent consultation documents, BCBS 306 and 307. The proposed rule changes involve (i) replacing the current Standardised Approach (SA) for calculating credit risk capital with a revised credit risk SA, and (ii) introducing a system of capital floors for banks employing the Internal Ratings-Based Approach (IRBA) derived from this revised SA.

Under the revised credit risk SA, risk weights would be based on risk indicators such as, in the case of corporate exposures, the borrower's revenue and leverage. Introducing dependence on risk indicators would make the SA more risk sensitive than is at present the case for unrated exposures. It would, however, probably reduce risk sensitivity for bank and large corporate exposures, which is achieved in the current SA by linking risk weights to agency ratings when available.

The system of capital floors proposed in BCBS 306 represents an attempt by Basel regulators to "tidy up" the current situation in which capital floors are implemented differently across regulatory jurisdictions. Confusion across countries in the approach taken to capital floors arose after the crisis when countries retained in different forms a transitional "Basel I capital floor", originally designed to limit sudden changes when Basel II rules came into force. Imposed at a bank level, the Basel I floor omits important new components of bank capital, for example CVA-related capital. So, this floor is not a binding constraint for most large banks and, crucially for the analysis performed in this paper, plays a limited role in pricing decisions.

The Basel Committee's interest in capital floors is motivated not just by a desire to restore uniformity of capital rules across jurisdictions, however. The Committee also wishes to use floors to reduce variation across banks in IRBA risk weights and to increase risk weights for low default probability exposures. Other policy changes will contribute to achieving these goals, specifically, the Basel III Leverage Ratio and recent risk weight benchmarking and comparison exercises. But, floors are seen as another mechanism for enforcing uniformity.

The key questions that arise in evaluating the BCBS proposals are the following. (i) How will the proposed changes affect banks and loan markets? (ii) Is the dependence of capital on risk indicators in the revised SA calibrated appropriately? (iii) At what level should capital floors be implemented? This paper tackles the first of these questions directly and sheds light on the second and third.

The approach we take is to forecast the impact of the proposed rule changes on key sectors of the Swiss credit market, specifically, Bank Exposures, Corporate Loans, and Commercial and Residential Mortgages. We forecast the effects of the rule changes on the capital of the 37 Swiss banks that hold the large majority of credit exposures to these sectors within Switzerland. We then estimate what effect higher capital will have on their lending spreads.

Our calculations are disaggregated in that we estimate the impacts on capital and spreads broken down by asset class and individual banks. We then aggregate results across groups of banks to obtain the results presented in the paper. This disaggregation is important because the BCBS 306 and 307 rule changes will have very diverse effects on different asset classes and categories of bank.

Our main findings are that the revised SA, together with the introduction of capital floors for IRB banks, will generate substantial increases in capital for Corporates and Commercial Mortgages in the Swiss market. Residential Mortgage exposures are much less affected and risk weights for this asset class will actually fall at least for SA banks.

To appreciate the magnitude of the changes implied by the new rules, if an 80% asset class level floor is imposed on Swiss IRB banks, the capital charges that these banks face for their exposures to Bank, Corporate, Commercial Mortgage, Residential Mortgage borrowers and Specialised Lending will increase by 18%, 160%,215% , 35% and 259% respectively. The total capital (measured as a weighted average across asset classes) of IRB banks will rise by 108%. Meanwhile, the capital of some SA banks heavily engaged in Residential Mortgage lending will actually drop. Total SA bank capital against Residential Mortgages will fall from CHF 22 billion to CHF 21 billion.

This reallocation of bank capital across sectors is hard to square with the fact that (a) the recent crisis began with the collapse of a mortgage market (albeit one located in the United States rather than Switzerland), (b) many commentators have expressed concern about possible house price bubbles in Switzerland driven by readily available mortgage financing, and (c) loans to corporates were remarkably resilient to the crisis in many countries.

Substantially higher capital is likely to lead to increases in lending spreads in Swiss loan markets. Using a version of the Capital Asset Pricing Model (CAPM), we estimate the possible impact on loan spreads of the proposed changes in capital rules. We find that, under different assumptions, spreads for Corporate Loans would rise by between 45 and 76 basis points assuming a full pass-through to borrowers and an 80% asset class level floor. If one assumes that IRB banks set prices in corporate lending, then the impact will be between 60 and 111 basis points.

Multiplying loan volumes by spread changes, one obtains a transparent monetary measure of the impact of the policy changes. This suggests that the annual flow cost of the new rules would be CHF 1.3 billion and CHF 2.1 billion. A conservative measure of the present discounted cost (assuming a 3% discount rate) is between CHF 42.8 billion and CHF 70.5 billion.

1. INTRODUCTION

The Basel Committee has recently published proposals for major revisions in an important component of regulatory capital rules, the credit risk Standardised Approach (SA) (see BCBS (2014c), also known as BCBS 307). Under the revised credit risk SA, risk weights for Bank, Corporate and Residential Mortgage exposures would depend on the values of *risk indicators*, specific to the exposure in question.[3] The dependence of SA capital on these risk indicators has been calibrated by the authorities through exercises that are briefly sketched in BCBS (2014c).

The Basel Committee also published in December 2014 a consultation paper on the use of capital floors (see BCBS (2014b), also known as BCBS 306). In this, they aim to "tidy up" discrepancies across regulatory jurisdictions in the approach taken to capital floors. When the Basel II rules came into force, regulators applied temporary capital floors equal to a declining fraction of Basel I capital levels. Following the crisis, this was retained in various forms in different jurisdictions. Since it is imposed at a bank level and is worked out excluding Basel III capital categories such as CVA, in practice, it does not bind on many large banks and plays a limited role in pricing decisions.

Regulators regard capital floors as a way of enforcing greater uniformity of risk weight calculations across banks. The Basel Committee has, for some time, expressed dissatisfaction with the inconsistency across banks of capital calculated using internal models (including Internal Ratings-Based Approach (IRBA) credit risk capital calculations). BCBS (2013), for example, documents such inconsistencies, presenting banks' IRBA risk weight calculations for a set of reference exposures.[4]

The authorities have engaged in other policy steps to reduce inconsistencies in capital calculations including an extensive set of evaluation exercises referred to as the Regulatory Consistency Assessment Programme (RCAP). The effectiveness of this and parallel industry benchmarking activities in improving consistency has yet to be established. But, the authorities have decided to push ahead by implementing systematically capital floors based on revised SA rules.

While they have attracted little attention outside risk and regulation specialists, the BCBS 306 and 307 proposals may have far-reaching implications for banks and the economies in which they operate.[5] In particular, the new rules will shift capital between SA and IRB banks and across asset classes. Understanding the nature of these shifts and the economic implications are important topics of study.[6] The Basel Committee has launched an official Quantitative Impact Study (QIS) for the proposed new rules but many banks have found it difficult to obtain the data necessary to calculate

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[3] For example, for residential mortgages, the risk indicators that the authorities propose to use as the basis for regulatory capital are Loan to Value (LTV) and Debt Service Coverage (DSC) ratios. More information on the risk indicators may be found in Section 2.

[4] Reportedly, some senior regulators from countries in which the recent crisis had little or no impact has been worried about the low default probabilities that banks have estimated and hence the low IRBA risk weights that are being used currently.

[5] It is worth noting that, following the crisis, the Basel Committee adopted major changes to the Basel II (see BCBS (2006)) capital definitions and capital target ratios. But, aside from the area of trading book rules, these changes (see BCBS (2009a), (2009b) and (2010b)) involved relatively minor changes in the definitions of Risk Weighted Assets (RWAs). The changes proposed in BCBS 307 are the first major post-crisis reform in RWAs.

[6] One may also be concerned that basing regulatory capital on accounting-data-related risk indicators will shift capital between sectors and jurisdictions in ways that depend more on differences in accounting practice than risk. In some countries, difficulties in obtaining the data necessary to calculate the indicators will mean that capital defaults to punitive values.

capital accurately. So, the reliability of the QIS, the results of which are in any case confidential, is somewhat open to doubt.

In this paper, we examine the implications of the proposals for a particular lending market, that of Switzerland. Primarily using public data, we investigate which banks and asset classes will attract higher or lower capital because of the proposed changes. We then proceed to analyse how the changes in capital will affect lending rates. We focus on Swiss banks' exposures to Banks, Corporates and Commercial and Residential Mortgage borrowers located in Switzerland.

We study the effects of the proposals on the capital and lending rates of 37 group or individual banks. These include the main suppliers of loans in the Swiss market: two large IRB banks, UBS and Credit Suisse; a large network SA bank, Raiffeisen (which is particularly active in residential mortgage lending); a group of Cantonal banks of varying size (that are all SA with one IRBA exception); and a group of other SA banks.[7]

We perform quantitative impact analysis of the proposals using data published by these 37 banks through their Pillar 3 disclosures and financial statements, calculating the implied changes in the capital individual banks apply to different asset classes. The private data we employ consists of estimates, supplied to us by UBS, of the distribution of its lending within Switzerland conditional on credit quality and the revised SA risk drivers.

Using the above information, we first perform top-down calculations of how one might expect individual banks' risk weights for each of several asset classes to be affected by the introduction of the BCBS 307 revised credit risk SA rules and the BCBS 306 capital floors regime. Second, we analyse the impact of the capital changes on the spreads that banks charge in different sectors of the Swiss loan market. Third, we calculate the immediate, direct monetary cost of the rule changes as the product of spread changes multiplied by current volumes. We do this in annual flow terms and also as a discounted sum of future costs.

To infer the impact of increased capital on spreads, we calculate the cost of bank equity employing the Capital Asset Pricing Model (CAPM) suggested by Kashyap, Stein and Hanson (2010) and subsequently used by Miles, Yang and Marcheggiano (2012) and Junge and Kugler (2013). This approach yields not just a calculation of the initial cost of equity but also an estimate of how that cost of equity may change as a bank increases its capital. In contrast to these other authors, we examine the impact of capital changes explicitly distinguishing between the costs of equity of individual banks.

Our most important finding is that the proposed changes in the capital rules would significantly boost the spreads that banks charge to corporate borrowers. The cost of Commercial Mortgages would also rise substantially while changes in lending rates to Residential Mortgages would be minor. We also conclude that the changes would significantly improve the relatively competitive position of the Cantonal Banks vis-à-vis the two large Swiss banks.

These implications run counter to policy lessons that one might draw from the recent crisis in which corporate loans were generally stable across many countries and residential mortgages contributed at least in the US to major instability. They are also inconsistent with recent concerns voiced by policy-makers in Switzerland about the dangers of an over-heating residential mortgage market.[8]

[7] In our results, we aggregate Raiffeisen with the Other SA Banks.

[8] For example, OECD (2012) (see page 12) discusses concerns of over-heating in the Swiss housing market. Brown and Guin (2013) examine the sensitivity of Swiss mortgage borrowers to interest rate and house price changes in the light of concerns about the stability of the market expressed by policy-makers. They find that

One may note that the regulatory landscape for Swiss banks is evolving not just because of the rule changes discussed in this paper. Examples of other developments include the phased introduction of Basel leverage ratios, alterations in trading book regulations and the minimum Total Loss Absorbing Capacity (TLAC) rules recently proposed by the Financial Stability Board. Here, we focus on the revised credit risk SA and its interaction with proposed capital floors since these changes have attracted relatively little attention and yet have the potential to alter very substantially the distribution and level of bank capital.

This paper is a contribution to a substantial literature on the impact of alterations in regulatory capital rules on aggregate bank capital and the wider economy. Repullo and Suarez (2004) and Ruthenberg and Landskroner (2008) examine the effects of the introduction of the Basel II rules on lending rates, focussing on how a bank's choices between SA and IRBA approaches would affect outcomes. Recent papers by Elliot (2009), King (2010), Kashyap, Stein and Hanson (2010), BCBS (2010a), Macroeconomic Assessment Group (2010), Institute of International Finance (2011), Cosimano and Hakura (2011), Slovik and Cournede (2011), Miles, Yang and Marcheggiano (2012), Junge and Kugler (2013), Baker and Wurgler (2013) and Basten and Koch (2014) study the economic effects of the increases in capital envisaged in Basel III.

Other studies have examined the dynamics of bank lending and capital econometrically. Early studies include Hancock, Laing, and Wilcox (1995), Peek and Rosengren (1995) and Ediz, Michael and Perraudin (1998). More recent analyses include Mora and Logan (2010) Francis and Osborne (2012) and Peek and Rosengren (2011). For other relevant studies see for example Bassett, Chosak, Driscoll and Zakrajŝek (2010), who examine how bank loan supply shocks feed through into real economic activity.

This study may also be viewed as a contribution to the literature on the Swiss banking market. This includes among other significant studies Neuberger and Schacht (2005), Dietrich (2009), Dietrich and Wanzenried (2009), Rochet (2014) discusses studies of the economic impact of capital rules in the context of Swiss bank regulation.

The paper is organised as follows. Section 2 describes how we map the Basel BCBS 306 and 307 proposals into estimates of changes in the capital individual banks will hold against exposures in different asset classes. Section 3 explains how we analyse the impact on spreads, again by bank and asset class. Section 4 presents the results of our calculations. Section 5 concludes. We provide an appendix on how we estimate risk driver distribution for Swiss bank exposures to other Swiss banks.

2. THE REVISED SA AND CAPITAL FLOORS

Background

This paper examines the impact on the Swiss loan market of the proposed changes in bank capital rules set out in BCBS 306 and 307.[9] This involves calculating the impact on capital for different banks

these sensitivities are potentially serious in the long run although less important in the short or medium term. Bourassa, Hoesli and Scognamiglio (2013) describe features of the Swiss housing market that made it more stable prior to the crisis and hence less subject to price falls afterwards, including the conservative lending practices of Swiss banks.

[9] Basel rule changes like those proposed in BCBS 306 and 307 are rarely subjected to detailed, public analysis. The authorities' current approach involves calibration efforts internal to the regulatory community followed by QIS exercises employing data provided by banks. But, the calibration exercises and the results of QIS analysis are rarely disclosed in any detail. Academics have analysed important packages of measures such as Basel III capital changes but their studies are typically performed long after decisions have been made.

and asset classes and then analysing how this will affect the spreads at which banks lend. We begin by providing background to the proposals contained in BCBS 306 and 307.

The existing credit risk SA is employed by banks that choose, subject to regulatory approval, to use less sophisticated approaches to calculating regulatory capital. The SA includes a set of asset-class specific risk weights that banks apply to their exposures to calculate their credit-related Risk Weighted Assets (RWAs). A bank's required capital is then calculated by multiplying its total RWA by a capital target ratio.

Under Basel I and II rules, banks apply target ratios of 4% and 8%, respectively, to their RWAs to derive their required Tier I and Tier II capital. Under Basel III, the system of capital target ratios is more complex and includes elements based on a Capital Conservation Buffer and a Counter-Cyclical Buffer as well as additional percentages for Systemically Important Financial Institutions (SIFIs).

Risk weights in the existing credit risk SA are relatively insensitive to risk in that they vary across, but not within, broad asset classes. Exceptions are exposures to rated corporate, bank or sovereign borrowers for which risk weights are determined, based on the exposure's credit rating, using look-up tables.

When Basel II was introduced, in order to prevent a possible, sudden reduction in capital levels for some institutions, a Basel I capital floor was included. Under this approach, a bank's required capital equals the maximum of its Basel II level and a percentage of the Basel I level (see BCBS (2006) paragraph 45). The Basel Committee intended that the "Basel I" floor be temporary. It was planned that the percentage used in the floor definition would fall over time from 95% in 2007, to 90% in 2008 and then to 80% in 2009, after which the floor would be dropped.

Following the 2007 crisis, however, some jurisdictions decided to maintain the Basel I floor. For example, the European Union determined to retain an 80% Basel I floor, at least until 2017 (see Article 500 of the Credit Risk Regulation (CRR) in European Parliament (2013)).[10] Switzerland also retained the Basel I floor after 2009.

The fact that the Basel I floor operates on total bank capital and excludes important new Basel III capital components (such as CVA-related capital) means that for large banks, the Basel I floor does not bind and plays a limited role in banks' loan pricing decisions.

Motivations for BCBS 306 and 307

The Basel Committee has cited the following motives and objectives in developing its BCBS 306 and 307 proposals:

1. The risk sensitivity of the credit risk SA could be improved.
2. It is desirable to reduce reliance in regulation on agency ratings.
3. The Basel I floor has been adopted to differing degrees and in different ways internationally, leading to a lack of comparability across jurisdictions.
4. Regulators' confidence in the consistency of banks' internal ratings-based capital calculations has been eroded by comparisons of IRBA risk weights for reference exposures as reported in BCBS (2013).[11] So, the use of capital floors binding at least on low default risk exposures is desirable (see BCBS (2014a)).

[10]Even when jurisdictions operate a Basel I floor, they may do so in different ways. In the European CRR formulation of the floor (see European Parliament (2013), Basel II capital must exceed a percentage of Basel I capital. In contrast, BCBS (2006) envisages that Basel II risk weights exceed a percentage of Basel I risk weights. Borchgrevink (2012) shows, through examples, that floors based on capital levels are markedly less conservative than floors based on risk weights.

[11]For a discussion and different possible policy solutions, see Le Leslé and Avramova (2012).

Point 1is correct for many asset classes, but not for exposures to sovereigns, banks and large corporates, for which agency ratings are often available. The authorities have decided to retain reliance on ratings for sovereigns but are apparently confident that their alternative risk indicator approaches for banks and large corporates are superior to ratings-based approaches.

This confidence requires more justification than is provided by the brief description of calibration provided in BCBS 307. The proposed indicators are likely to behave differently across countries and sectors. So, it appears to be a radical and ambitious claim that (i) such ratios perform better in forecasting defaults than agency ratings and (ii) introducing risk sensitivity (for unrated exposures) in this way represents a gain.

Point 2 is related to Point 1 as the importance of improving risk sensitivity increases if agency ratings are to be relied on less as a basis for capital. Point 2 expresses the consensus regulators achieved at the G20 Toronto summit in June 2010[12]. The summit reached the view that reliance on ratings should be reduced in the light of the agencies' perceived failures during the crisis and because of concerns that market participants may be discouraged from performing their own due diligence if ratings are afforded an overly prominent role in regulatory rules.[13]

On Point 3, there may well be a need to rationalise the variety of approaches taken to floors in different jurisdictions since 2009. However, the current Basel I floor fails to bind for many banks, so, depending on how this is done, introducing a new set of floors is more than a "tidying up", and may have significant implications.

On Point 4, the revised SA risk weights are unlikely to represent a genuine competitor in scientific rigour to IRBA risk weights as calculated by reputable banks working with detailed historical data on loans markets with which they are intimately familiar. Variation across banks in IRBA estimates of default probabilities may be tackled by a variety of benchmarking and inspection arrangements organised either by the authorities or by the industry. In our view, a simple indicator approach like that proposed in BCBS 307 is likely to be a poor substitute for detailed bank- and jurisdiction-specific statistical analysis.

The BCBS 307 Risk Weight Tables

Key elements of BCBS 307 that are material to our analysis are the risk weight look-up tables for exposures in individual asset classes. While the existing SA bases risk weights on agency ratings (where available) or employs simple undifferentiated risk weights for wide classes of exposures, under the revised SA, the Basel authorities propose to calculate risk weights on the basis of risk indicators.

For Bank Exposures, these risk indicators consist of the Core Equity Tier 1 ratio of the counter-party bank and the ratio of Net Non-Performing Assets to total loans. Table 1 shows the risk weights, proposed in BCBS 307, for exposures that have CET1 and NNPA ratios in particular, specified

[12] The Summit declaration stated: "We committed to reduce reliance on external ratings in rules and regulations. We acknowledged the work underway at the BCBS to address adverse incentives arising from the use of external ratings in the regulatory capital framework, and at the FSB to develop general principles to reduce authorities' and financial institutions' reliance on external ratings. [..]" (Appendix II, Paragraph 27).

[13] These views encouraged the US authorities to take steps to minimise regulatory dependence on ratings through the US Dodd-Frank Act; but they have little noticeable impact on regulatory changes in other jurisdictions. European regulators, in particular, while paying lip service to the G20 Toronto view, have so far taken few concrete steps to reducing regulatory reliance on ratings. See comments in Duponcheele, Perraudin and Totouom-Tangho (2014).

ranges. One may observe that the risk weights range from 30% to 300%, a substantial "times 10" range from least to most risky banks.

Table 1: RSA risk weights for bank exposures

	CET1 ratio ≥ 12%	12% > CET1 ratio ≥9.5%	9.5% > CET1 ratio ≥ 7%	7% > CET1 ratio ≥ 5.5%	5.5% > CET1 ratio ≥ 4.5%	CET1 ratio < 4.5%
NNPA ratio ≤ 1%	30%	40%	60%	80%	100%	300%
1% < NNPA ratio ≤ 3%	45%	60%	80%	100%	120%	300%
NNPA ratio > 3%	60%	60%	100%	120%	140%	300%

Note: The table, reproduced from BCBS 307, shows the risk weights banks must use for exposures to other banks under the revised credit risk SA. The risk weights depend on the Common Equity Tier 1 (CET1) ratio and Net Non-Performing Asset (NNPA) ratio of the bank in question.

If the data required for a bank to calculate capital for an exposure to another bank on this basis is not available (for example, because the obligor bank does not possess Basel III consistent RWA data and, hence, cannot publish a CET1 ratio), the default risk weight value is 300%. This approach contrasts with the current SA in which if a rating is not available, risk weights equal the Basel I level of 100%.

For Corporate Loans, the capital indicators proposed in BCBS 307 are Revenue and a Leverage ratio (defined as total assets over common equity). Table 2 shows the risk weights for different risk indicator ranges. In this case, proposed risk weights range from 60% to 300%, i.e., a "5 times" proportional variation. Leverage is a particularly controversial indicator to use since it varies so much across sectors without corresponding observed variation in default rates and loss given default.

Table 2: Risk weights for corporate exposures

	Revenue ≤ €5m	€5m < Revenue ≤ €50m	€50m < Revenue ≤ €1bn	Revenue > 1bn
Leverage: 1x-3x	100%	90%	80%	60%
Leverage: 3x-5x	110%	100%	90%	70%
Leverage: >5x	130%	120%	110%	90%
Negative Equity (*)	300%	300%	300%	300%

Note:The table, reproduced from BCBS 307, shows the risk weights banks must use for exposures to corporates under the revised credit risk SA. The risk weights depend on the obligor's leverage (the total liabilities to equity ratio) and on gross revenue.

For Commercial Mortgages, risk weights depend on the Loan to Value ratio and for Residential Mortgages, the risk indicators are Loan to Value and Debt Service Coverage ratios.
Tables 3 and 4 show the risk weights, proposed by the Basel authorities, for exposures to Commercial and Residential Mortgages. The risk weights in both cases depend on Loan to Value (LTV) ratios while Residential Mortgage risk weights also depend on Debt Service Coverage ratios.

Table 3: RSA risk weights for commercial mortgages

LTV < 60%	60% ≤ LTV < 75%	75% ≤ LTV
75%	100%	120%

Note: The table, reproduced from BCBS 307, shows the risk weights banks must hold, under the revised credit risk SA against exposures to commercial mortgages. Risk weights depend on Loan to Value (LTV) ratios.

Table 4: RSA risk weights for residential mortgages

	LTV < 40%	40% ≤ LTV < 60%	60% ≤ LTV < 80%	80% ≤ LTV < 90%	90% ≤ LTV < 100%	100% ≤ LTV
DSC ≤ 35%	25%	30%	40%	50%	60%	80%
DSC > 35%	30%	40%	50%	70%	80%	100%

Note: The table, reproduced from BCBS 307, shows the risk weights banks must hold, under the revised credit risk SA against exposures to residential mortgages. Risk weights depend on Loan to Value (LTV) and Debt Service Coverage (DSC) ratios.

The revised SA further defines so called Specialised Lending exposures. These are exposure types deemed to be particularly risky and are subject to a conservative non risk differentiated risk weight. Among others, Income Producing Real Estate (IPRE), Commodity Trade Finance (CTF) and Land Acquisition (LA) given certain conditions might qualify as Specialised Lending exposures, receiving 120%, 120% and 150% risk weights, respectively.

3. Capital Impact Analysis

This section describes how we infer the impact of the proposed capital rule changes for different banks and asset classes. Table 5 shows the market shares that different categories of bank contribute to the main segments of the Swiss loan market.

Table 5: Swiss credit market volume shares by bank category

	Banks	Corporate Financing	Mortgage to Corporate	Mortgage to Households	Total Mortgage
Large banks	9,167	48,112	59,211	197,369	256,580
Cantonal banks	10,360	45,274	95,645	220,358	316,003
Other	68,535	40,965	66,512	257,584	324,096
All banks	88,062	134,351	221,368	675,311	896,679

Note: Figures displayed are in CHF Million and pertain to the end of 2014. The data source is Swiss National Bank (SNB) reports.[14]

The pie charts that appear in Figure 1 exhibit the same data as Table 5. One may observe that 70% of Corporate Financing is supplied by the two Large Banks and the Cantonal Banks, the two categories of bank providing roughly equal market shares. The Cantonal Banks have the largest share of the market in Mortgages to Corporates followed by the Other Banks. The largest share of Mortgages to Households is supplied mostly by the Other Banks (which include Raiffeisen), followed by the Cantonal Banks.

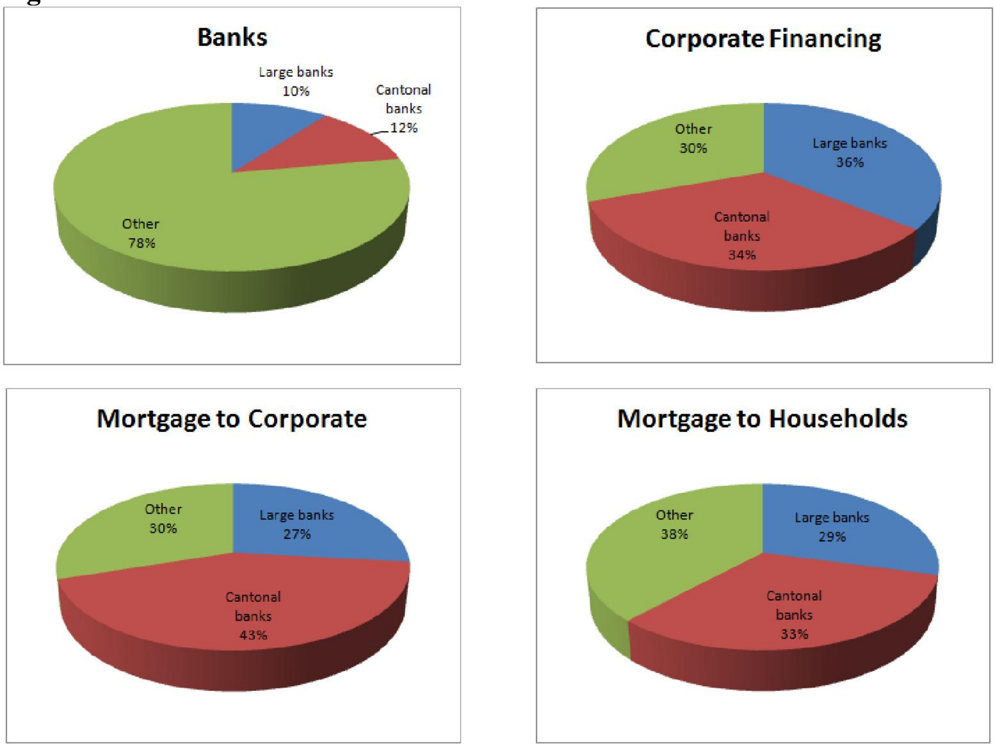
While helpful in showing the overall breakdown of the Swiss loan market in a timely fashion (the data we exhibit is for end 2014), SNB data are not sufficiently disaggregated for us to employ directly in

[14]The data sources for Table 5 are as follows: The total domestic credit volume in Switzerland, as of December 2014, is CHF 1,066,136 million. The data source is the SNB report: Credit volume statistics – domestic and foreign available at http://www.snb.ch/ext/stats/bstamon/pdf/deen/Kreditstatistik_IABG.pdf. Figures on Exposure to Banks come from the SNB report: http://www.snb.ch/ext/stats/bstamon/pdf/deen/Aktiven_I.pdf. Figures on Total Mortgages also come from this report. As this report presents statistics for the total domestic and foreign credit volumes, there is no breakdown by bank groups for domestic credit volume. We assume all foreign lending is performed by Large Banks. Figures on Corporate Financing and Mortgages to Corporate come from SNB report: Credit volume statistics – domestic, to companies, by company size and type of loan. http://www.snb.ch/ext/stats/bstamon/pdf/deen/Kreditstatistik_Betriebsgroessen.pdf. Figures on Mortgages to Households are calculated as the difference between Total Mortgages and Mortgages to Corporates.

our analysis.[15] We, therefore, use individual bank data taken from the annual reports and Pillar 3 disclosures of individual banks.

We wish to analyse bank loan exposure data in a disaggregated way.[16] It is natural to work with the standard regulatory categories such as: Sovereign, Bank, Corporate, Other Wholesale, Retail Mortgage, Revolving Facilities and Other Retail. It is not practical, however, to examine all of these categories because of data availability. We, therefore, focus our investigation on capital and spread impacts for the four key regulatory asset classes: Bank Exposures, Corporate Loans, Commercial Mortgages and Residential Mortgages. In the case of IRB banks, we will also provide some results on the impacts on several categories of Specialized Lending.[17]

Figure 1: Market shares of credit volume of banks in Swiss



Note: For information on data definitions and sources, see notes to Table 5 and footnote 10.

To obtain accurate estimates of impacts on capital, it is necessary to break the loan volumes down further, distinguishing loan exposure data based on (i) the approach the bank uses in calculating regulatory capital (IRB, SA, SRW and Other) and (ii) default probabilities (in the case of IRBA loans) or risk weight bands (in the case of SA loans). We concentrate our analysis only on IRBA and SA loans.

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[15] Aggregate statistics on the Swiss banking sector and loan markets may be found in Swiss National Bank (2012) and (2013).

[16] It is particularly interesting to look at the effects of capital requirements broken down by loan type. Brun, Fraisse and Thesmar (2013) go even further by using loan level data to examine the effects of capital regulations on lending. They find strong results of capital changes on lending.

[17] Lack of detailed data on Specialised Lending for Credit Suisse obliges us to make the simplifying assumptions that the bank's exposure to the Specialised Lending category Income Producing Real Estate is the same as UBS, i.e., CHF 20billion.

The banks that we study (37in number) are listed in Table 6. Of these, three are IRB banks, namely Credit Suisse, Banque Cantonale Vaudoise and UBS. Based on statements contained in either the bank's annual report or Pillar 3 disclosures, we consider all other banks to be following the SA in calculating credit risk capital.[18]

Table 6: List of banks covered in our study

Bank names	Bank groups	RW available
Credit Suisse	Large banks	NO
UBS	Large banks	NO
Raiffeisen	Other	NO
Aargauische Kantonalbank	Cantonal banks	NO
Appenzeller Kantonalbank	Cantonal banks	YES
Banca dello Stato del Cantone Ticino	Cantonal banks	NO
Banque Cantonale de Genève	Cantonal banks	NO
Banque Cantonale du Jura	Cantonal banks	YES
Banque Cantonale Neuchâteloise	Cantonal banks	NO
Banque Cantonale Vaudoise	Cantonal banks	NO
Basellandschaftliche Kantonalbank	Cantonal banks	NO
Basler Kantonalbank	Cantonal banks	NO
Berner Kantonalbank	Cantonal banks	NO
Freiburger Kantonalbank	Cantonal banks	NO
Glarner Kantonalbank	Cantonal banks	YES
Graubundner Kantonalbank	Cantonal banks	NO
Luzerner Kantonalbank	Cantonal banks	NO
Nidwaldner Kantonalbank	Cantonal banks	YES
Obwaldner Kantonalbank	Cantonal banks	YES
Schaffauser Kantonalbank	Cantonal banks	NO
Schwyzer Kantonalbank	Cantonal banks	NO
St. Galler Kantonalbank	Cantonal banks	NO
Thurgauer Kantonalbank	Cantonal banks	NO
Urner Kantonalbank	Cantonal banks	YES
Walliser Kantonalbank	Cantonal banks	NO
Zuger Kantonalbank	Cantonal banks	NO
Zurcher Kantonalbank	Cantonal banks	NO
Bank J. Safra Sarasin	Other	YES
Bank Linth	Other	NO
Cembra Money Bank	Other	YES
Clientis	Other	NO
Coop Bank	Other	NO
Julius Baer	Other	NO
Migros Bank	Other	NO
Neue Aargauer Bank	Other	YES
Valiant Holding	Other	NO
WIR Bank	Other	YES

Note: The table displays the list of banks for which we analyse credit risk exposures to Bank, Corporate and Mortgage Borrowers. The banks are categorised as Large, Cantonal and Other. The right hand column provides information on whether the Pillar 3 Disclosures or Annual Report of the bank in question contains break downs of credit exposures by PDs or risk weights.

[18] The approach used by Basler Kantonalbank is unclear but we assume it primarily uses the SA.

The data we obtain from annual reports and Pillar 3 disclosures pertains to end 2013.To bring the data up to date, we rescale[19] the exposure data so it is consistent with the more timely, end-2014 information in the SNB statistics displayed in Table 5.

The rescaled individual bank level loan volume data are displayed (in aggregated form) in Table 7. Because of the re-scaling, they, of course, differ from those published in the banks' 2013 annual reports and Pillar 3 disclosures.

Table 7: Volume shares based on bank level data after re-scaling

Bank groups	Banks	Corporates	Cml. Mtg.	Res. Mtg.	Total Mtg.
Large banks	9,167	48,112	72,837	183,743	256,580
Cantonal banks	10,360	45,274	59,575	256,428	316,003
Other	68,535	40,965	29,525	294,571	324,096
All banks	88,062	134,351	161,938	734,741	896,679

Note: Bank level data is only available for end 2013 except for the two large banks (for which end 2014 is available). We rescale data for all except the two large banks so that the aggregates are consistent with end 2014 aggregate data published by the SNB. The resulting rescaled, bank level data is what we employ in our analysis of the capital impact of the revised credit risk SA. Figures are in CHF millions.

After rescaling, we decompose each bank's asset-class-specific exposure data according to the PD or risk weight (if this is available) information contained in the bank's Annual Report or Pillar 3 Disclosures. For banks that do not publish default probability or risk weight breakdowns, we assume that the breakdown by risk weights equals the weighted average risk weight breakdown of banks for which the information *is* available.[20]The right hand column of Table 6 shows whether or not we were obliged to make such risk weight assumptions about a given bank.

Using the decomposed data for each bank, we proceed to calculate capital requirements using the revised SA approach. The process involves the following steps.

1. For IRB banks, we infer default probabilities (PDs) from risk weights using the standard Basel formula assuming values of loss given default (LGD) and maturity (MT).
2. For SA banks, we infer ratings from RW according to the look-up tables in the current SA approach.
3. From the inferred ratings, we map the corresponding PD based on a default probability master scale table provided by UBS (see Table 8).
4. We devise two rating buckets: AAA to A- and BBB+ to default.

[19]We rescale the exposure amounts for banks other than the two largest banks (for which we have timely data) to yield totals for the Raiffeisen and Cantonal Banks that equal those reported for end 2014 by the SNB. For Raiffeisen, we aggregate the exposure amount for each asset class; we rescale the total exposure amount for each asset class to match the SNB figures in Table 5. We are only able to rescale mortgages at the level of total mortgages. Since our data on 37 banks does not cover all banks, we create two additional bank groups to represent cantonal banks and other banks which are not covered in the 37 banks. The exposure amounts for the additional cantonal banks group is calculated as the difference between the figures in Table 5 and the aggregated figures for each asset class for the cantonal banks among our 37 banks. We suppose that their risk weights equal the weighted average of those we derive for the cantonal banks among our 37 banks. For the Other Banks group, we create a group called additional other banks and follow the same logic as for cantonal banks so as to cover all remaining banks. Raiffeisen is grouped together with the Other Banks for the purpose of reporting results after all rescaling is complete.

[20]In the case of Banque Cantonale Vaudoise, a breakdown is provided only for the bank's aggregated category: "banks, corporates and other institutions". We, therefore, assume that the bank and corporate exposures of this bank have the same risk weight breakdown as the aggregate category.

5. For each asset class that depends on two capital indicators, we estimate three joint distributions: one unconditional distribution and two conditional distributions for the above two rating buckets.
6. For each asset class, we associate to each of the exposure categories (broken down by credit quality) a distribution of the two capital indicators conditional on their credit quality.
7. Given the look-up table in the revised SA paper, the indicator distribution and the loan exposure at default, we calculate the risk weighted assets and capital requirement for the loan book.

Table 8: Default probabilities

Rating	PD	Rating	PD	Rating	PD
AAA	0.02%	A-	0.08%	BB-	2.70%
AA+	0.04%	BBB+	0.17%	B+	4.60%
AA	0.04%	BBB	0.17%	B	7.75%
AA-	0.04%	BBB-	0.35%	B-	13.00%
A+	0.08%	BB+	0.63%	Cs	22.00%
A	0.08%	BB	1.00%	Default	1

Note: When a bank reports risk weights for a particular loan book, we infer the implied rating category using the existing SA rules and then deduce a corresponding default probability (PD) using the master scale shown in this table. The master scale was provided by UBS.

In this process, the distribution of exposures by risk indicator plays a crucial role. One may reflect that a bank can calculate its revised SA capital without loan level information if it knows its total exposure in each regulatory loan class and the fractions of those total exposures that fall into each bucket defined by the risk indicator ranges specified in Tables 1, 2, 3 and 4.

Table 9: Generated joint distribution of CET1 and NNPA

	CET1 ratio ≥12%	12%> CET1 ratio ≥9.5%	9.5%> CET1 ratio ≥7%	7% > CET1 ratio ≥5.5%	5.5% > CET1 ratio ≥4.5%	CET1 ratio <4.5%
			Large banks			
NNPA ratio≤1%	79.64%	1.25%	1.25%	0.00%	0.00%	0.00%
1%<NNPA ratio≤3%	13.21%	1.25%	0.00%	0.00%	0.00%	0.00%
NNPA ratio>3%	2.14%	1.25%	0.00%	0.00%	0.00%	0.00%
			Cantonal banks			
NNPA ratio≤1%	81.52%	0.94%	0.94%	0.00%	0.00%	0.00%
1%<NNPA ratio≤3%	12.59%	0.94%	0.00%	0.00%	0.00%	0.00%
NNPA ratio>3%	2.14%	0.94%	0.00%	0.00%	0.00%	0.00%
			Other banks			
NNPA ratio<=1%	83.39%	0.63%	0.63%	0.00%	0.00%	0.00%
1%<NNPA ratio<=3%	11.96%	0.63%	0.00%	0.00%	0.00%	0.00%
NNPA ratio>3%	2.14%	0.63%	0.00%	0.00%	0.00%	0.00%

Note: To calculate capital under the revised credit risk SA, for a given bank, we need the breakdown of its exposures according to the risk indicators specified in BCBS 307. For bank exposures, the relevant indicators are Common Equity Tier 1 and Net Non-Performing Asset ratios. This table displays the distributions we employed for estimating capital for bank exposures. The distributions differ for Large, Cantonal and Other banks. The methodology employed in estimating these distributions is described in the Appendix.

To calculate the revised SA capital for each bank in each regulatory asset class, we therefore focus on estimating the distribution of loans in the Swiss market across the buckets defined in the BCBS 307 tables. In the case of Swiss bank exposures to other Swiss banks, we estimate this distribution based on a combination of public data and informed by guidance to us from an expert with experience of Swiss interbank exposures. This estimation is described in the Appendix. It leads to the distributions shown in Table 9.

Almost all Swiss banks for which we have data fall into the highest CET1 bucket given in Table 1 and one may presume that NNPA ratios are very high. Given a judgment-based assumption of the distribution of Swiss bank lending to other Swiss banks, we infer the fractions that Swiss banks in the categories: Large Banks, Cantonal Banks and Other Banks, will have in each of the risk indicator buckets. These are displayed in Table 9.

To calculate the risk weights for individual banks implied by the revised SA, one must take the sum of the products of elements in the relevant block of Table 9 with the risk weights specified in Table 1. Let *Nr* and *Nc* be the number of categories corresponding to the row and column risk indicators in the table, then the risk weights for the i^{th} bank are:

$$RW_i = \sum_{r=1}^{Nr} \sum_{c=1}^{Nc} p_{r,c,i} \times rw_{r,c} \qquad (1)$$

The results of this calculation are shown in Table 10. As it turns out, according to our calculation, the risk weights implied by the revised SA for the different banks in Switzerland are quite similar, being clustered around 33%.

Table 10: Revised SA weighted average risk weights

	Large banks	Cantonal banks	Other banks
RW	34%	33%	33%

Note: This table shows estimates of Swiss banks' risk weights for exposures to other Swiss banks. The values, which depend on the estimated distributions of exposures by risk indicators shown in Table 9, turn out to be quite similar across banks in different categories.

Table 11: Categorisation of institutions

	Total assets	Assets under management	Privileged deposits	Required equity
Category 1	≥ 250	≥ 1,000	≥ 30	≥ 20
Category 2	≥ 100	≥ 500	≥ 20	≥ 2
Category 3	≥ 15	≥ 20	≥ 0.5	≥ 0.25
Category 4	≥ 1	≥ 2	≥ 0.1	≥ 0.05
Category 5	< 1	< 2	< 0.1	< 0.05

Note: Swiss rules on capital target ratios differentiate banks based on 5 categories. To qualify for a particular category the scale of a bank's activities as measured by at least three of four quantitative indicators must exceed specified thresholds. This table displays the thresholds expressed in CHF millions.

Swiss banks are required to calculate minimum capital requirements based on using capital target Financial Market Supervisory Authority (FINMA) minimum capital ratios. These are equal to those specified in the Basel III framework plus additional percentages introduced as a so-called Swiss

Finish[21]. FINMA minimum capital requirements depend on the size and complexity of banks, divided into 5 categories.

Table 11 lists the criteria that determine into which category an institution falls. The institution must meet at least three of the criteria listed to qualify for a given category. Table 12 shows the FINMA minimum capital ratio that banks in each category are required to employ[22].

Table 12: CET 1 and total capital target

	CET 1 capital ratio	Total capital ratio
Category 1	10%	14% - 19%
Category 2	8.7% - 9.2%	13.6 -14.4%
Category 3	7.80%	12%
Category 4	7.40%	11.20%
Category 5	7%	10.50%

Note: Swiss banks that fall into the categories listed in Table 11 are required to employ the capital target ratios shown in this table. We employ these ratios in our calculations of the capital impact of the revised credit risk SA for Bank and Corporate. For Commercial mortgage exposures and Residential Mortgages, we add an additional 2% reflecting the countercyclical capital buffer adopted by the Swiss authorities for such exposures.

In Switzerland, as of end 2014, only four banks have been classified by FINMA as systemically important financial institutions (SIFI) banks and allocated to category 1, and subject to higher minimum capital requirements[23]: UBS, Credit Suisse, Zurcher Kantonalbank (ZKB) and Raiffeisen. SIFIs banks have to hold 10% of total risk weighted assets in CET1 capital (constituted by common shares, retained earnings and other comprehensive income net of regulatory filters and deductions).

In addition to CET1 minimum capital requirements, SIFIs have to hold contingent convertible bonds (CoCos), that convert into common equity contingent on the breach of a predetermined ratio of CET1 over total RWA, SIFIs are required to hold a conservation buffer of 3% in form of high trigger CoCos[24], and a progressive component from 1% to 6% of low trigger CoCos.[25]

The amount of resolution CoCos a bank must hold depends on the systematic importance of the banks (including total exposure, market share in Switzerland and resolvability considerations).Because of lack of data, the remaining non-SIFI banks were allocated to the FINMA categories 2 to 5 based exclusively on the total asset criterion.

Using the assumptions and data described above, one may deduce capital requirement for the i^{th}bankfor a given regulatory asset class j using the following equation:

$$K_{i,j} = \begin{cases} max\left(RWA_{i,j}^{target} \times RW_{i,j} \times EAD_{i,j}\,, L_{i,j}^{target} \times EAD_{i,j}\right), & if\ bank\ i\ is\ a\ SIFI\ bank \\ RWA_{i,j}^{target} \times RW_{i,j} \times EAD_{i,j} & ,\ otherwise \end{cases} \quad (2)$$

[21] See FINMA Circular 2011/2.
[22] These measures are expressed as ratios of minimum required capital to total risk weighted assets.
[23] See the Swiss TBTF bank capital regulations.
[24] High trigger CoCos convert to common equity when a 7% ratio of CET1 to total RWA is breached.
[25] Low trigger CoCos convert to common equity when a 5% ratio of CET1 to total RWA is breached.

Here, RWA^{target} is the risk weight target for the bank in question and L_i^{target} is the leverage ratio target. Under Swiss regulations, the $L_{i,j}^{target}$ is equal to $RWA_{i,j}^{target} \times 24\%$.

In what follows, we shall focus mainly on the impact of changes in the rules on CET1 capital although we present results below on total regulatory capital as well.

For each SIFI bank $i,$ we adjust the capital by a convexity adjustment ratio which is calculated as follows:

$$ConvexityAdj_i = \frac{max\left(\sum_{j=1}^{N} RWA_j \times RWA_j^{target}, \sum_{j=1}^{N} EAD_j \times LRD_j^{target}\right)}{\sum_{j=1}^{N} max\left(RWA_j \times RWA_j^{target}, EAD_j \times LRD_j^{target}\right)} \tag{3}$$

Here, N is the number of asset classes. Such convexity adjustments are implemented in some banks and serve to ensure that the individual exposure class capital amounts add up to total capital once the effects on the latter of both regulatory capital and leverage ratio rules are allowed for.

Formula (2) may then be modified as follows

$$K_{i,j} = \begin{cases} max\left(RWA_{i,j}^{target} \times RW_{i,j} \times EAD_{i,j}, L_{i,j}^{target} \times EAD_{i,j}\right) \times ConvexityAdj_i & , if\ bank\ i\ is\ a\ SIFI \\ RWA_{i,j}^{target} \times RW_{i,j} \times EAD_{i,j} & , otherwise \end{cases} \tag{4}$$

Up to now, we have concentrated on capital for the exposures of Swiss banks to other Swiss banks. We employ similar approaches to deduce the effect of the revised SA on capital for other asset classes, notably Corporate Loans and Commercial and Residential Mortgages.

We deduce the corresponding risk weights using the weights for specific risk driver ranges appropriate to Corporate Loans, Commercial and Residential Mortgages, respectively, in Tables 2, 3 and 4. In so doing, we use risk factor distributions based on internal, confidential data supplied by UBS.[26] These distributions consist of the frequencies of loans for the different regulatory risk factor buckets with conditional default probability being in certain specified ranges.

It is sensible to condition on credit quality in this way because the distribution of loans across risk factors is likely to be very different for high and low credit quality loans. Since we possess data on the default probabilities of loans culled either directly from IRBA default probabilities or inferred from SA risk weights, by conditioning as just described, we are able to obtain a more accurate estimate of the capital impact.

4. SPREAD IMPACT ANALYSIS

In this section, we describe how we investigate the spread impact, at an asset class level, for each bank. We assume that:

$$\Delta spread = capital_{new} \times return\ on\ equity_{new} - capital_{old} \times return\ on\ equity_{old} \tag{5}$$

[26] Without access to internal bank data, it would be extremely difficult to assess the impact of the revised SA as we do in this paper. To illustrate, even to estimate the distribution of revenue for Swiss SMEs that borrow from banks is very challenging. Summary survey data is available on the average, range and median revenues of such SMEs (CHF million 14, 0–1,450 and 4, respectively) from Christen et al (2013). But deducing the joint distribution of revenue, leverage and credit quality without private bank data appears impossible. UBS is active throughout Switzerland and in all of the sectors on which we focus. There may be differences between its loan book distribution and that of other individual Swiss banks; but we would expect use of its data to give reasonably unbiased results when one aggregates across multiple banks as we do in our results sections.

Here the "capital level" is measured per Swiss franc of exposure. To estimate the return on equity, we use the Capital Asset Pricing Model (CAPM) used in this context by Kashyap, Stein and Hanson (2010) and by subsequent studies such as Miles, Yang and Marcheggiano (2012) and Junge and Kugler (2013).

This CAPM methodology allows for the possibility that the required return on equity that a bank faces is reduced if its total capital level increases. The required return on equity according to the CAPM equals the net premium on the equity market multiplied by the coefficient of the bank's asset return in a regression on an appropriately selected market index. (This net premium on the equity market equals the expected return on the market index minus the return on a short-dated Treasury security.)

Thus, for asset class i belonging to bank j , the spread change $\Delta spread_{i,j}$ is calculated as:

$$\Delta spread_{i,j} = \begin{cases} \left(K_{i,j}^{RSA} \times \beta_j^{SA} - K_{i,j}^{SA} \times \beta_j^{SA}\right) \times \gamma, & constant\ cost\ of\ equity \\ \left(K_{i,j}^{RSA} \times \beta_j^{RSA} - K_{i,j}^{SA} \times \beta_j^{SA}\right) \times \gamma, & varying\ cost\ of\ equity \end{cases} \quad (6)$$

Here, $K_{i,j}^{(.)}$ is the capital requirement per unit exposure amount expressed as:

$$K_{i,j}^{(.)} = \begin{cases} max\left(RWA_{i,j}^{target} \times RW_{i,j}^{(.)}, L_i^{target}\right), & if\ exposure\ i\ belongs\ to\ a\ SIFI\ bank \\ RWA_{i,j}^{target} \times RW_{i,j}^{(.)} & , otherwise \end{cases} \quad (7)$$

$RW_{i,j}^{(.)}$ is the average risk weight of asset class i in bank j, γ is the equity market risk premium and is set to be 6% in our calculation.[27] β_j is the bank's equity market beta, the regression coefficient of the bank's equity return (net of the safe rate) on a relevant (net) market index equity return. The capital $K_{i,j}^{(.)}$ is then adjusted in the same manner as described in equations (3) and (4).

We investigate the spread impact using either the CET1 capital target or the total capital target as RWA^{target} in equation (7).

Several past studies have emphasised the possibility that when a bank increases its capital levels, its beta and hence cost of equity funding will fall. This "Modigliani-Miller effect", while indisputably relevant, may be of greater or lesser magnitude and, hence, should be analysed empirically.[28]

According to a strict version of the Modigliani-Miller theory (in which banks are viewed as simple and transparent asset pools financed by debt and equity), the bank's equity market beta should equal:

$$\beta_{Asset} = \beta_{Equity} \times \frac{Equity}{Assets} + \beta_{Debt} \times \frac{Debt}{Assets} \quad (8)$$

For simplicity, we suppose that the bank's debt is close to riskless so that: $\beta_{Debt} = 0$, and subtracts from tax effects. In this case, the bank's equity beta will be proportional to the assets-to-equity or "leverage" ratio.

$$\beta_{Equity} = \beta_{Assets} \times \frac{Assets}{Equity} \quad (9)$$

[27] This is consistent with survey evidence from developed economies; see, for example, Fernandez, Linares and Fernandez Acin (2014).

[28] Within frictionless markets, the distribution of financing between debt and equity does not affect the discount rate a firm uses to value cash flows. See Modigliani and Miller (1958). For a bank, this implies that lending spreads will be unaffected by holding more equity. When frictions are present such as agency costs, incomplete information or tax differentials between debt and equity, loan spreads may be affected by changes in capital ratios.

The above reasoning depends on the absence of frictions such as (i) asymmetries of information between bank insiders and the market, (ii) agency effects in the running of the bank, (iii) asymmetries in the tax treatment of debt and equity. In this sense, it corresponds to an idealised extreme case. To evaluate the empirical magnitude of Modigliani-Miller effects, we allow for a more general dependence of bank beta on leverage in that we suppose:

$$\beta_{Equity} = \alpha_0 + \alpha_1 \times \frac{Assets}{Equity} \quad (10)$$

Following other authors, we estimate the parameters α_0 and α_1 by (i) estimating betas for a set of banks in different time periods and then (ii) regressing these estimated betas on the leverage level that the relevant bank had at the start of the period in question.

There are several important choices that must be made in formulating such regressions. First, one must select an appropriate sample of banks, data frequency, equity index and window length for the beta estimation. Second, having estimated betas, one may choose whether to estimate the relationship between betas and leverage in a fully pooled way or whether to allow for period-specific or bank -specific parameters. Since the regression of beta on leverage has a panel-data form, this latter choice amounts to deciding whether or not to use fixed effects.

Figure 2 shows the log prices of the Swiss banks we covered in regression while Figure 3 shows the Swiss market index. The share prices of the Large Banks and some of the Other Banks appear reasonably correlated with the Swiss equity market index. The Cantonal Bank equity prices on the other hand show little correlation and, indeed, exhibit relatively little volatility.

Tables 13 and 14 present results for a range of different equations. Our sample period stretches from 1999 to 2014. The banks included in the estimations are all from Switzerland, the Eurozone or the UK and are chosen on the basis that their assets exceed10 billion national currency units at the end of the sample period.

In all cases, we employ weekly data to estimate the betas. This partly offsets concerns that the equity securities of some banks in the sample might be illiquid. We repeated the exercises using daily data and did not obtain appreciably different results. We estimate betas using data windows one year in length. Again, we verified that the results are not substantially different if a six month window length is employed.

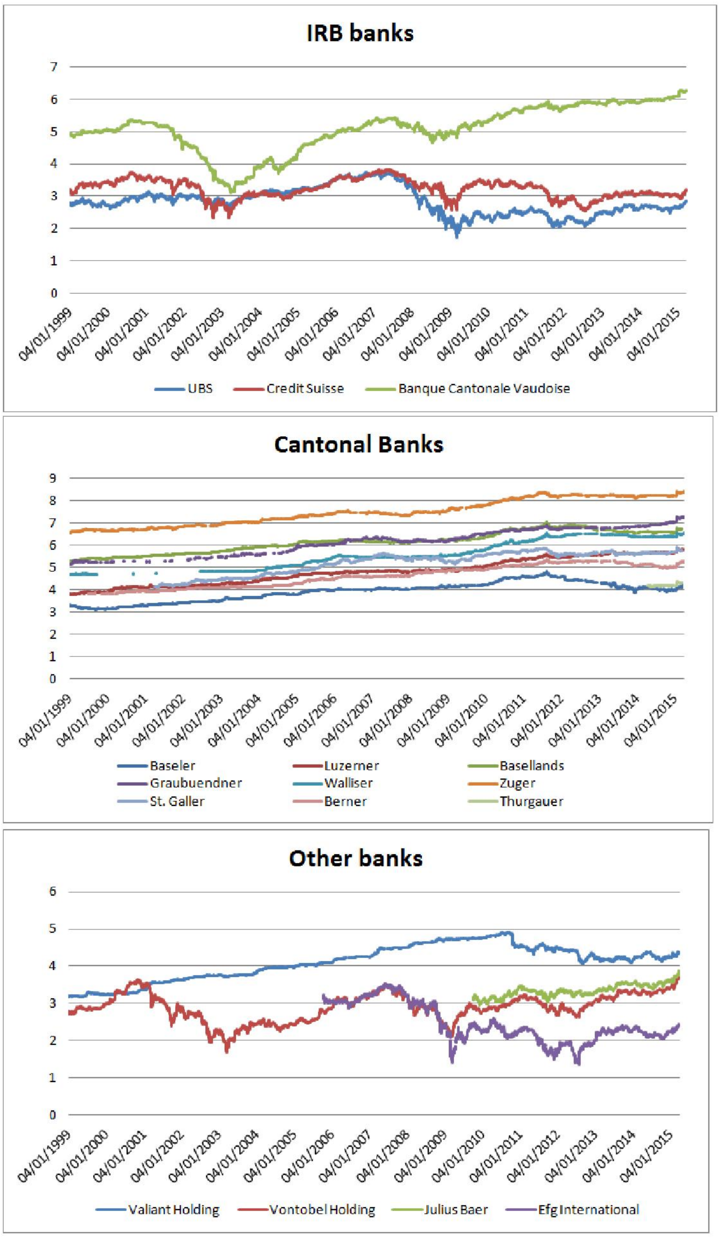
The regressions for which we show results in Table 13 vary according to the group of banks analysed: we exhibit regressions for (a) Swiss banks alone, (b) UK banks alone, (c) Eurozone banks alone and (d) all banks. In each of these four cases, we show results for regressions with no bank or year dummies, with year dummies alone, with banks dummies alone, and with both year and bank dummies.

Table 14 shows the same regressions but employing a single European index while the results shown in Table 13 correspond to regressions in which the betas for Swiss, UK and Eurozone banks are measured with respect to Swiss, UK or Eurozone indices, respectively.

In all the regressions, the right hand side variables, including the dummies, are demeaned prior to the performing the regression. Hence, the constant in the regression equals the unconditional mean of the left hand side variable in the regression. We will assume, in what follows, that the premium on the equity index is 6%. Since the return on equity equals the product of beta and the premium, we scale the left hand side variable in the regression by 6 so that the constant may be interpreted as the average return on equity across banks implied by the regression expressed in percent.

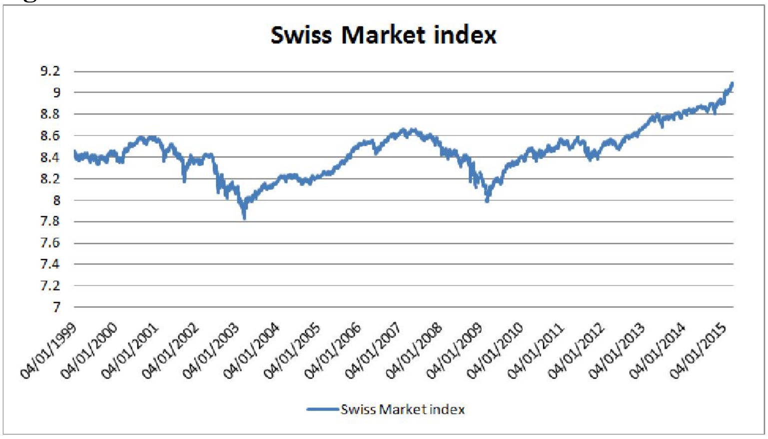
As one may observe, the average returns on equity implied by the regression constants are low, being 4.3, 7.7, 4.9 and 5.1 percent when national indices are used to estimate betas. Typical returns on equity employed within large European banks are closer to 10%. Inspection of betas for individual banks suggested that there was considerable variation across banks, justifying the use of bank specific dummies in the regression.

Figure 2: Selected Swiss banks share prices (in logs)



Note: The figure shows the log share prices of Swiss banks from 1999 to 2015 taken from Bloomberg. Cantonal bank share price time series (apart from that of Banque Cantonale Vaudoise) trend upwards with little volatility suggesting relatively low liquidity. Share prices for the two large banks appear less correlated with those of other banks.

Figure 3: Swiss market index time series



Note: The figure shows the Swiss stock market index from 1999 to 2015 taken from Bloomberg. The index appears correlated with the large bank share prices exhibited in Figure 2 until late in the sample period (post 2011) when the bank share prices under-perform the index.

Examination of the estimates contained in Tables 13 and 14 shows that when bank-specific fixed effects are introduced, the value of the regression coefficient on leverage is significantly reduced. For example, in the case of Swiss banks using betas against a Swiss national index, the leverage coefficient drops from 0.20 to 0.07 when one compares regression 2 (which employs year dummies alone) to regression 4 (which uses both bank and year dummies).[29]

It appears likely that the reduction in the size of the leverage effect that occurs when bank dummies are introduced is a reflection of the fact that large banks tend to be more levered and have higher correlation with equity market indices. However, one might reasonably expect that the degree of variation in leverage for individual banks across the sample period should be enough to identify significant leverage effects in required returns on equity if they are present in the data.

In the exercises we report below, we will use the estimates corresponding to regression 4 (i.e., including year and bank dummies). This panel data approach seems to us the most defensible given the issues referred to in the last paragraph. The approach is also consistent with that employed in recent studies by Miles, Yang and Marcheggiano (2012) and Junge and Kugler (2013). We also choose to focus on Swiss banks and to use a Swiss national index. These assumptions appear most sensible given that our study relates to Swiss banks.

One might ask why do we find weaker leverage effects than Miles, Yang and Marcheggiano (2012) and Junge and Kugler (2013)? The latter study employs a log specification of regression. The theory, we would argue is more consistent with the linear specification that we use. In preferring the linear specification, we are consistent with Miles, Yang and Marcheggiano (2012). When we restrict our data to UK banks and the sample period of Miles, Yang and Marcheggiano (2012), we obtain results similar to theirs.

[29] Baker and Wurgler (2013), like Kashyap, Stein and Hanson (2010), find strong a relationship between the leverage and equity market betas of US banks. When Baker and Wurgler look only at large institutions involved in investment banking, the results weaken significantly. If returns on investment banks (which tend to be more levered) are more correlated with market indices, then this would exaggerate the apparent relationship between leverage and market betas. Including bank-specific dummies would remove this effect.

Table 13: Beta regression estimates based on weekly return (National index)

	Swiss banks				UK banks				Euro zone banks				European banks			
Regression	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Constant(%)	4.32	4.32	4.32	4.32	7.71	7.71	7.71	7.71	4.93	4.93	4.93	4.93	5.08	5.08	5.08	5.08
t-statistic	15.34	14.86	24.49	24.55	26.79	36.54	27.69	41.20	35.85	39.92	44.05	56.63	42.53	45.42	54.70	66.74
Leverage(%)	0.19	0.20	0.08	0.07	0.13	0.08	0.16	0.01	0.12	0.13	0.04	0.06	0.13	0.14	0.05	0.04
t-statistic	8.80	8.23	2.64	2.28	3.24	2.23	2.86	0.16	8.34	9.88	1.79	2.82	11.34	12.52	2.78	2.44
R-squared	0.38	0.42	0.79	0.82	0.12	0.62	0.22	0.72	0.09	0.28	0.45	0.68	0.13	0.25	0.52	0.68
WACC(%)	0.55	0.44	2.84	2.90	5.22	6.22	4.63	7.52	2.43	2.21	4.01	3.74	2.32	2.15	4.11	4.34
Observations	129	129	129	129	80	80	80	80	680	680	680	680	889	889	889	889

Note: The regressions are defined as follows

Regression 1: OLS Regression with no bank or year dummies;

Regression 2: Fixed effect with year dummy: 2014 dropped;

Regression 3: Fixed effect with bank dummy: Walliser Kantonalbank dropped for Swiss banks, Standard Chartered dropped for UK banks, Vseobecna Uverova Banka dropped for Eurozone Banks and European banks.

Regression 4: Fixed effect with bank dummy and year dummy: 2014 dropped; Walliser Kantonalbank dropped for Swiss banks, Standard Chartered dropped for UK banks, Vseobecna Uverova Banka dropped for Eurozone Banks and European banks.

Table 14: Beta regression estimates based on weekly return (European index)

	Swiss banks				UK banks				Euro zone banks				European banks			
Regression	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Constant(%)	3.55	3.55	3.55	3.55	7.54	7.54	7.54	7.54	5.57	5.57	5.57	5.57	5.44	5.44	5.44	5.44
t-statistic	13.39	12.89	23.35	24.35	23.12	33.00	23.94	37.06	36.99	40.58	45.86	56.78	42.17	44.45	54.47	64.38
Leverage(%)	0.18	0.18	0.08	0.05	0.14	0.07	0.20	0.01	0.13	0.15	0.04	0.06	0.14	0.15	0.05	0.04
t-statistic	8.81	7.98	3.11	1.86	3.24	1.92	3.22	0.17	8.51	9.95	1.41	2.44	11.09	12.08	2.59	2.36
R-squared	0.38	0.41	0.82	0.86	0.12	0.65	0.22	0.74	0.10	0.27	0.46	0.66	0.12	0.22	0.52	0.66
WACC(%)	0.00	-0.01	2.05	2.59	4.73	6.16	3.61	7.33	2.77	2.53	4.78	4.41	2.52	2.35	4.47	4.65
Observations	129	129	129	129	80	80	80	80	680	680	680	680	889	889	889	889

Note: The regressions are defined as follows

Regression 1: OLS Regression with no bank or year dummies;

Regression 2: Fixed effect with year dummy: 2014 dropped;

Regression 3: Fixed effect with bank dummy: Walliser Kantonalbank dropped for Swiss banks, Standard Chartered dropped for UK banks, Vseobecna Uverova Banka dropped for Eurozone Banks and European banks.

Regression 4: Fixed effect with bank dummy and year dummy: 2014 dropped; Walliser Kantonalbank dropped for Swiss banks, Standard Chartered dropped for UK banks, Vseobecna Uverova Banka dropped for Eurozone Banks and European banks.

5. RESULTS

In this section, we report the results of our capital and spread impact calculations. We begin by examining the effect of the switch from the current to the revised SA approach for SA banks. Table 15 presents the weighted average risk weights for different asset classes and categories of banks. The weighted averages are worked out using weights based on each individual bank's share of the total exposure of the set of banks being considered.

One may observe from Table 15 that the existing weighted average risk weights for all SA banks are 19%, 66%, 92% and 39% for Bank, Corporate, Commercial Mortgage and Residential Mortgage exposures, respectively. There is little variation across the categories of Cantonal and Other banks.

Substituting the revised SA for the existing SA, risk weights change substantially, rising to 120% for Corporate exposures (almost double the existing risk weight level). Bank risk weights are somewhat higher under the revised rather than the existing SA, and, risk weights for Residential Mortgages are actually down from 39% to 37%. Risk weights for Commercial Mortgages drop from 92% to 87%.

Table 15: Current and revised RWs for SA banks

Bank groups	Banks	Corporates	Cml. Mtg.	Res. Mtg.	Sum
		Current risk weights			
Cantonal banks	23%	66%	92%	38%	49%
Other	19%	65%	94%	39%	42%
All SA banks	19%	66%	92%	39%	45%
		Revised SA risk weights			
Cantonal banks	33%	118%	87%	37%	54%
Other	33%	121%	87%	37%	48%
All SA banks	33%	120%	87%	37%	51%

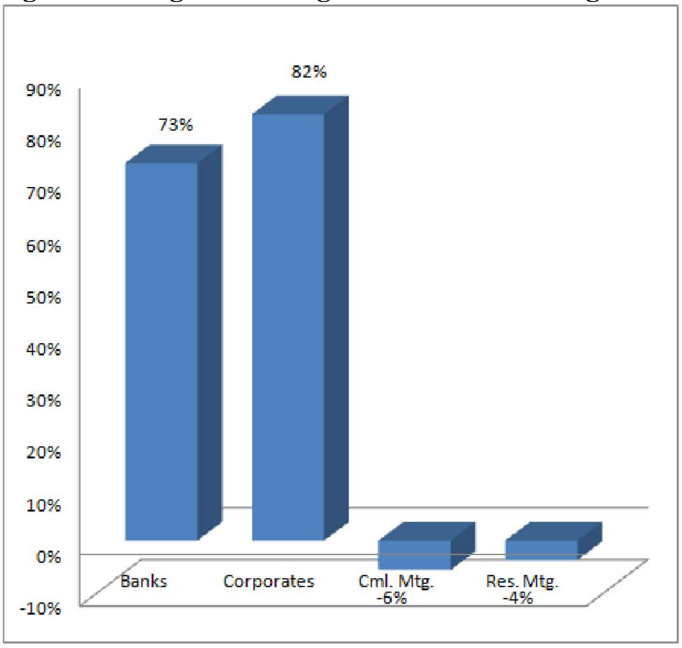
Note: The table shows the risk weights for SA banks under the current SA rules and under the revised credit risk SA rules set out in BCBS 307. The aggregated risk weights for each bank category are the weighted average risk weights of individual banks within the category. Results are shown for exposures to counter-parties in Switzerland categorised by Bank exposures, Corporate exposures, Commercial Mortgages and Residential Mortgages.

Figure 4 shows the key results from Table 15 in graphical form. Corporate and Bank revised SA risk weights are respectively 82% and 73% higher than the existing SA risk weights, while Commercial Mortgage and Residential Mortgage risk weights are 6% and 4% lower.

Table 16 shows the implied increase in capital that SA banks devote to different segments of the domestic, Swiss loan market. The existing CHF 4.3 billion and CHF 1.3 billion capital that SA banks assign to Corporate and Bank lending rises to CHF 7.9 billion and CHF 2.1 billion after the introduction of the revised SA. This is offset by a fall of around CHF 1.2 billion in the capital that Swiss SA banks hold against Commercial and Residential Mortgage lending.

Table 17 shows risk weight calculations results for IRB banks under different scenarios. We present risk weights for the different asset classes and aggregated using exposure-weighted averages (i) under the existing rules, (ii) assuming the revised SA is introduced, (iii) with the revised SA and with 60% exposure-level capital floors, (iv) as in (iii) but with asset-class level floors, and (v) as in (iii) but with a bank level floor. We then repeat scenarios (iii), (iv) and (v) assuming capital floors are imposed equal to 70% and 80% of the revised SA capital levels.

Figure 4: Weighted average SA bank RW changes



Note: The figure shows percentage changes in risk weights of Swiss SA banks (for selected exposure categories) implied by a switch from the current SA to the revised credit risk SA rules in BCBS 307. The exposure categories shown are bank exposures, corporate loans, commercial mortgages and residential mortgages. The figure shows substantial increases in bank exposure and corporate loan risk weights and small declines in mortgage related risk weights.

Table 16: Current capital and revised SA capital for SA banks

Bank groups	Banks	Corporates	Cml. Mtg.	Res. Mtg.	Sum
			Current capital		
Cantonal banks	204	2,156	4,802	9,379	16,542
Other	1,061	2,169	2,845	12,528	18,603
All SA banks	1,266	4,326	7,646	21,907	35,145
			Revised SA capital		
Cantonal banks	272	3,869	4,584	9,182	17,908
Other	1,819	4,043	2,641	11,926	20,429
All SA banks	2,091	7,912	7,226	21,109	38,337

Note: This table shows the weighted average capital requirements for categories (Cantonal and Other) of Swiss SA banks under the current SA rule and the revised credit risk SA rules proposed in BCBS 307. Figures are expressed in CHF Million.

The introduction of the revised SA makes almost no difference to the IRB banks. (The only slight change evident in Corporate risk weights occurs because while predominantly applying the IRBA, these banks calculate capital for a small proportion of their Corporate exposures under SA rules.) The introduction of revised SA-capital-based floors has a very large impact on the capital of the IRB banks, however.

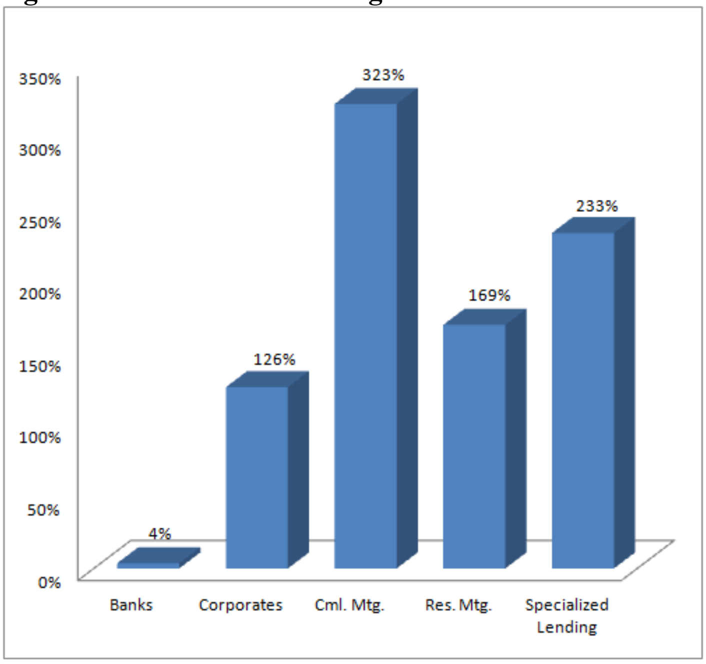
The 60% floor imposed at the exposure level boosts IRB banks' Corporate, Commercial Mortgage, Residential Mortgage and Specialized Lending risk weights from 43%, 16%, 11% and 29% to 78%, 50%, 24% and 73%, respectively. When an 80% floor is imposed at the exposure level, the risk weights for these four asset classes rise to 98%, 67%, 30% and 97%. These increases exceed factors of 2, 4, 2 and 3. Weighted average risk weights (across all IRB banks and the five asset classes we consider) go from 19% to 53%, a factor exceeding2.

Table 17: Weighted average risk weights for IRB banks under different scenarios

	Banks	Corporates	Cml. Mtg.	Res. Mtg.	Specialized Lending	Wtd. Avg.
Current risk weights	30%	43%	16%	11%	29%	19%
RSA without floor	30%	48%	16%	11%	29%	20%
RSA exposure level 60% floor	33%	78%	50%	24%	73%	42%
RSA asset class level 60% floor	30%	75%	50%	22%	72%	40%
RSA bank level 60% floor	21%	75%	50%	22%	72%	40%
RSA exposure level 70% floor	35%	88%	59%	27%	85%	48%
RSA asset class level 70% floor	30%	86%	59%	26%	85%	46%
RSA bank level 70% floor	24%	86%	59%	26%	85%	46%
RSA exposure level 80% floor	37%	98%	67%	30%	97%	54%
RSA asset class level 80% floor	31%	97%	67%	29%	97%	53%
RSA bank level 80% floor	27%	97%	67%	29%	97%	53%

Note: This table shows the weighted average risk weights of the three IRB banks we study, under existing rules and under the revised SA rules of BCBS 307. We present results under different assumptions about how IRBA risk weight floors would be linked to revised SA risk weights. Specifically, we suppose (i) that IRBA risk weight floors are set to different percentages (60%, 70% and 80%) of revised SA risk weights and (ii) that floors are imposed at individual exposure, asset class and overall bank level. We show results for exposures to banks, corporate loans, commercial and residential mortgages.

Figure 5: IRB bank RW changes with 80% asset class level floor



Note: The figure shows percentage changes in weighted average IRBA bank risk weights for four exposure categories: Bank Exposures, Corporate Loans and Commercial and Residential Mortgages. The calculations are performed assuming an asset class level floor equal to 80% of the revised credit risk SA risk weights. All except bank exposure risk weights are substantially increased by the introduction of the revised credit SA risk weight floor.

Note that an exposure level floor is more conservative in its impact on capital than an asset class level floor which, in turn is more conservative than a bank level floor. This intuitive finding results from the fact that there may be offsets when the floor is applied at a more aggregate level. However, imposing capital floors at the three different levels leads to broadly similar results in practice.

Figure 5 shows the overall risk weight impact by asset class with 80% asset class level floors. Risk weights rise by 126% for Corporate exposures, 323% for Commercial Mortgage exposures, 169% for Residential Mortgage exposures and 233% for Specialized Lending.

Table 18: Weighted average capital requirements for IRB banks

	Banks	Corporates	Cml. Mtg.	Res. Mtg.	Specialized Lending	Total
	Weighted average capital requirement					
Current capital	109	960	386	2,381	595	4,430
RSA without floor	109	977	386	2,381	595	4,447
RSA exposure level 60% floor	134	1,927	895	2,664	1,600	7,219
RSA asset class level 60% floor	119	1,808	879	2,533	1,558	6,898
RSA bank level 60% floor	102	1,802	877	2,527	1,554	6,863
RSA exposure level 70% floor	147	2,256	1,063	2,966	1,879	8,311
RSA asset class level 70% floor	123	2,185	1,062	2,819	1,872	8,060
RSA bank level 70% floor	106	2,184	1,062	2,819	1,872	8,042
RSA exposure level 80% floor	157	2,535	1,215	3,338	2,144	9,390
RSA asset class level 80% floor	129	2,493	1,214	3,220	2,140	9,195
RSA bank level 80% floor	120	2,493	1,214	3,220	2,140	9,187
	Change in capital					
RSA exposure level 60% floor	23%	101%	132%	12%	169%	63%
RSA asset class level 60% floor	10%	88%	128%	6%	162%	56%
RSA bank level 60% floor	-6%	88%	127%	6%	161%	55%
RSA exposure level 70% floor	35%	135%	176%	25%	216%	88%
RSA asset class level 70% floor	13%	128%	175%	18%	214%	82%
RSA bank level 70% floor	-2%	128%	175%	18%	214%	82%
RSA exposure level 80% floor	44%	164%	215%	40%	260%	112%
RSA asset class level 80% floor	18%	160%	215%	35%	259%	108%
RSA bank level 80% floor	10%	160%	215%	35%	259%	107%

Note: The upper panel show the capital requirements (in CHF millions) of the three Swiss IRB banks for individual asset classes under different scenarios. The lower panel shows the implied percentage changes in the three banks' asset-class-specific capital compared to current capital levels. Total capital is doubled when an 80% floor is implemented. For Corporate Loans and Commercial Mortgages, capital is 154% and 208% greater when an 80% asset class level floor is introduced.

Table 18 shows the impact on the capital of the IRB banks of the various scenarios so far considered. Overall (based on weighted averages across IRB banks and the five Swiss loan asset classes we consider), capital is 108% higher than current levels, if an asset class level 80% floor is introduced. The increases for Corporate and Commercial Mortgage exposures are 160% and 215%, while capital held against Residential Mortgages rise by just 35%. In monetary terms, the capital that the three IRB banks hold against their Swiss lending rises from CHF 4.4 billion to CHF 9.2 billion, in this case.

Table 19 shows the impact on the total capital that all banks hold against different asset classes. If an asset-class-level 80% floor is introduced for IRB banks, the increases in capital for exposures to

Banks, Corporates and Specialized Lending are 56%, 105% and 263%. Capital held against Commercial Mortgages and Residential Mortgages rises by just 17% and 4%, in the same case.

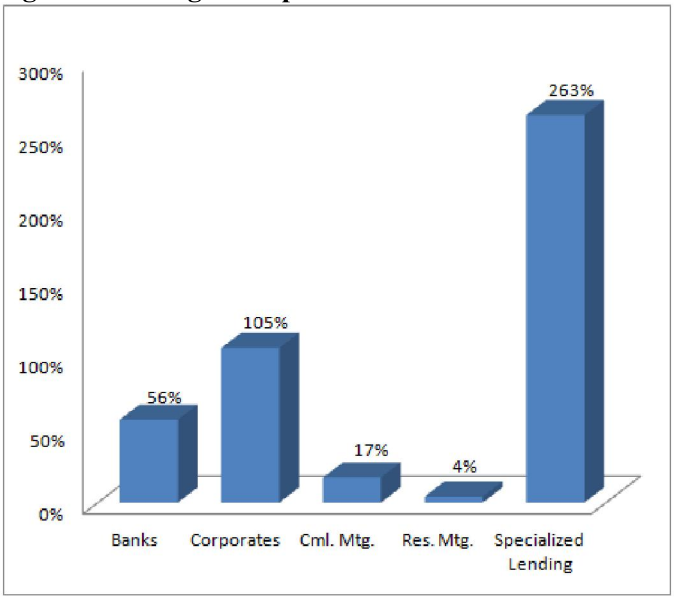
Table 19: Current and revised SA capital (with IRB floor) for all banks

	Banks	Corporates	Cml. Mtg.	Res. Mtg.	Specialized Lending
Current capital	1,537	6,162	8,498	26,917	1,328
Revised SA capital	2,402	12,639	9,943	28,003	4,822
Change in capital	56%	105%	17%	4%	263%

Note: The table shows current capital (broken down by asset class) for all banks and the capital implied by the revised credit risk SA and an 80% asset level floor for IRB banks. Total capital for Bank Exposure, Corporate Loans, Commercial and Residential Mortgages rises by 56%, 104%, 22% and 4%, respectively. Capital requirement figures are expressed in CHF million.

We now turn to the spread implications of the Basel Committee's proposed BCBS 306 and 307 capital rule changes. We calculate the spread impact using equations (6) and (7) in Section 4. We multiply post-rule change risk weights by the relevant capital target to obtain the per-Swiss-franc capital level under the new rules. We adjust for the leverage ratio target if the bank is a SIFI as in equation (7) and impose the relevant floor if this is included in the scenario we are examining. We multiply the resulting per Swiss-franc capital by the required equity return. We subtract off the pre-rule-change capital multiplied by a pre-rule-change required return on equity.

Figure 6: Change in capital for all banks



Note: The figure shows the percentage change in the total capital of Swiss banks, broken down by asset class, when the current rules are replaced with the revised credit risk SA and 80% asset-class level floors.

Table 20 shows the resulting weighted average (across individual banks) spread impacts for SA banks, specifically for Cantonal and Other banks. We report spread impacts assuming either (a) that the capital rule changes do not alter the required return on equity that the bank faces or (b) that the capital rule changes reduce leverage and hence lead to a reduction in the cost of equity. The calculation of the reduction in cost of equity employs the Swiss bank regression 4 results (with both bank and year dummies) from Table 13.

Table 20: Spread impact in basis points for SA banks

	Spread Impact 1 (Constant Equity Return)					Spread Impact 2 (Reduced Equity Return)				
Bank groups	Banks	Corp.	Cml. Mtg.	Res. Mtg.	Wtd. Avg.	Banks	Corp.	CML. Mtg.	Res. Mtg.	Wtd. Avg.
					CET 1 capital target					
Cantonal banks	6	33	-3	0	3	6	33	-3	-1	3
Other	9	40	-6	-2	4	8	38	-7	-2	3
All SA banks	8	37	-4	-1	3	8	36	-5	-1	3
					Total capital target					
Cantonal banks	8	49	-4	-1	5	8	49	-5	-1	4
Other	13	60	-9	-2	6	13	59	-10	-3	5
All SA banks	13	55	-6	-2	5	12	54	-6	-2	5

Note: The table shows the impact on the spreads charged by Swiss SA banks of replacing current rules with the revised credit risk SA. Units are basis points. The upper panel shows results when the capital impact is based on CET1 capital targets alone, while the lower panel shows results when the capital change is based on the Total Capital target ratio. The spread impacts are calculated assuming constant equity returns and equity returns that adjust endogenously as total bank capital levels change. Spreads on commercial and residential mortgages fall slightly while those on corporate loans increase by 36 and 56 basis points (depending on the capital target ratio employed) when the revised credit risk SA is introduced.

The SA bank spread impacts shown in Table 20 are sizeable for exposures to Corporates, showing weighted average rises of 37 basis points for all SA banks when a CET1 capital target is employed and no reduction in cost of equity is assumed. When a total capital target is used, the impact is55basis points for Corporate. SA bank spreads for Residential Mortgages actually drop by 1 basis point with a CET1 target ratio and 2 basis points when a total capital target ratio is employed.

The right hand block of numbers in Table 20 corresponds to the case in which cost of equity is allowed to decline as capital increases and bank leverage falls. The difference between these results and those in the left hand block is rather small. This reflects the fact that when bank dummies are included in the regressions in Table 13, the leverage effect parameter is small in magnitude. Also, for SA banks, while the changes in capital rules boost capital for exposures to Corporates, they reduce that for Residential Mortgages. We assume that the proportional change in capital for the asset classes we study equals that of the bank's total capital.[30] So, this offsetting effect weakens the overall Modigliani-Miller effect.

Table 21 shows the spread impact of introducing the revised SA and an asset class level floor for weighted averages of IRB banks and IRB and SA banks combined for the different asset classes under assumptions of (i) CET1 and (ii) total capital target ratios and (a) no change in cost of equity and (b) reduced cost of equity through Modigliani-Miller effect. The spread impact is not very different under cases (a) and (b). Assuming (ii) rather than (i) boosts the impact substantially, as one might expect.

Applying a CET1 target ratio, one finds that IRB bank Corporate spreads are 60 basis points higher with the 80% revised SA floor, while Commercial Mortgage, Residential Mortgage and Specialized Lending spreads are 57, 9 and 70 basis points higher. When the total capital target ratio is applied, the

[30] In principle, one might try to calculate the bank wide change in capital resulting from the BCBS 306 and 307 rule changes and then use this to adjust the return on equity. This would require much more information about the breakdown by the revised SA risk indicators of the banks' exposures outside Switzerland, however. Hence we made the simplifying assumption that the proportional impact of the rule changes on total capital (i.e., capital for exposures inside and outside Switzerland) equalled that for exposures within Switzerland.

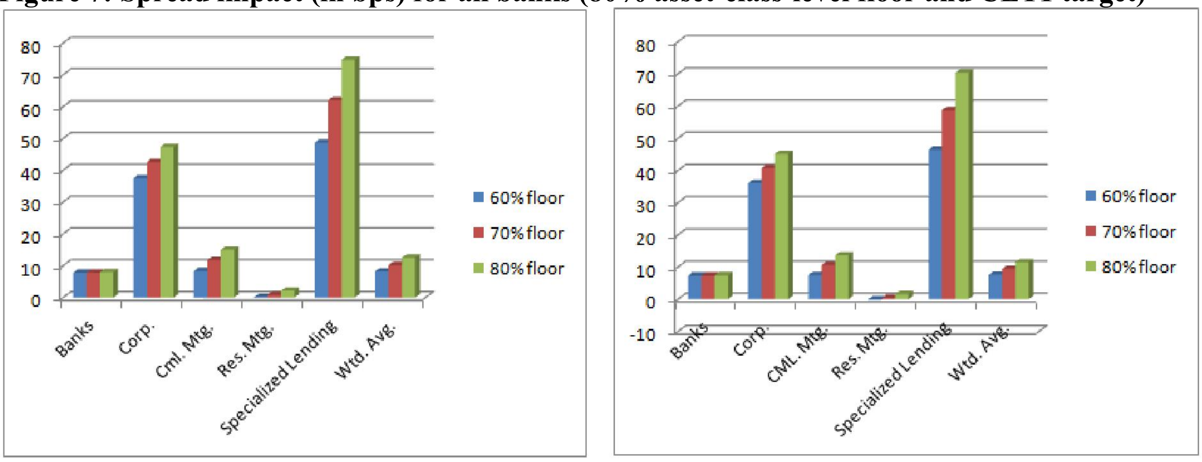
spread increases are 103, 90, 15 and 121 basis points. The weighted average across asset classes of spread impacts is 30 basis points for the CET1 target ratio and 51 basis points for the total capital target ratio. Figures 7 and 8 show the spread effects graphically.

Table 21: Spread impact in basis points (asset class level floor for IRB banks)

		Spread Impact 1 (Constant Equity Return)						Spread Impact 2 (Reduced Equity Return)					
		Banks	Corp.	Cml. Mtg.	Res. Mtg.	Specialized Lending	Wtd. Avg.	Banks	Corp.	CML. Mtg.	Res. Mtg.	Specialized Lending	Wtd. Avg.
CET 1 capital target							60% floor						
	Wtd. Avg. of IRB Banks	3	39	38	4	49	19	3	37	36	3	46	18
	Wtd. Avg. of IRB and SA Banks	8	38	8	0	49	8	7	36	7	0	46	8
							70% floor						
	Wtd. Avg. of IRB Banks	4	52	49	6	62	25	3	49	47	5	59	23
	Wtd. Avg. of IRB and SA Banks	8	43	12	1	62	10	7	41	11	0	59	9
							80% floor						
	Wtd. Avg. of IRB Banks	5	65	60	11	75	33	3	60	57	9	70	30
	Wtd. Avg. of IRB and SA Banks	8	47	15	2	75	13	7	45	14	2	70	11
Total capital target							60% floor						
	Wtd. Avg. of IRB Banks	6	67	60	6	84	32	4	63	57	5	80	29
	Wtd. Avg. of IRB and SA Banks	12	60	14	0	84	13	11	57	12	0	80	12
							70% floor						
	Wtd. Avg. of IRB Banks	6	90	79	10	107	43	4	84	74	8	101	39
	Wtd. Avg. of IRB and SA Banks	12	68	19	2	107	17	11	65	18	1	101	15
							80% floor						
	Wtd. Avg. of IRB Banks	8	111	96	18	128	55	6	103	90	15	121	51
	Wtd. Avg. of IRB and SA Banks	12	76	24	4	128	21	11	73	22	3	121	19

Note: The table shows the weighted average impacts (in basis points) on the spreads charged by IRBA and SA Swiss banks of introducing the revised credit risk SA and 80%, asset-class-level IRBA capital floors. Results are exhibited assuming the capital change is based on the CET1 capital target ration or the Total Capital target ratio. Results are reported for Bank Exposures, Corporate Loans, Commercial and Residential Mortgages.

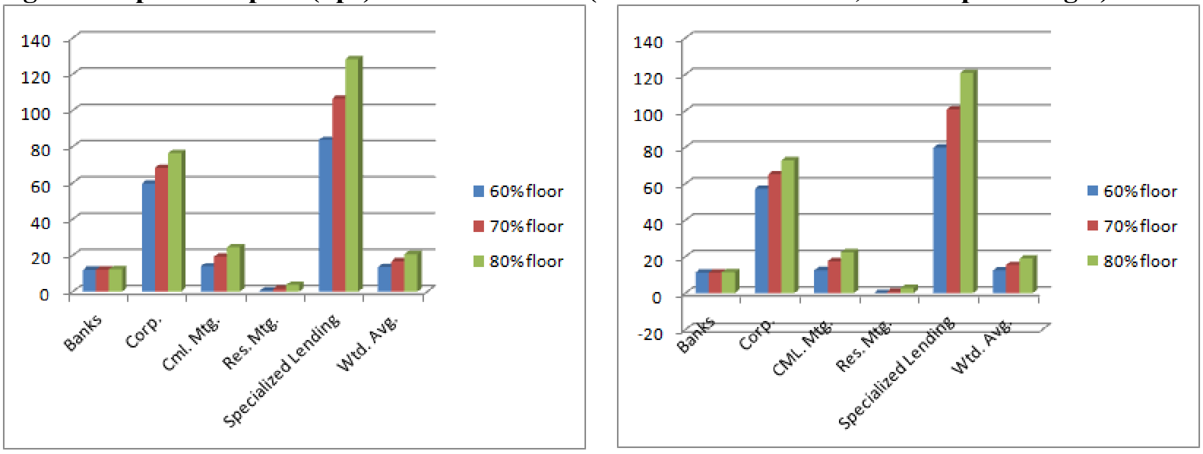
Figure 7: Spread impact (in bps) for all banks (80% asset-class-level floor and CET1 target)



a) Spread impact 1: constant equity return **b) Spread impact 2: reduced equity return**

Note: The figure shows spread impacts (in basis points and allowing for endogenous cost of equity) for all banks. The spread impacts are weighted by banks' relative exposure volumes and assume the revised credit risk SA is introduced with asset-class-level 80% IRBA risk weight floor and that the capital impact is based on the CET1 ratio.

Figure 8: Spread impact (bps) across all banks (asset class level floor, total capital target)



a) Spread impact 1: constant equity return   b) Spread impact 2: reduced equity return

Note: The figure shows spread impacts (in basis points and allowing for endogenous cost of equity) for all banks. The spread impacts are weighted by banks' relative exposure volumes and assume the revised credit risk SA is introduced with asset-class-level 80% IRBA risk weight floor and that the capital impact is based on the Total Capital.

Table 22: Monetary impact per year

	Monetary cost (Constant Equity Return)						Monetary cost(Reduced Equity Return)					
	Banks	Corp.	Cml. Mtg.	Res. Mtg.	Specialized Lending	Total	Banks	Corp.	CML. Mtg.	Res. Mtg.	Specialized Lending	Total
CET 1 capital target												
RSA exposure level 60% floor	72	507	98	33	254	963	67	487	87	5	241	887
RSA asset class level 60% floor	68	488	96	14	250	916	64	469	86	-12	238	845
RSA bank level 60% floor	62	483	94	7	246	892	58	464	84	-19	235	822
RSA exposure level 70% floor	74	567	137	94	320	1,192	70	542	123	59	302	1,096
RSA asset class level 70% floor	69	554	136	62	319	1,140	64	530	123	30	302	1,049
RSA bank level 70% floor	63	554	136	62	318	1,133	59	530	123	29	301	1,042
RSA exposure level 80% floor	77	623	174	181	385	1,440	72	594	157	139	362	1,323
RSA asset class level 80% floor	70	616	174	156	384	1,399	65	587	157	115	361	1,286
RSA bank level 80% floor	66	616	174	156	384	1,396	62	587	157	115	361	1,283
Total capital target												
RSA exposure level 60% floor	110	808	162	63	437	1,580	104	775	145	20	415	1,458
RSA asset class level 60% floor	105	775	160	33	430	1,503	98	744	144	-7	410	1,389
RSA bank level 60% floor	94	766	155	22	423	1,461	88	736	140	-17	403	1,350
RSA exposure level 70% floor	115	910	224	162	550	1,960	108	869	203	108	519	1,805
RSA asset class level 70% floor	105	888	223	111	547	1,875	99	849	203	60	518	1,728
RSA bank level 70% floor	96	888	223	110	547	1,863	89	848	202	60	517	1,717
RSA exposure level 80% floor	119	1,007	283	302	661	2,372	111	958	257	235	621	2,183
RSA asset class level 80% floor	107	994	283	261	659	2,304	100	946	258	197	620	2,121
RSA bank level 80% floor	102	994	283	261	659	2,299	95	946	258	197	620	2,116

Note: The table shows the annual cost in CHF millions of introducing the revised credit risk SA and 80% asset-class-level risk weights floors for IRB banks. The cost is calculated by multiplying individual bank spread impacts by their exposure volumes in the relevant asset class.

Our results may be compared to those of recent studies that have examined the impact of capital rules changes on spreads in Swiss loan markets. Basten and Koch (2014) use panel data on mortgage offers to examine whether Swiss banks raised mortgage lending rates because of the introduction of the Counter-Cyclical Buffer increase in capital target rates. (In February 2013, the Swiss authorities activated a Counter Cyclical Buffer requiring banks to increase CET1 capital by an amount equal to 1% of their risk-weighted domestic Residential Mortgages by September 2013.)

Table 23: PDV of monetary impact assuming a 3% discount rate

	Banks	Corp.	Cml. Mtg.	Res. Mtg.	Speciali zed Lending	Total	Banks	Corp.	CML. Mtg.	Res. Mtg.	Speciali zed Lending	Total
						CET 1 capital target						
RSA exposure level 60% floor	2,385	16,902	3,258	1,088	8,474	32,107	2,243	16,224	2,904	151	8,048	29,570
RSA asset class level 60% floor	2,278	16,260	3,213	450	8,341	30,542	2,142	15,626	2,876	-416	7,950	28,177
RSA bank level 60% floor	2,072	16,098	3,126	234	8,202	29,732	1,943	15,472	2,793	-619	7,819	27,409
RSA exposure level 70% floor	2,473	18,888	4,551	3,136	10,671	39,719	2,320	18,055	4,100	1,972	10,074	36,522
RSA asset class level 70% floor	2,288	18,472	4,539	2,081	10,625	38,006	2,144	17,671	4,099	991	10,050	34,956
RSA bank level 70% floor	2,099	18,459	4,532	2,066	10,614	37,770	1,962	17,660	4,094	981	10,042	34,738
RSA exposure level 80% floor	2,557	20,775	5,796	6,045	12,827	48,001	2,395	19,790	5,247	4,625	12,055	44,112
RSA asset class level 80% floor	2,326	20,527	5,789	5,195	12,799	46,636	2,174	19,563	5,248	3,836	12,043	42,864
RSA bank level 80% floor	2,214	20,527	5,789	5,195	12,799	46,524	2,067	19,564	5,249	3,838	12,044	42,763
						Total capital target						
RSA exposure level 60% floor	3,680	26,927	5,392	2,112	14,557	52,669	3,456	25,817	4,849	663	13,828	48,614
RSA asset class level 60% floor	3,497	25,834	5,323	1,099	14,335	50,087	3,283	24,799	4,808	-237	13,664	46,317
RSA bank level 60% floor	3,149	25,549	5,180	745	14,091	48,714	2,946	24,529	4,673	-569	13,434	45,014
RSA exposure level 70% floor	3,830	30,326	7,450	5,398	18,319	65,323	3,588	28,951	6,753	3,585	17,295	60,171
RSA asset class level 70% floor	3,514	29,615	7,432	3,704	18,242	62,507	3,286	28,295	6,752	2,009	17,256	57,598
RSA bank level 70% floor	3,192	29,593	7,420	3,678	18,223	62,106	2,977	28,276	6,743	1,991	17,242	57,229
RSA exposure level 80% floor	3,974	33,564	9,436	10,061	22,018	79,053	3,715	31,927	8,583	7,835	20,693	72,753
RSA asset class level 80% floor	3,578	33,141	9,425	8,695	21,971	76,809	3,337	31,541	8,584	6,568	20,672	70,703
RSA bank level 80% floor	3,389	33,141	9,425	8,695	21,971	76,620	3,157	31,543	8,585	6,571	20,675	70,531

Note: The table shows the present discounted cost in CHF millions of introducing the revised credit risk SA and 80% asset-class-level risk weights floors for IRB banks. The cost is calculated by assuming a perpetual annual cost as exhibited in Table 22 and discounting this by 3%.

Basten and Koch find that, following the change, banks charged on average 17 to 18 basis points more while insurers charged on average 26 to 28 basis points more. The later finding suggests that banks are the marginal price setters and that insurers took the opportunity created by pressure on bank capital to raise their lending spreads significantly.

Table 22 contains annual flow costs of lending and discounted sums of future costs. One may observe that the costs are between CHF 1.3billion and CHF 2.1 billion (the cases corresponding to CET1 and total capital target rates). Assuming a discount rate of 3%, we present estimates of the present discounted sum of future costs in Table 23. Overall, the present discounted cost of the rule changes is between CHF 42.8 billion and CHF 70.5 billion.

6. CONCLUSIONS

This paper examines the impacts on the Swiss loan market of the capital rule changes proposed in BCBS 306 and 307. The rule changes include the substitution of a risk-indicator-based, revised SA for the current SA and the imposition of capital floors for IRB capital based ona percentage of revised SA capital.

We study the effects of these changes on the risk weights and capital levels of 37 Swiss banks and banking groups including three IRB banks. We then examine how the capital changes are likely to affect the lending rates of these banks in different segments of the Swiss loan market, specifically lending to (i) other Swiss banks, (ii) Corporates (iii) Commercial Mortgage borrowers and (iv) Residential Mortgage borrowers.

If implemented in Switzerland, we estimate that the proposed changes in capital rules would increase Corporate loan risk weights for IRB banks by 126% and those for Commercial and Residential

Mortgages, by 323% and 161% respectively. Assuming full "pass through" to borrowers, a weighted average of lending rates on Corporate loans for all IRB and SA banks would rise by between 45 and 76 basis points.An incomplete 50% pass through would lead to rises in lending rates of between 23 and 38 basis points.[31]

We calculate monetary impacts of the spread changes on the Swiss economy by multiplying weighted averages (across banks) of the spread changes with the volumes of outstanding loans and an assumed pass through parameter of 100%.[32] The resulting estimates suggest that the annual cost of the policy change would be between CHF 1.3 billion and CHF 2.1 billion while the total present discounted cost would be between CHF 42.8 billion and CHF 70.5 billion (assuming a 3% discount rate).

[31] We do not try to infer a pass through fraction for spreads changes consequent on changes in capital rules since (i) inferring such a pass through percentage is difficult and arbitrary and (ii) even if not passed through, spread changes impose costs on bank shareholders. Illustrating the difficulty of inferring pass through percentages, Cecchin (2011) looks at the pass though of bank funding costs (due to changes in market interest rates) to floating and fixed rate Swiss mortgage lending rates. The results are complex suggesting different degrees of competition in the fixed and floating rate segments of the market and consequent upward and downward inflexibilities.

[32] We think it appropriate to perform these calculations assuming a 100% pass through as this gives a measure of the total cost on both borrowers and bank shareholders.

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APPENDIX 1: RISK DRIVER DISTRIBUTION FOR BANKS

This section describes how we estimate the distribution of risk drivers for exposures to banks.

Assumptions

- We classify the Swiss banks into 3 groups: Large Banks, Cantonal Banks and Other Banks. For each bank group, we assume the credit exposures to the three bank groups are distributed as Table A1.1. Large banks' exposure is partially data driven and the rest is expert based.
- Table A1.2 shows the risk drivers (Net NPA (NNPA) ratios and CET1 ratios) for 48 Swiss banks. The risk drivers represented here are proxies rather than exact figures. These do not exactly match either the definition of CET1, or the definition of Net NPA ratio, as defined in the revised SA approach. The following assumptions are made to derive the required ratios:
    1) Basel II Tier One Regulatory Capital ratio as proxy for CET1
    2) Modified definition of NNPA ratio, namely (Non-Performing Loans – Loan Loss Reserve)/(Total Earning Assets – Total Securities)
    3) Risk driver values taken from the 2013 End of year Financial statements

Table A1.1: Interbank credit risk exposure distribution for different bank groups

	Large banks	Cantonal banks	Other banks
Large banks	0.3	0.3	0.4
Cantonal banks	0.4	0.3	0.3
Other banks	0.5	0.3	0.2

Note: This table shows the assumptions we make regarding the exposure shares that each individual bank (within one of the three groups of banks) has with respect to other Swiss banks in the three different categories we consider. Hence, we suppose that, for each of the two large Swiss banks, 30% of its reported exposure to Swiss banks is with respect to the other large bank and 30% is with respect to cantonal banks. The assumed percentages were provided to us by a banker closely familiar with the Swiss interbank market and are based on the judgments of that individual.

Each row represents the credit risk exposure distribution for that bank group.
The number of banks in each bank group is given in Table A1.3.

Table A1.2: NNPA and CET1 ratios

Issuer Name	Classification with respect to Net NPA proxy	Classification with respect to CET1 proxy	Bank group
Caisse d'Epargne d'Aubonne	Net NPA <= 1%	12% <= CET1	O
Banque Cantonal du Jura	1% < Net NPA <= 3%	12% <= CET1	CB
Basellandschaftliche Kantonalbank	1% < Net NPA <= 3%	12% <= CET1	CB
Basler Kantonalbank	Net NPA <= 1%	12% <= CET1	CB
Berner Kantonalbank	Net NPA <= 1%	12% <= CET1	CB
Banque Cantonale du Valais	1% < Net NPA <= 3%	12% <= CET1	CB
Bank CIC (Schweiz) AG	Net NPA <= 1%	12% <= CET1	O
Bernerland Bank	Net NPA <= 1%	12% <= CET1	O
Leumi Private Bank Ltd.	Net NPA <= 1%	12% <= CET1	O
BSI SA	Net NPA <= 1%	12% <= CET1	O
Clientis AG	Net NPA <= 1%	12% <= CET1	O
Coutts & Co Ltd	Net NPA <= 1%	12% <= CET1	O
Credit Suisse Group AG	Net NPA <= 1%	12% <= CET1	LB
Banque Cantonale Vaudoise	Net NPA <= 1%	12% <= CET1	CB
EFG International	Net NPA <= 1%	12% <= CET1	O
Freie Gemeinschaftsbank BCL	1% < Net NPA <= 3%	9.5% <= CET1 < 12%	O
Graubundner Kantonalbank	Net NPA <= 1%	12% <= CET1	CB
Bank Coop AG	Net NPA <= 1%	12% <= CET1	O
Bank Hapoalim (Switzerland)	Net NPA <= 1%	12% <= CET1	O
Privatbank IHAG Zurich	Net NPA <= 1%	12% <= CET1	O
Julius Baer Group Ltd	Net NPA <= 1%	12% <= CET1	O
Bank Linth	1% < Net NPA <= 3%	12% <= CET1	O
Luzerner Kantonalbank	Net NPA <= 1%	12% <= CET1	CB
Maerki Baumann & Co. AG	Net NPA <= 1%	12% <= CET1	O
Migrosbank AG	Net NPA <= 1%	7% <= CET1 < 9.5%	O
Bank Morgan Stanley AG	Net NPA <= 1%	12% <= CET1	O
Neue Aargauer Bank	Net NPA <= 1%	12% <= CET1	O
Notenstein Private Bank Ltd	Net NPA <= 1%	12% <= CET1	O
Valartis Group AG	Net NPA <= 1%	12% <= CET1	O
BNP Paribas (Suisse) SA	Net NPA > 3%	9.5% <= CET1 < 12%	O
Piguet Galland & Cie SA	Net NPA <= 1%	12% <= CET1	O
PKB Privatbank AG	Net NPA <= 1%	12% <= CET1	O
Regiobank Solothurn	1% < Net NPA <= 3%	12% <= CET1	O
J. Safra Sarasin Holding AG	Net NPA <= 1%	12% <= CET1	O
Schaffhauser Kantonalbank	Net NPA > 3%	12% <= CET1	CB
Baloise Bank SoBa	Net NPA <= 1%	9.5% <= CET1 < 12%	O
St. Galler Kantonalbank	1% < Net NPA <= 3%	12% <= CET1	CB
Swissquote Group Holding Ltd.	Net NPA <= 1%	12% <= CET1	O
Acrevis Bank AG	Net NPA <= 1%	12% <= CET1	O
Thurgauer Kantonalbank	Net NPA <= 1%	12% <= CET1	CB
Banca Dello Stato Del Cantone Ticin	1% < Net NPA <= 3%	12% <= CET1	CB
Union Bancaire Privee	Net NPA <= 1%	12% <= CET1	O
UBS AG	Net NPA <= 1%	12% <= CET1	LB
Vontobel Group	Net NPA <= 1%	12% <= CET1	O
Banca Zarattini & Co SA	Net NPA <= 1%	12% <= CET1	O
Raiffeisen Schweiz Genossenschaft	Net NPA <= 1%	12% <= CET1	O
Zuger Kantonalbank	Net NPA <= 1%	12% <= CET1	CB
Zuercher Kantonalbank	Net NPA <= 1%	12% <= CET1	CB

Note: The table shows the classification of a set of Swiss banks according to Net Non-Performing Asset and CET1 ratios and according to whether they are Large Banks, Cantonal Banks or Other Banks.

Table A1.3: Numbers of banks by group

	Large banks	Cantonal banks	Other banks
Count	2	14	32

Note: The Table shows the numbers of banks in each of the three categories we study, Large, Cantonal and Other Banks.

Estimate distributions

Given the interbank credit exposure distribution (Table A1.1) for each bank group and the risk drivers (Table A1.2), we can estimate the risk driver distributions for each bank group in a simplified approach. The estimation steps are given as following:

Step 1: We classify each bank into the three bank groups.

Step 2: For each bank, determine which CET1 and NNPA bucket it belongs to given its CET1 ratio and NNPA ratio.

For $g = 1{:}\,3$ (for each bank group)

For j $= 1{:}\,3$ (for each bank group)

For $i = 1{:}\,48$ (for each bank)

Step 3: Calculate the i^{th} bank's weight as $w_i = w_{g,j}/N_j$ if bank i belongs to bank group j, where $w_{g,j}$ is the total weight of bank group j asshown in row g in table A1, N_j is the total number of banks in group j.

End

End

Step 4: Calculate the probability for CET1 and NNPA bucket k as: $p_k = \sum_{i=1}^{N} w_i$, where $w_i = w_{g,j}/N_j$ if bank i belongs to CET1 and NNPA bucket k, otherwise $w_i = 0$.

End

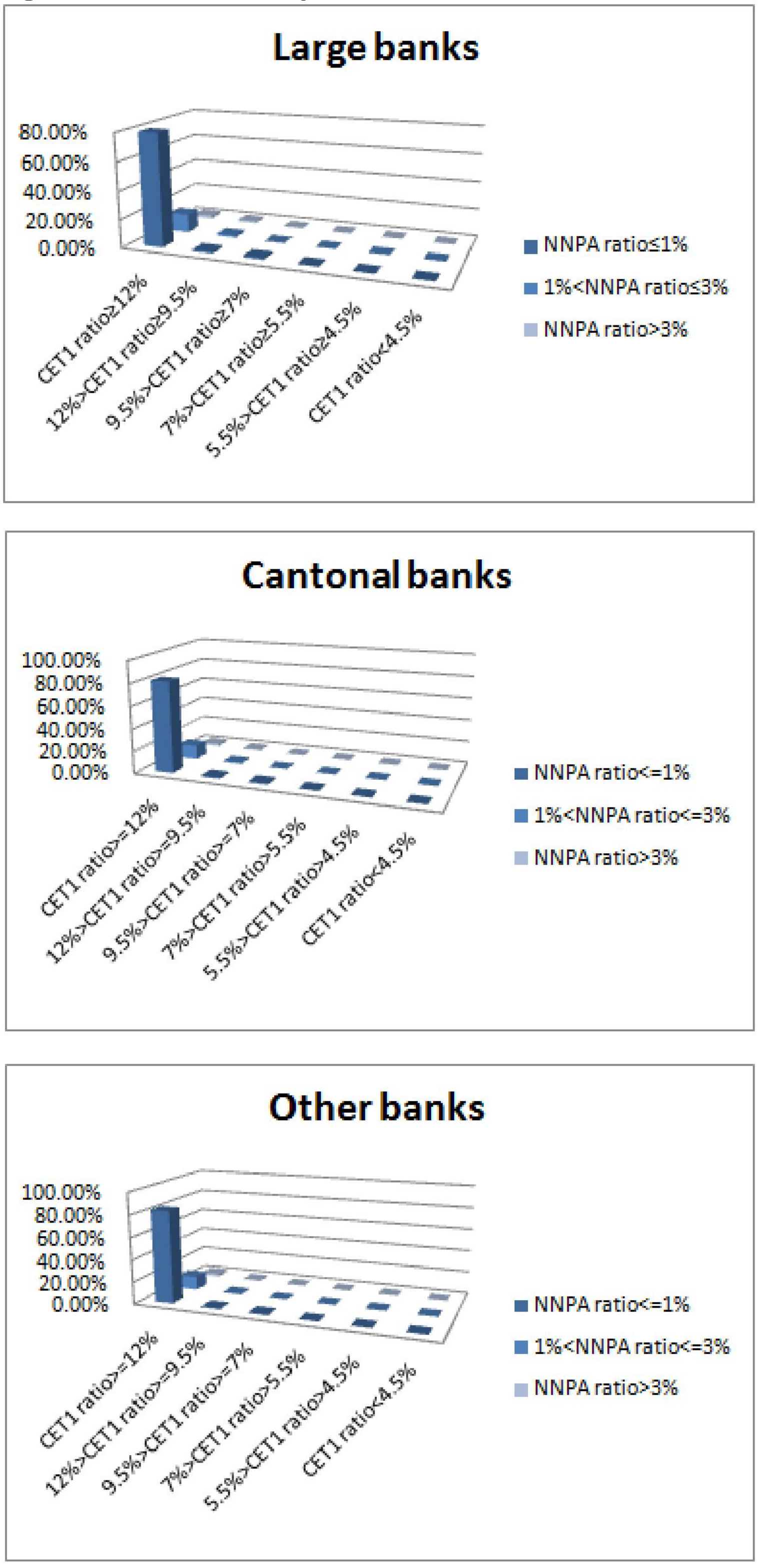
The estimated distribution is given in Table A1.4.

Table A1.4: Generated joint distribution of CET1 and NNPA

	CET1 ratio ≥12%	12%> CET1 ratio ≥9.5%	9.5%> CET1 ratio ≥7%	7% > CET1 ratio ≥5.5%	5.5% > CET1 ratio ≥4.5%	CET1 ratio <4.5%
			Large banks			
NNPA ratio≤1%	79.64%	1.25%	1.25%	0.00%	0.00%	0.00%
1%<NNPA ratio≤3%	13.21%	1.25%	0.00%	0.00%	0.00%	0.00%
NNPA ratio>3%	2.14%	1.25%	0.00%	0.00%	0.00%	0.00%
			Cantonal banks			
NNPA ratio≤1%	81.52%	0.94%	0.94%	0.00%	0.00%	0.00%
1%<NNPA ratio≤3%	12.59%	0.94%	0.00%	0.00%	0.00%	0.00%
NNPA ratio>3%	2.14%	0.94%	0.00%	0.00%	0.00%	0.00%
			Other banks			
NNPA ratio<=1%	83.39%	0.63%	0.63%	0.00%	0.00%	0.00%
1%<NNPA ratio<=3%	11.96%	0.63%	0.00%	0.00%	0.00%	0.00%
NNPA ratio>3%	2.14%	0.63%	0.00%	0.00%	0.00%	0.00%

Note: The table shows for individual banks in each of our three categories of banks the distributions (by Net Non-Performing Asset (NNPA) and Common Equity Tier 1 (CET1) ratios) of that bank's exposures to other Swiss banks in the three categories.

Figure A1.1: Generated joint distribution of CET1 and NNPA



Note: The figure shows graphically the distributions contained in Table A1.4.