Why do banks need capital and what are the costs associated with it?

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Abstract

In nowadays world the amount of capital required by a bank is prescribed by binding regulatory minimum capital requirements. Nonetheless, it is insightful to revisit why banks hold equity capital and how much capital would be needed from an economic viewpoint. As shown by an exemplary case, this amount is typically lower than the regulatory minimum amount which results from a bank's risk-weighted assets and leverage ratio requirements. It is, however, important to avoid two common fallacies. It is neither appropriate to argue that increased capital requirements translate one-to-one into higher costs for banks, nor to assume that more stringent capital requirements do not increase costs for banks because there is a perfect offset through a lower cost of equity as suggested by theory.

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JEL-Classification: G21, G28

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Appreviations

AIRB	Advanced Internal Ratings Based Approach
AT1	Additional Tier 1
BCBS	Basel Committee on Banking Supervision
BIS	Bank of International Settlements
CET1	Common Equity Tier 1
CRD	Capital Requirements Directive
CRR	Capital Requirements Regulation
D-SIB	Domestic Systemically Important Bank
DTA	Deferred Tax Asset
EBA	European Banking Authority
ECB	European Central Bank
FINMA	Financial Markets Supervisory Authority
F-IRB	Foundation Internal Ratings Based Approach
FSB	Financial Stability Board
G-SIB	Global Systemically Important Bank
HQLA	High Quality Liquid Assets
LGD	Loss Given Default
LRD	Leverage Ratio Denominator
LTV	Loan to Value
MREL	Minimum Requirement for own Funds and Eligible Liabilities
PD	Probability of Default
RWA	Risk Weighted Assets
SREP	Supversiory Review and Evaluation Process
TLAC	Total Loss-Absorbing Capacity

1 Executive Summary

In today's world the amount of equity capital held by banks is determined by regulatory capital frameworks like Basel III or CRR2/CRD5. In this paper, I first take a step back and revisit why banks need equity capital. As opposed to industrial companies, the use of equity as a source of funding is secondary for banks. Equity in a bank has the main purpose to protect the deposits of a bank's clients. Equity serves as a buffer to absorb unexpected losses that the bank may incur from defaults on its credit portfolio, trading activities or operational risks, among others. A bank which becomes undercapitalized can easily lose the trust of its depositors. If clients start to withdraw their funds, a bank can quickly come into serious difficulties. It is therefore in the very own interest of banks to hold a sufficiently large amount of equity capital to maintain the confidence of their clients.

How much capital a bank requires is ultimately a question of how large losses the bank is expected to face under a worst case scenario. The tricky point is that there exists no upper bound for potential losses, albeit losses above a certain threshold can be ruled out with high statistical confidence because of diversification effects. In the absence of capital regulations, banks would therefore need to find the optimal balance between providing clients sufficient safety and meeting the return expectations of their shareholders. However, as in nowadays world regulatory capital requirements have been significantly increased, this trade-off has lost importance. Instead, banks face the challenge that some business activities require so much regulatory capital that these businesses are no longer attractive for their shareholders.

Regulatory capital requirements for banks are prescribed by a set of complex rules under different standards, methodologies and legal rules which vary across jurisdictions. To ensure a certain alignment internationally, the Basel Committee on Banking Supervision (BCBS) sets with its Basel capital accords global minimum standards which are implemented in national banking regulations. It is at the national regulators own discretion to impose stricter standards than prescribed by the BCBS. Moreover, the Financial Stability Board (FSB) identifies in consultation with the BCBS and national authorities a list of global systemically important banks (G-SIBs).[1] Because of their importance for the overall economy, these banks face increased capital requirements which are governed by a separate framework.

Technically, the amount of capital required by a bank is determined by minimum capital ratios that banks have to maintain. While capital requirements based on risk-weighted assets (RWA) remain the main focus, the unweighted leverage ratio has regained popularity because of its simplicity and transparency. For the calculation of RWA, banks can choose whether they want to develop and use their own internal models, or whether they prefer to rely on a standardized approach provided by the regulator. Typically, the standardized approach results in higher capital requirements so that banks have incentives to invest into their own modelling and risk-management techniques. While this is desired, it

[1] `https://www.fsb.org/2019/11/fsb-publishes-2019-g-sib-list/`

bears the danger that banks may estimate their RWA in a non-conservative way. The leverage ratio helps to provide more transparency on a bank's exposures and serves as an important backstop measure against the shortcomings of the risk-weighted approach. However, the leverage ratio can also provide unwanted effects and should therefore be calibrated in a way which makes it normally not binding.[2]

In nowadays world, regulatory capital requirements exceed in most cases the amount of capital that would be needed from an economic viewpoint. When looking at the costs associated with this, it is important to avoid two common fallacies. On the one hand, the cost of equity capital should not be treated as a fixed percentage number, at it depends on the riskiness of the business model and importantly also on the amount of capital hold by the bank. On the other hand, it is also not realistic to believe that higher capital requirements do not cause any burden to banks because theoretically there should be a perfect offset in the form of a lower cost of equity. Most likely, reality is somewhere in between. In that case, banks are well advised to develop and use capital allocation frameworks which incentivize decision makers in the business to use their financial resources sparingly. In addition, banks should regularly update their cost of equity and use different rates across different business lines.

The remainder of this paper is organized as follows. Section 2 provides an overview on the role of capital in a bank and answers the question how much capital a bank would need to hold from an economic viewpoint, i.e., in the absence of regulatory capital requirements. Section 3 explains the regulatory concepts used to determine the amount of capital required by a bank. It covers the various methods banks can use to compute their risk-weighted assets, explains the most relevant capital ratios and provides an overview over the minimum capital requirements prescribed by the BCBS and how those are implemented in the capital adequacy rules in the European Union and Switzerland, with a focus on the capital requirements for large systemically relevant banks. Section 4 discusses the seminal work of Modigliani and Miller and how their proposition impacts the banks' cost of underpinning their business activities with more capital than what would be needed from an economic viewpoint.

2 The role of capital in a bank

Evidently, banks need to hold equity capital in order to meet the mandatory minimum capital requirements under the Basel capital accord. However, in this section I first take a different view as I aim to answer the question how much capital a bank needs to hold from an economic perspective. This will help us to get a clearer understanding on the cost of capital in situations where capital regulations oblige banks to hold more capital than what they regard as necessary based on their own models.

[2]Binding is meant in a mathematical sense, i.e., as the one of two or more constraints which effectively determines the requirement

It is important to acknowledge that equity in banks serves a different purpose compared to non-financial companies. In industrial companies equity is mainly used to finance fixed-assets like property, plants and equipment. By contrast, for banks the use of equity as a source of funding is only secondary. In essence, banks raise deposits from their clients and use these funds to lend to their clients. Equity provides a buffer which protects the depositors from unexpected losses that the banks may incur on their lending portfolios.

Trust is the keyword when it comes to the question of how much capital a bank requires. If clients do no longer believe in the solvency of a bank, they will start to withdraw their deposits quickly. This is seen as a negative signal by other clients who will react by withdrawals as well. While initially there will be enough money to serve these withdrawals, a rapid decline in the bank's liquidity reserves will further undermine trust and can lead in a bank run and ultimately bankruptcy. Therefore, it is in a bank's very own interest to hold an amount of equity capital which is large enough to maintain the trust of its clients under all reasonably possible circumstances. Nonetheless, banks should also not hold excess equity, as they otherwise diminish the return for their shareholders.

2.1 Economic capital requirement

In the following, I show based on the example of mortgage loans how the optimal amount of equity capital can be determined for a bank.

For the sake of illustration, let's first look at the special case where a bank grants only one large mortgage loan to a single client. Presume that the probability of the loan defaulting in a given year is 1% and that 70% of the loan value can be recovered by the sale of the underlying property in the case of default. Or put in the language of bankers, the mortgage loan has a probability of default (PD) of 1% and a loss given default (LGD) of 30%. Hence, the expected loss on the mortgage loan which the bank has to include in the loan interest rate is 1%*30%=0.3%.

In the following, let's assume that the loan interest rate is set at 1.5% and that the interest rate due on client deposits is 0%. After one year, there are in the case of a single loan only two possible outcomes. Either the loan is repaid or not. In the first case, the bank makes a 0.3% extra profit as the expected loss did not realize, i.e., the bank earns the full loan interest of 1.5% and not just the 1.2% net of expected credit losses. However, in the second case the bank loses 30% and also does not get the loan interest from the client. Hence, the bank needs at least 30% of equity capital to absorb the loss and to be able to fully repay the client deposits.

Now, let's assume that the bank lends the same overall amount to two different clients with identical characteristics and collateral quality as above. In this case, PD, LGD and expected loss remain the same. However, there are now four different cases. In the first case where none of the loans defaults the bank makes the same 0.3% extra profit as above because the expected loss did not realize. The second and the third case are identical. In both cases, one loan

defaults while the other does not. Hence, the 30% loss on the defaulting loan is reduced by the 1.5% interest earned on the non-defaulting loan. As both loans make up half of the bank's balance sheet, the amount of equity needed is 0.5*30%-0.5*-1.5%=14.25%. In the fourth case both loans default and the bank requries 30% of equity to absorb the losses. To remain solvent under all possible outcomes, the bank needs therefore still 30% of equity capital.

What happens now if the bank lends the same overall amount to many different clients, let's say 100 individuals. As shown in table 1, there is a high likelihood that there are either zero, one or two defaulting loans if the defaults are assumed to be independent from each other. However, there is still a reasonably high probability of observing three, four or more defaults. It is important to understand that theoretically even all 100 loans could default concurrently, although this outcome is highly unlikely. In fact, observing more than 6 loan defaults is already associated with a probability of less than 0.01%. Hence, it should be sufficient if the bank prepares for the default of 6 loans as plausible worst case scenario. In this case, 6/100*30%-94/100*-1.5%=0.39% of capital would already be enough to rule out bankruptcy with very high likelihood. Note though that the amount of capital will be insufficient should there be more than 6 defaults so that viability is no longer given in that case.

In reality, credit losses are not independent from each other. Factors like unemployment, political and economic environment as well as natural disasters or epidemics impact many borrowers concurrently so that the loan defaults are positively correlated. As shown in table 2, the number of loan defaults which is not expected to be exceeded with 0.01% probability increases to 17 if we assume a moderate positive correlation of defaults with the likelihood of an adverse scenario.[3] Thus, the bank requires 17/100*30%-83/100*-1.5%=3.86% of equity capital to be prepared for the expected worst case. And of course, even higher losses cannot be ruled out with certainty.

As shown in figure 1, diversification is a powerful mean to reduce the required amount of capital. In fact, by the law of large numbers allocating the overall balance sheet amount to infinitely many clients would bring the required amount of capital close to the expected loss if loan defaults are independent. In that case credit losses are fully absorbed by the interest earnings and consequently no equity capital would be needed at all. But as in reality loan defaults are correlated, risks cannot be fully diversified away and banks need to hold capital to be able to absorb unexpected credit losses.

[3]Example based on the following assumptions: unconditional PD of 1%, probability of adverse scenario 5%, correlation 0.134. This implies a conditional PD of 6.8% under the adverse scenario. Formulas for default correlation obtained from `https://www.math.ust.hk/~maykwok/courses/Dyn_Cred_Models/Topic2.pdf`

Table 1: Capital requirements for independent defaults

This table shows the capital requirement in percent (capital need %), depending on the number of defaulting loans (# of defaults) and based on the assumptions that defaults are independent. The assumed PD is 1%. Probabilities are reported for a specific number of defaults (probability) as well as cumulative for the number of defaults which is not exceeded (cum probability). The capital requirement is determined so that the bank remains viable with a confidence level of 99.99% (viability = 'ok'). If the number of loan defaults is higher than this threshold, capital will be insufficient and the bank faces bankruptcy (viability ='no').

# of defaults	**probability**	**cum probability**	**capital need %**	**viability**
0	0.3660	0.3660	-1.50%	ok
1	0.3697	0.7358	-1.19%	ok
2	0.1849	0.9206	-0.87%	ok
3	0.0610	0.9816	-0.56%	ok
4	0.0149	0.9966	-0.24%	ok
5	0.0029	0.9995	0.07%	ok
6	**0.0005**	**0.9999**	**0.39%**	**ok**
7	0.0001	1.0000	0.71%	no
8	0.0000	1.0000	1.02%	no
9	0.0000	1.0000	1.34%	no
10	0.0000	1.0000	1.65%	no
...	...	...	...	
20	0.0000	1.0000	4.80%	no
...	...	...	...	
30	0.0000	1.0000	7.95%	no
...	...	...	...	
40	0.0000	1.0000	11.10%	no
...	...	...	...	
50	0.0000	1.0000	14.25%	no
...	...	...	...	
60	0.0000	1.0000	17.40%	no
...	...	...	...	
70	0.0000	1.0000	20.55%	no
...	...	...	...	
80	0.0000	1.0000	23.70%	no
...	...	...	...	
90	0.0000	1.0000	26.85%	no
...	...	...	...	
100	0.0000	1.0000	30.00%	no

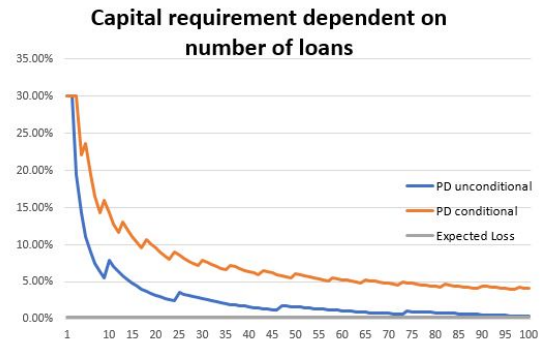
Table 2: Capital requirements for correlated defaults

This table shows the capital requirement in percent (capital need %), depending on the number of defaulting loans (# of defaults) and based on the assumptions that defaults are correlated with a systematic risk factor (conditional PD=6.8%). Probabilities are reported for a specific number of defaults (probability) as well as cumulative for the number of defaults which is not exceeded (cum probability). The capital requirement is determined so that the bank remains viable with a confidence level of 99.99% (viability = 'ok'). If the number of loan defaults is higher, capital is insufficient and the bank faces bankruptcy (viability ='no').

# of defaults	**probability**	**cum probability**	**capital need %**	**viability**
0	0.0009	0.0009	-1.50%	ok
1	0.0064	0.0073	-1.19%	ok
2	0.0230	0.0303	-0.87%	ok
3	0.0549	0.0852	-0.56%	ok
4	0.0971	0.1823	-0.24%	ok
5	0.1361	0.3184	0.07%	ok
6	0.1572	0.4756	0.39%	ok
7	0.1540	0.6296	0.71%	ok
8	0.1306	0.7602	1.02%	ok
9	0.0974	0.8577	1.34%	ok
10	0.0647	0.9224	1.65%	ok
11	0.0386	0.9610	1.97%	ok
12	0.0209	0.9819	2.28%	ok
13	0.0103	0.9922	2.60%	ok
14	0.0047	0.9969	2.91%	ok
15	0.0020	0.9988	3.23%	ok
16	0.0008	0.9996	3.54%	ok
17	**0.0003**	**0.9999**	**3.86%**	**ok**
18	0.0001	1.0000	4.17%	no
...	...	...	...	
30	0.0000	1.0000	7.95%	no
...	...	...	...	
40	0.0000	1.0000	11.10%	no
...	...	...	...	
50	0.0000	1.0000	14.25%	no
...	...	...	...	
60	0.0000	1.0000	17.40%	no
...	...	...	...	
70	0.0000	1.0000	20.55%	no
...	...	...	...	
80	0.0000	1.0000	23.70%	no
...	...	...	...	
90	0.0000	1.0000	26.85%	no
...	...	...	...	
100	0.0000	1.0000	30.00%	no

Figure 1: Diversification effects

This figure shows how the capital requirement reduces with an increasing number of loans. The capital requirement in percent is computed for different number of loans, ranging from n=1 to 100, based on an unconditional PD of 1% as well as a conditional PD of 6.8%. By the law of large numbers, the unconditional PD converges towards the expected loss for large n. By contrast, risks cannot be fully diversified away if defaults are correlated because of a common systematic risk factor. As a consequence, capital requirements based on conditional PD do not converge towards the expected loss for large n.



In our example with the mortgage loans, 3.86% of equity capital are sufficient to ensure the bank remains in business at a confidence level of 99.99%. However, how does this economic capital requirement compare to the minimum capital requirements under Basel III? This question is answered in the following section.

3 Regulatory capital requirements

In the Basel III capital adequacy framework, assets are first risk-weighted and then underpinned with a certain amount of capital. In addition, banks have to meet a non-risk weighted leverage ratio requirement. In this subsection, we discuss the specific capital treatment based on the exemplary credit portfolio from the last section. First, we will look at the different options to compute the risk-weighted assets. Thereafter, we will discuss the different capital requirements depending on bank size and jurisdiction, as well as the different layers of capital.

3.1 Risk-weighted assets

3.1.1 Standardized Approach

The standardized approach allows banks to use a mapping table for risk-weights prescribed by the regulator. This simplicity in application goes, however, at the price of only a crude graduation and thus only little risk-sensitiveness of RWA. Under the existing BCBS standards, mortgages are assigned risk-weights of 35% for residential real estate and 50% for commercial real estate.[4] From 2022,

[4] `https://www.bis.org/basel_framework/chapter/CRE/20.htm`

this approach will be replaced by an enhanced methodology. For regulatory residential real estate exposures which are not materially dependent on cash flows generated by the property the future risk-weights will range from 20% to 70%, depending on six different Loan to Value (LTV) buckets.[5]

In Switzerland, the local regulator FINMA already prescribes staged risk-weights.[6] The 35% risk-weight can only be applied on residential real estate related exposures up to an LTV of 66.6%. For exposures between 66.6% and 80%, the risk-weight is 75%. Residential real estate exposures above 80% LTV and other type of real estate are risk-weighted with 100%. Unfortunately we have for our explanatory example no LTV available. However, if we assume a typical situation where a new borrower finances self-occupied real estate with a mortgage in the amount of 80% of the property value, 5/6 of a mortgage loan fall in the 35% risk-weight bucket and 1/6 in the 50% bucket. Hence, we should be approximately right by presuming a risk-weight of 41.7% under the standardized approach.

3.1.2 Internal Ratings based Approaches (IRB)

As an alternative to the standardized approach, banks are allowed to calculate RWA based on their own internal models. Unter the advanced internal ratings based (AIRB) approach for credit risk banks compute all risk components using their own internal models. By contrast, under the foundation internal ratings based (F-IRB) approach banks only estimate the PD of their loans based on their own internal models, while LGD and other parameters are prescribed by regulators.

Because risk-weights under AIRB are computed by banks individually, an RWA calculation for our exemplary mortgage loan portfolio is not possible. However, F-AIRB is well-suited as we know the PD from our initial assumption.

Under F-AIRB, the risk-weight for our exemplary mortgage loan portfolio can be computed by the following formulas given by paragraph 328 of the BIS standard.[7]

The so called Capital Requirement (K) is defined as

$$LGD \times N[(1-R)^{-0.5} \times G(PD) + (R/(1-R))^{0.5} * G(0.999)] - PD * LGD$$

where $N(x)$ is the cumulative distribution function for a standard normal random variable and $G(z)$ is the inverse cumulative distribution function for a standard normal random variable.

$$RWA = K * 12.5 * EAD$$

[5] https://www.bis.org/basel_framework/chapter/CRE/20.htm?inforce=20220101
[6] https://www.admin.ch/opc/de/classified-compilation/20121146/index.html
[7] https://www.bis.org/publ/bcbs128.htm

For our exemplary portfolio, we have $PD = 0.01$ and $LGD = 0.30$ from our initial assumptions. The correlation $R = 0.15$ is prescribed by the standard.

Evaluating the above formulas yields $K = 0.0294$ and $RWA = 0.367$.

Hence, our exemplary portfolio would be risk-weighted with 36.73% under F-IRB.

3.2 Capital definitions

The capital of banks consists of different types and goes beyond equity capital. In addition to the going capital required to operate a bank, systemically important banks have to hold gone concern capital. This latter type of capital was introduced after the financial crisis, with the aim of facilitating the resolution of a failed bank without state aid. Gone concern capital is typically provided in the form of subordinated debt with a contractual write-down clause. Additionally, banks are allowed to meet a part of their going concern capital requirement with so called Additional Tier 1 (AT1) instruments. This hybrid capital instruments convert into equity or are written down if the capital ratio of the issuing bank falls below a certain threshold.

More specifically, the capital structure of large banks typically consists of the capital components listed in table 3 below.

Table 3: Capital components

This table lists the different capital components under the Basel III framework

Component	**Instrument**
Common Equity Tier 1 (CET1)	Equity less deductions
Additional Tier 1 (AT1)	Perpetual capital instrument with conversion clause
Total Loss-Absorbing Capacity (TLAC)	Subordinated debt with write-down clause

Common Equity Tier 1 (CET1) is capital of the highest quality. It consists of the bank's equity capital, reduced by a number of deductions, e.g. for goodwill and intangible assets, deferred tax assets (DTA), unrealized gains on cash flow hedges, among others. These items need to be deducted from capital as their value might be difficult to realize in a crisis situation.

AT1 consists of capital instruments with a perpetual maturity and a contractual conversion or write-down clause. These instruments pay a fix coupon and are no longer repayable if the CET1 ratio of the bank falls below a certain level (e.g. 7% in UK and Switzerland, 5.125% under EU rules). Thus, the conversion of the AT1 instruments generates fresh CET1 capital when a bank is under capitalized.[8] Despite sometimes being regarded as inferior to CET1, AT1 provides therefore an economic equivalent to equity.

[8]Note though that there is no impact on liquidity from the conversion

The Total Loss-Absorbing Capacity (TLAC) is the international equivalent to the Minimum Requirement for own funds and Eligible Liabilities (MREL) in the European Union. Typically, TLAC instruments are subordinated bonds which can be written-down by the regulator in case of resolution. As these funds are only used in a gone concern situation, the properties of TLAC instruments are closer to debt than equity.

3.3 RWA-based capital requirements

The capital ratio of a bank is generally defined as a capital amount divided by the total of a bank's RWA. Table 4 below provides an overview of the most commonly used capital ratios. While the denominator is always the same, the ratios vary with regards to the capital definitions in the nominator.

Table 4: Capital ratios

This table lists the most commonly used risk-based capital ratios.

Ratio	**Definition**
CET1 ratio	CET1/Total RWA
Tier 1 ratio	(CET1+AT1)/Total RWA
TLAC ratio	(CET1+AT1+T2+TLAC)/Total RWA

Capital requirements for banks are defined in ratio terms, i.e., as percentage of risk-weighted assets (or assets in case of the leverage ratio). The BCBS prescribes in the Basel III framework the minimum requirements which national regulators have to implement in their jurisdictions. National regulators are allowed to issue more stringent rules at their own discretion. Thus, capital requirements for banks should be regarded under the applicable local rules. Importantly, for large banking groups different regimes can apply for the consolidated group overall and the individual banking entities operating in different locations.

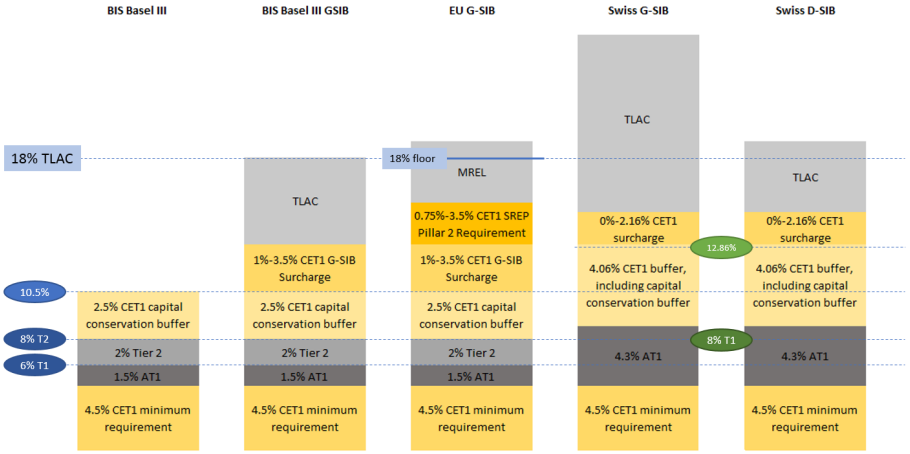
Figure 2 shows the capital requirements specified by the BCBS and how it implemented for systemically relevant banks in the European Union and Switzerland. The BCBS prescribes for all banks minimum capital ratios of 6% for Tier 1 and 8% for Tier 2 capital, of which at least 4.5% need to be hold in form of CET1.[9] These minimum requirement has to be maintained at all times. On top of the minimum requirement, banks have to build up a capital conservation buffer of 2.5% in the form of CET1. The minimum capital requirement for all banks is therefore 10.5% of RWA. The capital conservation buffer can be used to absorb losses during a crisis, but has to be re-established subsequently. Banks classified as G-SIBs are required to hold additional capital. The amount of the G-SIB buffer depends on a bank's score and starts at 1% of RWA for banks in the lowest bucket and ends at 3.5% of RWA for banks in the top bucket.[10] Importantly, national regulators can impose higher buffer requirements in their jurisdictions. Since 1 January 2019, G-SIB are in addition subject to a TLAC

[9] `https://www.bis.org/basel_framework/standard/RBC.htm`

[10] `https://www.bis.org/fsi/fsisummaries/g-sib_framework.htm`

Figure 2: Risk-weighted Capital Requirements

This figure shows the Basel III capital requirements as issued by the BCBS and implemented for systemically relevant banks in the European Union and Switzerland, excluding countercyclical and systemic risk buffers. Capital requirements are stated in percentage of risk-weighted assets.



requirement in the amount of 16% of RWA, which will increase to 18% of RWA by 1 January 2022.[11]

For European G-SIB, the capital requirements are largely the same as under the BCBS standard. The G-SIB surcharges are identical with those proposed by the FSB. In addition, the MREL requirements for European G-SIB are subject to a floor, so that these banks need to hold at least as much loss-absorbing capital as prescribed by the G-SIB framework, namely 18% of RWA from 1 January 2022 (currently 16% of RWA).[12] As most notable deviation, European banks are subject to Pillar 2 requirements which come on top of the Pillar 1 capital requirement. In the annual Supervisory Review and Evaluation Process (SREP), competent authorities impose bank specific Pillar 2 requirements which are legally binding.[13] These currently range from 0.75% to 3.5% of RWA. In addition, the banks also receive from their regulator a so called Pillar 2 guidance which is not legally binding and therefore is not shown in the chart.

For Switzerland, the framework is designed differently, but also consistent with the BCBS standards.[14] First, systemically relevant banks in Switzerland have to meet their minimum capital requirement of 8% entirely in the form of

[11] https://www.fsb.org/2015/11/total-loss-absorbing-capacity-tlac-principles-and-term-sheet/

[12] https://eba.europa.eu/sites/default/documents/files/documents/10180/1695288/be1ffc3e-e966-4bfe-a5fc-5e80e1873726/EBA%20Final%20MREL%20Report%20%28EBA-Op-2016-21%29.pdf

[13] https://www.bankingsupervision.europa.eu/banking/srep/srep_2019/html/p2r.en.html

[14] https://www.admin.ch/opc/de/classified-compilation/20121146/index.html

Tier 1 capital (under BIS rules 2% can be met with Tier 2 capital). Second, systemically relevant banks are subject to a base requirement (Sockelanforderung) in the amount of 12.86% of RWA. This means that there is a capital buffer of 4.86% which also includes the capital conservation buffer. As banks can maximally use 0.8% of AT1 capital for the capital buffer, the remaining 4.06% of RWA need to be hold in the form of CET1. On top of the base requirement, systemically relevant banks are subject to bucket-based surcharges considering their balance sheet size and domestic market share. Surcharges start with 0% in the lowest bucket and gradually increase by 0.36% of RWA per bucket. For a bank in the top buckets under both criteria the surcharge would amount to 2.16% of RWA. Thus, the so called going concern capital requirement for systemically relevant banks (G-SIB and D-SIB) is in the range from 12.86% to 15.02% of RWA. On top of this, systemically relevant banks are subject to a so called gone concern capital requirement in the form of TLAC. For the two Swiss G-SIB, the gone concern capital requirement amounts to 100% of the going concern requirement. For the D-SIBs, the gone concern capital requirement is 40% of the going concern requirement. In both cases banks are eligible for a rebate on the gone concern requirement if they implemented measures which facilitate the resolution of the bank or if they hold a part of their gone concern capital in better quality, i.e., in the form of CET1 or AT1. Relief is also granted for banks with an explicit state guarantee if certain conditions are met.

3.4 Leverage ratio requirement

In recent years, the leverage ratio gained back popularity. As opposed to the RWA-based capital ratios discussed in the previous subsection, the leverage ratio considers balance sheet exposures on an unweighted basis. Because of its simplicity, it is seen as a transparent measure which is less vulnerable to model risk or manipulation. In my view, the leverage ratio provides a powerful backstop measure against known weaknesses of risk-based capital ratios. However, it is essential that it is calibrated in a way which is generally not binding. We will discuss this important point further below.

The nominator of the leverage ratio consists of the same capital layers as used for the RWA-based capital ratios. Internationally, it is usual to include AT1 capital in the leverage ratio, i.e., to use the Tier 1 capital definition.[15]. Generally, the denominator of the leverage ratio, the so called Leverage Ratio Denominator (LRD), considers balance sheet exposures one to one and without netting. There are, however, exceptions, for example for derivatives and security financing transactions. In addition, the LRD also includes off-balance sheet exposures such as unused credit lines.

In its separate standard for the leverage ratio, the BCBS prescribes a 3% leverage ratio requirement which banks must meet at all times.[16] From 1 January 2022, G-SIBs will be subject to an increased leverage ratio requirement.

[15]The usage of CET1 + AT1 in the nominator of the leverage ratio is somewhat surprising given the high focus on the CET1 ratio for the RWA-based capital requirements

[16]`https://www.bis.org/fsi/fsisummaries/b3_lrf.htm`

Specifically, G-SIBs have to add 50% of their RWA-based G-SIB buffer requirement to the 3% leverage ratio requirement.[17] This means for example for a G-SIB in the lowest bucket a leverage ratio requirement of 3.5%, consisting of 3% plus 50% of the 1% G-SIB buffer requirement based on RWA.

The European Union will with CRR2/CRD5 impose a 3% leverage ratio requirement consistent with the BIS standard and including a G-SIB leverage buffer. The latter is determined as half of the G-SIB buffer based on RWA.

Switzerland has already introduced leverage ratio requirements for systemically relevant banks in 2015. Capital requirements are consistently defined as dual requirements, meaning that banks have for each capital component to meet the higher of the RWA-based and the leverage ratio based requirement. Specifically, systemically relevant banks in Switzerland are subject to a base leverage ratio requirement of 4.5% in the form of Tier 1 capital.[18] The minimum leverage ratio requirement which has to be met at all times is 3%, of which maximally 1.5% can be in the form of AT1 capital. The buffer above the 3% minimum can only be met in the form of CET1 capital. Similar as for the RWA-based requirement, systemically relevant banks are also subject to bucket-based surcharges considering their balance sheet size and domestic market share. Surcharges start with 0% in the lowest bucket and gradually increase by 0.125% of LRD per bucket. For a bank in the top buckets under both criteria the surcharge would amount to 0.75% of LRD. Thus, the going concern leverage ratio requirement is in the range of 4.5% to 5.25%. In addition, systemically relevant banks have also for the leverage ratio to meet gone concern capital requirements, which are for the G-SIBs 100% and for the D-SIBs 40% of their going concern requirements, respectively.

The leverage ratio requirements in Switzerland are calibrated in a way which make them binding if the ratio of RWA over LRD (known as risk-density) is below 35%. This means that the leverage ratio only constrains banks which hold much of their balance sheet in assets with low risk-weights. While this can provide a powerful backstop measure against model risk and non-conservative RWA calculations, binding leverage ratio requirements punish banks with a low-risk business model. As I have shown in one of my academic papers, a binding leverage ratio provides incentives for banks to reduce their balance sheet size and to switch from low risk assets into high risk assets.[19] Moreover, a binding leverage ratio makes it also costly for banks to hold liquidity reserves if even virtually risk-free High Quality Liquid Assets (HQLA) need to be fully underpinned with capital. It is therefore crucial that leverage ratio requirements are defined in a way which make them generally not binding, i.e., that the leverage ratio sets a lower bound to the amount of capital which only affects banks with unusually low average risk-weights.

[17] https://www.bis.org/basel_framework/chapter/LEV/40.htm?inforce=20220101
[18] https://www.admin.ch/opc/de/classified-compilation/20121146/index.html
[19] https://papers.ssrn.com/sol3/papers.cfm?abstract_id=2884961

3.5 Comparison based on exemplary portfolio

This subsection provides some high-level estimates for the regulatory capital requirements for the exemplary portfolio used in section 2. As capital requirements are in reality determined at the level of a bank overall, such estimates at a hypothetical portfolio level are associated with high uncertainty, rely on a number of additional assumptions and can therefore only be approximative. The following figures should therefore solely be used for illustrative purposes.

For a system relevant bank in the European Union or Switzerland using F-IRB, the RWA-based capital requirement is around 4.7-5.3 currency units per 100 currency units of notional. Compared with our modelled economic capital requirement of 3.86 currency units, the F-IRB based capital requirement amounts to around 122%-138% of what would be necessary in the absence of capital regulations. For a systemically relevant bank in Switzerland using the Standardized Approach, 5.4-5.8 currency would be necessary, which is around 139%-151% of the economic capital requirement. Values above 100% are not overly surprising, as regulators naturally tend to calibrate their frameworks in a conservative way.

For the leverage ratio, comparisons at portfolio level are more tricky because a simple non-risk sensitive measure will deviate from the economically required capital by design. For systemically relevant banks in Switzerland, the leverage ratio requirement is around 117%-130% of the amount that would be necessary economically. By contrast, the leverage ratio requirements for European G-SIBs are at around 91%-97% of the economic capital requirement. This is, however, not an issue, as the non-risk sensitive leverage ratio requirement should be considered at the level of the bank overall rather than on an individual portfolio.

Table 5: Capital ratios

This table compares the capital requirements for the exemplary mortgage loan portfolio introduced in the first section under different regulatory standards with the economic capital requirement. As in reality capital requirements are determined at the level of a bank overall, the following calculations at portfolio level are only illustrative and subject to a number of assumptions and uncertainties.

Rule[abc]	**RW**	**Ratio**	**RegCap**	**Economic/RegCap**
European G-SIB, F-IRB	36.7%	13%-14.5%-	4.77-5.32	124%-138%
Swiss G-SIB, F-IRB	36.7%	12.86%-14%	4.72-5.14	122%-133%
Swiss G-SIB/D-SIB, SA	41.7%	12.86%-14%	5.36-5.84	139%-151%
European G-SIB, Lev. Ratio	N/A	3.5%-3.75%	3.50-3.75	91%-97%
Swiss G-SIB/D-SIB, Lev. Ratio	N/A	4.5%-5.00%	4.50-5.00	117%-130%
Economic requirement	N/A	N/A	3.86	100%

[a]F-IRB risk-weight and standardized approach (SA) risk-weight as per sections 3.1.1 and 3.1.2, respectively

[b]For European G-SIBs: assumed SREP Pillar 2 requirement of 1.5%-2.5% of RWA and G-SIB add-on of 1%-1.5% of RWA, consistent with observed surcharges in 2019

[c]For Swiss G-SIBs/D-SIBs: surcharges for balance sheet size and market share based on values observed in 2019

4 Modigliani-Miller and the cost of equity

As we have seen in the section before, the regulatory capital requirements are in most cases exceeding the amount of capital that would be needed from an economic perspective.

Let us for a moment assume that the regulatory capital requirement for a business exceeds the economic capital requirement by a factor of two. Can we conclude from this that the regulation makes the use of capital double as costly as in the absence of the inflated capital requirement? The answer is no, because more capital also reduces the risk so that the cost of equity should be lower than in the absence of the regulation. In their seminal work, Franco Modigliani and Merton Miller have shown that the two effects cancel exactly out under idealized conditions. Thus, if the cost of equity is 8% on the elevated capital level, it would be 16% in the absence of capital regulations. Or put in different words, the product of the capital and the cost of equity is always the same, no matter how much or how little capital a bank employs. However, it is unclear how well their theorem works for banks in practice.

In my view, neither the common misbelief of practitioners that the cost of equity is a fixed percentage rate nor the purely theoretical argument that how much capital a bank uses is irrelevant are appropriate arguments. Even in the academic literature theorist acknowledge that the Modigliani-Miller theorem does not fully work for banks. By how much is a hotly debated question. More recent empirical research papers typically find effects in the magnitude of 50% of the effect predicted by the theorem, but estimates vary significantly.

How should banks respond to this challenge. I see the following practical consequences. First, larger banks with multiple business lines should implement capital allocation frameworks to monitor and steer the use of equity capital within their business lines. Given the fact that nowadays the capital requirement of a bank is in very most cases determined by regulatory capital constraints, the capital allocation methodology should mainly consider regulatory capital measures like RWA or leverage ratio rather than economic capital. However, with the increasing importance of stress tests those could also start to play a more prominent role in capital allocation. Second, banks may want to recalibrate their cost of equity rate regularly, e.g. annually, to ensure that changes in the capital structure are taken into account in the firm's cost of equity in a timely matter. Keeping the cost of equity constant over decades goes at the risk of erroneously using a too high hurdle rate and thereby rejecting profitable business opportunities. Third, banks should differentiate their cost of equity rates across business lines, in particular if the business models are very different or if certain business lines need to be overcapitalized because of non-risk sensitive constraints like capital floors or leverage ratio requirements. Internal models like economic capital may see a revival when trying to set differentiated cost of equity rates. As opposed to earlier times, these models would, however, no longer be used to determine the amount of capital needed, but rather to determine the price of the capital which is prescribed by non-risk based constraints.