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This dissertation is composed by four independent essays:

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Contents

List of Figures

List of Tables

Chapter 1

Introduction

In the last decade, tighter regulatory requirements, persistently low interest rates, the ongoing process of digitalisation alongside the growing relevance of sustainability issues confronted the banking sector with various challenges. Inspired by these developments, this thesis analyses selected questions in four largely independent essays and provides recommendations for bank management.

The global financial crisis of 2007 marked a major turning point in the recent history of banking regulation. Above all, the collapse of the US investment bank Lehman Brothers symbolised the almost unlimited risk appetite at that time and the shortcomings of capital requirements regulation. In order to strengthen the long-term resilience of the banking sector, the regulatory response to the crisis focused on improving the quality and quantity of the regulatory capital base with Basel III. The newly introduced leverage ratio was designed to limit banks' leverage. To strengthen banks' loss-absorbing capacity, the Basel III framework forces the use of hybrid capital instruments like contingent convertible bonds ("CoCo bonds"). These financial products combine selected features of debt and equity instruments. In the case of CoCo Bonds, the subordinated financial instrument is converted into Common Equity Tier 1 (CET1) or written down upon activation of the trigger event defined at the time of issuance. In the first article of the thesis, together with Arndt-Gerrit Kund and Patrick Hertrampf, we examine the extent to which banks systematically use the balance sheet treatment of CoCo bonds as debt or equity in order to optimise potential funding gaps in the respective capital ratios. Based on a global dataset of 389 CoCo bonds from 2012 to 2018, the analysis shows that Additional Tier 1 (AT1) eligible CoCo bonds are used to manage Leverage Ratio, while Tier 2 (T2) eligible CoCo bonds have no impact on Total Loss-Absorbing Capacity (TLAC).

Alongside tighter capital requirements, the supervisory crisis assessment also took attention to the Incurred Credit Loss model (ICL) under IAS 39 for quantifying Loan Loss Provisions (LLPs). The inherent subjectivity in the classification of impairments and the painful experience of inadequate and delayed provisioning ("too little, too late") in the ICL model were seen as key weaknesses. In 2018, the ICL model was replaced by the three-stages Expected Credit Loss model (ECL) of IFRS 9 and the calculation of LLP was fundamentally reformed. In the second part of this thesis, together with Arndt-Gerrit Kund, we examine the impact of the reformed LLP recognition and calculation on the Earnings and Capital Management of European banks in the EBA stress test for the period 2014-2020: previous research has established the discretionary nature of Loan Loss Provisions as a prominent tool for Earnings and Capital Management in banks. However, the transition from the Incurred Credit Loss model of IAS 39 to the Expected Credit Loss model of IFRS 9 has altered this leeway. We investigate the implications of this shift in accounting on the Earnings and Capital Management in European banks by drawing inference from the bank stress test data. Doing so generates two distinct advantages for our identification strategy: first, we have homogeneous incentives, as all banks want to apply Earnings and Capital Management in order to appear resilient in the stress test. Second, it allows us to obtain unpublished data for IFRS 9, such that we can create a panel spanning the old and the new accounting standard. The conjunction of these two attributes makes this setting predestine for investigating the true impact of the novel accounting standard. We find that the analysed banks generally employ Earnings and Capital Management. More precisely, the level of impairments grows under IFRS 9, in line with the hypothesis. Besides that, we show that risk-sensitive capital requirements are managed, whereas the opposite is true for risk-insensitive metrics. Our results are robust to different models, parametrizations, and definitions of required capital.

In addition to the repercussions of the financial crisis, the low interest rate period that began in 2009 tested the traditional business model of many banks to the limit. In Germany's banking sector, the period of low interest rates impacted the profitability of both capital market-oriented large banks and regionally focused cooperative and savings banks. Consequently, many banks saw themselves compelled to diversify their income sources towards non-interest income. However, the diversification possibilities of regional-oriented banks like savings banks are comparatively limited due to specific regulations. In the third part of this thesis, the effects of diversification on the risk-return profile of German savings banks are analysed in detail: Since decades, the effects of bank income diversification remain a hotly debated topic in academic and practice. Inspired by the mixed evidence in the existing literature, this paper investigates the impact of diversification on banks' profitability and risk in the aftermath of the financial crisis that emerged in 2007. The empirical analysis covers a dataset of 459 German savings banks over the period 2009-2018. The results indicate that diversification towards non-interest income reduces profitability. Moreover, income diversification is associated with an increase in the bank risk for German savings banks on average. The results are robust to the use of different time lags and the expansion of the database. While the negative performance relationship can be attributed to insufficient realization of diversification synergies, the increased risk can be explained by a higher risk-taking. Overall, the results suggest that income diversification is not a panacea to overcome profitability weaknesses and it is essential to assess the costs and benefits of diversification in the light of the individual business model.

In the fourth essay of the thesis, co-authored by Matthias Petras, we address the increasing relevance of sustainability in the financial sector: the concept of sustainable banking has developed significantly in recent years. Previous research found that corporate social responsibility reduces firm risk, yet this empirical evidence refers almost exclusively to non-financial companies and it remains unclear whether the risk-mitigating effect stems from the environmental, social, or governance pillar. The paper aims to analyse the impact of corporate social responsibility activities on bank risk and to explore its determinants. Using a sample of 582 banks worldwide over the period from 2002 to 2018, we confirm a risk reducing effect of the corporate social responsibility activity on an aggregated level. The decomposition of this effect suggests that environmental activities determine this risk mitigation. In contrast, social and governance activities do not show similarly unambiguous results. In this way, our analysis highlights the great importance of environmental aspects in banks' risk management.

Taken together, the four papers of the thesis, built on empirical evidence and innovative datasets, provide different implications for bank management. The first two papers focus on bank regulation and accounting: while the first paper highlights the benefits of CoCo bonds for the fulfilment of regulatory going concern capital ratios, the second paper reveals the systematic use of leeway in the calculation of LLP for a successful outcome in the EBA stress test. Thus, both articles contribute to the evaluation of post-crisis regulatory measures. The third article provides guidelines for the design of diversification strategies in terms of risk and return for the German savings bank sector. Finally, the fourth article analyses the interdependencies between CSR activities and bank risk and draws management implications for sustainable banking.

Chapter 2

Bail-in requirements and CoCo bond issuance ◆

2.1 Introduction

With the U.S. housing market going strong until the global financial crisis that started in 2007, banks' ability to absorb losses had hardly been tested. However, when push came to shove and Lehman Brothers filed for bankruptcy, an era of enormous risk appetite came to an end (Acharya and Naqvi, 2012). Lehman's failure showed that the loss-absorbency of banks was not only constrained in terms of quantity, but also quality of capital (Košak et al., 2015). For this reason, regulatory capital requirements were expanded and the eligibility of financial instruments that could be counted towards regulatory capital was constrained (Cao and Chou, 2022), when revisiting the Basel Accords after the financial crisis. From then on and based i.a. on the proposal of the Squam Lake Working Group on Financial Regulation (Squam Lake Working Group, 2009), CoCo bonds are the only remaining hybrid capital that will be included either as Additional Tier 1 (AT1) or Tier 2 (T2) in the regulatory capital (Oster, 2020). CoCo bonds are subordinated financial instruments that convert in times of crisis into Common Equity Tier 1 (CET1) or extraordinary gains by means of an ex ante contractually defined trigger. The lack of optionality, but rather contractual obligation to write down or convert CoCo bonds provides loss-absorbing capital within the bank contrary to previous hybrid capital (Ambrocio et al., 2020). Generally, T2 CoCo bonds are subordinated to AT1 CoCo bonds in the liability cascade. However, in banking practice, there are some cases of T2 CoCo bonds with a mechanical trigger event that could occur before the AT1 CoCo bond is triggered. Lawmakers differentiate between

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the requirements for AT1 and T2 instruments (Sections 26, 28, 51, 52, 54, 62, 63 and 77 CRR). For example, a CoCo bond qualifies as AT1 capital if the requirements of Section 52 (1) CRR are fully met. In addition, AT1 instruments must be available for an unlimited period of time and the trigger is set at a minimum of 5.125% CET1, while the minimum maturity of a T2 instrument is defined as 5 years. A noticeable difference arises in the coupon payments: in the case of AT1 instruments, the bank can decide independently on the interest payments and stop them, whereas in the case of T2 instruments, the interest must be paid as long as the bank is solvent.[1] The differences described between AT1 and T2 CoCo bonds should show up in higher capital costs for banks. This creates an incentive for banks to fill existing capital gaps with cheaper T2 CoCo bonds rather than AT1 CoCo bonds.

We will investigate in this paper an interesting design feature of CoCo bonds that relates to their accounting. While being considered regulatory capital in any case, they can be counted towards either debt or equity on the balance sheet. Against this background, the exact motives of banks when to include CoCo bonds in AT1 or T2, respectively debt or equity remain opaque (Rudolph, 2013). Generally speaking, the balance sheet treatment is a function of the design characteristics of the CoCo bond (e.g. its perpetuity and trigger design). The treatment of CoCo bonds on the balance sheet is determined both by their regulatory recognition and by specific contractual terms. In this sense, it is our assumption that the inclusion of CoCo bonds in AT1 or T2 capital is an exogenous decision of the bank that manages its capital structure and underpins the difference between the two forms of regulatory capital. More specifically, AT1 is part of Tier 1 (T1) capital together with CET1, which consists mostly of shares and retained earnings. The inclusion of CoCo bonds in AT1 is subject to the going-concern approach (Goncharenko et al., 2021). In this case, the conversion into CET1 capital is intended to ensure that the bank remains viable. In the event of bankruptcy, the capital is therefore subordinate to the T2 capital, which is in contrast subject to the gone-concern approach and intends to ensure the resolvability of the bank in the event it is failing or likely to fail (Flannery, 2014). Against this background, T2 capital can be used to meet regulatory requirements in terms of Total Loss-Absorbing Capacity (TLAC). TLAC as a global standard intends to ensure that G-SIBs hold sufficient bail-in eligible capital as required within the framework of the resolution mechanism (Markoulis et al., 2020). With this, a novelty was created by the banking regulator: Bail-in capital is intended to replace state support measures (bail-out) in the event of a bank being likely to fail or failing (Flannery, 2017). The innovation also allows non-subordinated debt capital to be held against losses outside of insolvency

[1] For detailed description, see Cahn and Kenadjian (2014) and Oster (2020).

proceedings (Kupiec, 2016). The creation of bail-in-able capital thus reflects a lesson learnt from the financial crisis, in the sense that investors must not only benefit from generated profits, but also share the losses in the event of failure.

Against this background, the heterogeneity of CoCo bonds with regard to their eligibility as AT1 or T2 capital opens up an interesting research question. While AT1 eligible CoCo bonds improve both the going- and gone-concern capital ratios (i.e. leverage ratio (LR) and TLAC), T2 eligible CoCo bonds exclusively improve the bail-in-able capital and hence TLAC of the issuing bank. Could it thus be, that the decision to issue AT1 or T2 eligibile CoCo bonds is taken in order to actively manage the LR or TLAC?

Based on a worldwide data set of 214 AT1 and 175 T2 CoCo bonds issuances of 49 publicly listed banks from 25 countries covering the period from 2012 to 2018, we address this gap in the literature. Our analysis shows that banks use CoCo bonds to optimize their regulatory capital ratios in select cases. While banks with a high LR headroom – that is the amount of percentage points above the regulatory required minimum – are less likely to issue AT1 eligible CoCo bonds, we inversely find that a high TLAC headroom does not influence the issuance of T2 eligible CoCo bonds. As such our results are important, as they shed further light on the capital management of banks.

The paper is structured as follows: the subsequent Section 2.2 presents the current literature and therefrom derives the research hypothesis of this study. Section 2.3 presents the data set and the empirical framework. The findings are reported in Section 2.4, while Section 2.5 concludes.

2.2 Development of the research question

The number of publications on CoCo bonds is growing constantly (Flannery, 2014; Oster, 2020). Relating to the issuance effects, Liao et al. (2017) show that banks record negative abnormal returns in the post-announcements period after the issuance of new CoCo bonds. Avdjiev et al. (2020) provide empirical evidence that in general larger and higher capitalized banks are more likely to issue CoCo bonds. Goncharenko et al. (2021) emphasize the impact of debt overhang on banks‘ decision to issue CoCo bonds. However, empirical research is lacking on banks’ specific motives for issuing CoCo bonds as AT1 (going concern) or T2 (gone concern) capital. Exemplary, Fiordelisi et al. (2020) and Abdallah and Fernandez (2022) investigate these mechanics, but fail to reach a conclusive answer. Consequently, we tackle this blank spot on the research map with our study.

We investigate the drivers of AT1, respectively T2 CoCo bond issuance under the hypothesis that this is an active decision taken by banks in the course of their capital planning and management. More specifically, we test whether CoCo bonds are used to manage going- and/or gone-concern capital. To this end, we exploit that AT1 eligible CoCo bonds count towards both, the LR requirement, as well as the national transposition of TLAC. Compared to other common regulatory capital ratios, the leverage ratio uses only Tier 1 capital in the numerator, making it highly suitable for the analysis. We thereby focus on the transmission channel of bail-in capital, where banks with a shortfall in such capital could explicitly issue T2 eligible CoCo bonds to address this deficit, while benefiting from the hybrid capital structure. Against this background, we posit:

Hypothesis 1 *Banks use the design features of CoCo bonds to manage their going- or gone-concern capital ratios specifically.*

We test this hypothesis by looking to the capital headroom with regard to the regulatory minimums above the LR, respectively TLAC. While the literature has mostly focused on going-concern capital ratios (i.e. CET1 ratio, T1 ratio, and LR), gone-concern capital becomes ever the more important against the lessons learnt from the past financial crisis and the subsequent shift from bail-out to bail-in regimes. In particular the creation of T2 capital has been a challenge for banks, which is why the usage of CoCo bonds as one tool to this end is a focal point of our analysis. Given the regulatory limits on recognition, it may not be helpful for banks with very low CET1 ratios to recognise additional AT1 instruments as CET1 is required. Thus, an analysis of LR headroom would not be sufficient to answer the research question. However, the review of the capital market oriented banks included in our dataset has shown that such a constellation does not exist. Also, in Europe AT1 capital may be recognised in TLAC up to a maximum of 2.5% of RWA. Again, the review of the included institutions did not reveal any evidence that would call into question the validity of the TLAC headroom.

2.3 Data

The analyzed data cover 49 publicly listed significant institutions from 25 countries over the period of 2012 to 2018. During this time 389 CoCo bonds were issued, of which the majority (214, i.e. 55 %) were AT1-eligible, with the remainder counting towards T2 capital. Our data set is hence representative to that of Avdjiev et al. (2020) and thereby disperses any concerns that crossholdings of financial institutions may constitute unaccounted for transmission channels. Similarly, our starting year in 2012 ensures a mostly level playing field with regard to the Basel Accords and the subsequent issuance incentives for banks in our sample. As the CoCo bonds in our sample have neither been called, nor written-down or converted, our sample remains free of a potential survivor bias.

We use this data on CoCo bonds to construct a panel data set by mapping the CoCo bond issuances to the corresponding banks. In doing so, we carry forth the differentiation between AT1 and T2 CoCos against the rational of our research question. However, where a bank has multiple issuances of either kind, they are aggregated to accommodate the panel data set. Taken together, our data set consists of 343 bank-year observations with the respective CoCo bond issuances. Table (2.2) gives an overview over the used variables, while Table (2.3) contains their summary statistics. Correlations can be obtained from Table (2.4).

2.4 Results

In order to test our hypothesis, we employ a regression model with bank (α_i) and time (μ_t) fixed effects. We extend this model as described in Equation 2.1 in a step-wise approach in order to control for bank- and macro-specific variables that we denote for differentiation with β and γ, respectively.

$$
\begin{aligned}
CoCo\text{-}Issuance_{i,t}^{capital\ tier} &= \beta_1 capital\ headroom_{i,t} \\
&+ \underbrace{\beta_2 ROA_{i,t} + \beta_3 Size_{i,t} + \beta_4 ROID_{i,t} + \beta_5 NPL_{i,t}}_{\text{bank controls}} \\
&+ \underbrace{\gamma_1 ln(GDP)_{c,t} + \gamma_2 GDP_{c,t}^{growth} + \gamma_3 Inflation_{c,t} + \gamma_4 C2GDP_{c,t}}_{\text{macro controls}} \\
&+ \alpha_i + \mu_t + \epsilon_{i,t}
\end{aligned}
\tag{2.1}
$$

For the bank-specific variables we choose the profitability as measured by the Return on Assets (ROA), instead of the Return on Equity (ROE) in order to prevent any biases from the leverage, which is intrinsic to the ROE. The business model of the bank is proxied by its size as measured by the natural logarithm of its total assets (SIZE) in order to remediate distortions from few very large banks, and the revenue diversification (ROID) between interest and non-interest income as depicted in Equation 2.2 and originally used by Laeven and Levine (2007a). Ultimately, the ratio of non-performing loans over total loans (NPL) accounts for the risk profile of the bank.

$$\text{ROID}_{i,t} = 1 - \left| \frac{\text{NII}_{i,t} - \text{NNII}_{i,t}}{\text{NOPI}_{i,t}} \right| \tag{2.2}$$

The macro-specific control variables are the natural logarithm of GDP, again to account for distortions from outliers, together with its year-on-year change ($\text{GDP}^{\text{Growth}}$). Inflation is measured by the level of CPI, while financial imbalances are accounted for the with Credit to GDP gap (C2GDP). Banks are denoted by i, while c identifies countries and t time. The error term is denoted by ϵ.

Table 2.1: Results of the regressions on the nominal amounts of AT1 and T2 CoCo bond Issuance

	AT1			T2		
	Model A.1	Model A.2	Model A.3	Model B.1	Model B.2	Model B.3
$LR^{headroom}$	-0.5880***	-0.5277**	-0.4031*			
	(0.0003)	(0.0034)	(0.0405)			
$TLAC^{headroom}$				0.2041	0.1557	0.1759
				(0.1588)	(0.3494)	(0.2930)
ROA		2.6914*	2.4834*		0.2249	0.2963
		(0.0312)	(0.0475)		(0.8924)	(0.8587)
Size		6.7324*	5.3149		8.5303*	5.6012
		(0.0117)	(0.0808)		(0.0178)	(0.1606)
ROID		7.3063	5.2307		9.8324	7.7712
		(0.1435)	(0.3065)		(0.1280)	(0.2465)
NPL		-3.1198	-2.1465		1.8433	0.9517
		(0.0956)	(0.2821)		(0.4459)	(0.7127)
ln(GDP)			13.1966			23.2244
			(0.2620)			(0.0997)
GDP^{growth}			0.4022			-0.4857
			(0.2269)			(0.2632)
Inflation			-0.0326			-0.1523
			(0.8933)			(0.6305)
Cons	11.5789***	-83.6546*	-205.5641	1.4429	-115.3952*	-319.8984*
	(0.0000)	(0.0185)	(0.0648)	(0.2308)	(0.0169)	(0.0177)
N	343	309	309	333	306	306
R_w^2	0.0429	0.0933	0.1066	0.0070	0.0380	0.0499

Note: The table above shows the step-wise expansion of the basis model, which investigates the relationship between the LR headroom and the issuance of AT 1 eligible CoCo bonds for the models labeled with A, and for the linkage between TLAC headroom and T2 eligible CoCo bond issuance for models referred to as B. Model 1 shows the univariate regression of the variable of interested, while Model 2 includes bank-specific controls, whereas Model 3 considers additional macroeconomic-controls. We find that lower levels of capital headroom regarding the leverage ratio make banks more susceptible to issue AT1 eligible CoCo bonds, likely in order to avert potential capital shortfalls. This observation is robust through all investigated models. To the contrary, banks with a potential deficit of bail-in capital as required by the TLAC requirements, do not respond thereto by issuing in particular T2 eligible CoCo bonds. Results are reported to the 95 % (*), 99 % (**), and 99.9 % (***) confidence level. P-Values are indicated in parenthesis below the coefficients.

Table (2.1) shows the nominal issuance of AT1 (T2) CoCo bonds for models referred to as A (B) regressed on our variable of interest, the LR (TLAC) capital headroom.[2] We find in the first univariate specification of the model a very strong relationship between how comfortably above the regulatory minimum requirements a bank operates, and how much additional capital is issued. More specifically, more AT1 eligible capital is nominally issued in the form of CoCo bonds, where the LR headroom is smaller, i.e. closer to breaching the regulatory minimum requirements. The addition of bank- and macro-specific control variables does not change this observation. However, we do find that ROA is a significant indicator for the issuance of AT1 eligible CoCo bonds. This observation might be due to the fact that profitable banks can not only easier tap into the funding market, but also benefit from a tax-shield effect when issuing CoCo bonds (Petras, 2020). As the addition of the macro-specific control variables renders the intercept insignificant, we generate evidence against further unexplained variables that drive AT1 eligible CoCo bond issuance.

In contrast to that, we cannot establish a statistical significant link between potential shortfalls with regard to the TLAC requirements and the issuance of T2 eligible CoCo bonds, even in the univariate base case. Neither the addition of bank- nor macro-specific control variables changes this observation. Even more, the intercept remains statistically significant, in the ultimate specification of the model, suggesting the presence of unaccounted transmission mechanisms. This understanding is mirrored by the comparably low level of R^2 vis-à-vis the AT1 model in the preceding columns. Taken together, we generate evidence that banks use CoCo bonds to manage their going-concern capital ratios, while it may not be the case for gone-concern requirements. This observation is supported by the current trend in banking practice towards a secondary role for T2 CoCo bonds or the fact that banks rather issue debt instruments, over hybrid instruments. The only conceivable motives for T2 CoCo bonds are to meet risk-weighted capital requirements.

2.5 Conclusion

In response to the financial crisis that started in 2007 numerous reforms concerning the financial system were enacted. Most prominently, standard setters required banks not only to increase the quantity of their minimum regulatory capital, but also restricted the eligible items to this end, in a push to also improve the quality of the regulatory capital and thereby ultimately expanding the loss-absorbing capacity of banks. In doing so, CoCo bonds have become de facto the only hybrid capital instrument eligible under the revised Basel III Accords. Crucially to this paper, CoCo bonds find themselves at yet another

[2] The empirical analysis consider the upper thresholds of AT1.

intersection of the lessons learnt from the financial crisis: in order to align incentives, investors must not only bear the fruit of their investment, but also participate in potential losses therefrom. In this light, the previous bail-out regime, where banks were saved by governments at the expense of deteriorating public finances, has been revisited in favor of the bail-in principle. Because of this fundamental shift, banks are now required to hold sufficient bail-in-able capital under the national transposition of the TLAC standard. In this context, CoCo bonds fulfill a particular function as they can be used to precisely address funding shortfalls of bail-in-able capital while benefiting from the characteristics of hybrid capital. We investigate in this paper, whether CoCo bonds are indeed used with such surgical precision to address particular capital needs of a bank. To this end, we generate mixed results: while we substantiate our hypothesis that AT1 eligible CoCo bonds are used as one tool among others in the toolbox of going-concern capital management, we fail to demonstrate a similar mechanism in the instance of gone-concern T2 capital. A possible explanation for this observation may lie in the fact that banks mostly satisfy their gone-concern capital needs by issuing merely debt instruments, without making use of the hybrid possibilities of CoCo bonds. In terms of capital costs, T2 CoCo bonds are only attractive if the capital expenses are significantly lower than those of AT1 CoCo bonds. Our results are thus important for policy makers as they suggest that TLAC may be yet to achieve its full potential, as financial instruments of inferior quality are used over more resilient choices, such as hybrid capital in the form of CoCo bonds. Future research should further look into this interlinkage and in particular investigate the drivers of T2 CoCo bond issuance.

2.6 Appendix

Table 2.2: Used Variables and their Sources

Variable	Description	Source
AT1	Additional Tier 1 capital	Nominal issuance of AT1 eligible CoCo-bonds
T2	Tier 2 capital	Nominal issuance of T2 eligible CoCo-bonds
$LR^{headroom}$	Headroom Leverage Ratio	$LR^{headroom}_{i,t} = LR_{i,t} - 3.0\% - \text{SIB-add-on}_{i,t}$
$TLAC^{headroom}$	Headroom Total Loss Absorbing Capacity	$TLAC^{headroom}_{i,t} = TLAC_{i,t} - 18.0\%$
ROA	Return on Assets	$ROA_{i,t} = \frac{\text{Net Income}_{i,t}}{\text{Total Assets}_{i,t}}$
Size	Logarithm of Total Assets	$Size_{i,t} = ln\left(\text{Total Assets}_{i,t}\right)$
ROID	Income Diversification	$ROID_{i,t} = 1 - \left\lvert \frac{NII_{i,t} - NNII_{i,t}}{NOPI_{i,t}} \right\rvert$
NPL	Ratio of non-performing to total loans	$NPL_{i,t} = \frac{\text{non-performing loans}_{i,t}}{\text{total loans}_{i,t}}$
ln(GDP)	Logarithm of GDP in USD	World Bank: NY.GDP.MKTP.CD
GDP^{growth}	Annual Change in GDP	Computed from NY.GDP.MKTP.CD
Inflation	Annual Inflation Rate	World Bank: FP.CPI.TOTL.ZG
C2GDP	Credit to GDP gap	BIS credit-to-GDP gap statistics

Note: The table above describes the data sources and any calculations we derive therefrom. Size and GDP are logarithmized in order to account for outliers in the distributions. GDP^{growth} is computed as the ratio of the current over the previous USD GDP minus one.

Table 2.3: Descriptive Statistics

	N	Min	$Q_{0.25}$	Median	$Q_{0.75}$	Max	σ
AT1	343	0.0000	0.0000	0.0000	667.1114	4,568.5950	741.7394
T2	343	0.0000	0.0000	0.0000	0.0000	10,979.0800	854.8243
$LR^{headroom}$	343	0.8620	9.4033	11.8059	15.2380	35.5339	5.0850
$TLAC^{headroom}$	333	-2.8404	1.2921	5.7912	10.2278	84.5455	11.6520
ROA	343	-0.3870	0.9861	1.3285	1.8829	4.1961	0.7119
Size	343	8.2788	12.2975	13.1796	13.7251	15.0222	1.3406
ROID	336	0.1397	0.5352	0.7189	0.8574	0.9997	0.2167
NPL	312	-0.0821	0.0776	0.1601	0.4626	1.5658	0.3652
ln(GDP)	343	9.3161	10.5014	10.6540	10.7157	11.4086	0.4256
GDP^{growth}	343	-3.4816	1.1490	2.0463	2.8590	9.3327	2.0345
Inflation	343	-8.8625	0.2938	1.1525	1.9673	16.1543	2.1737
C2GDP	343	36.0167	154.3932	173.9659	209.4000	348.6077	57.8021

Note: The table above provides the descriptive statistics of the variables used in this paper. A notable observation can be made with regard to the TLAC headroom, which is negative at its minimum, suggesting a shortfall of bail-in capital and therwith a regulatory non-compliance. We find these observations to cluster before the release of the final stance from the FSB in 2015. Untabulated results show that restricting the sample to the time after the final FSB stance does not alter the results.

Table 2.4: Correlation Matrix of used Variables

	AT1	T2	$LR^{headroom}$	$TLAC^{headroom}$	ROA	Size	ROID	NPL	GDP	GDP_{growth}	Inflation	C2GDP
AT1	1.0000											
T2	0.0861	1.0000										
$LR^{headroom}$	0.1385	0.0270	1.0000									
$TLAC^{headroom}$	-0.0396	0.1105	0.0123	1.0000								
ROA	-0.1594	-0.0268	-0.4218	-0.0384	1.0000							
Size	0.3797	0.2362	0.5403	-0.1198	-0.3158	1.0000						
ROID	0.1802	-0.0383	0.3324	0.0983	-0.3694	0.2535	1.0000					
NPL	-0.1861	-0.0743	-0.4430	-0.1215	0.1858	-0.2230	-0.1497	1.0000				
GDP	0.0959	-0.1012	0.1310	0.0678	-0.3424	-0.0523	0.0294	-0.4598	1.0000			
GDP^{growth}	-0.0398	0.1458	-0.3251	0.1389	0.4010	-0.1260	-0.3420	0.0373	-0.3348	1.0000		
Inflation	-0.1097	-0.0301	-0.2201	0.1058	0.2554	-0.1535	-0.0859	0.1635	-0.2934	0.1846	1.0000	
C2GDP	0.0732	0.1640	0.4016	0.1607	-0.2711	0.3642	0.2539	-0.0828	-0.1201	-0.2288	-0.2032	1.0000

Note: The table above depicts the correlation between the used regressors throughout our analyses. The majority of correlations is rather small, such that multicollinearity appears unproblematic. The highest positive correlation can be observed between bank size and the LR headroom, suggesting that bigger banks are better capitalized. As this relationship is economically reasonable and not excessive in absolute terms, we deem it unproblematic. Furthermore, this explanation is consistent with the notion that better capitalized banks tend to be less profitable, as coincidentally displayed by the largest negative correlation between return on assets and the LR headroom. Against this background, it appears as if banks that hold more capital, fail to employ this economically meaningful, which is also consistent with diminishing returns of capital.

Chapter 3

Only blunt Tools left? ◆

How IFRS 9 affects the Earnings and Capital Management of European Banks

3.1 Introduction

The primary function of financial intermediaries is to provide capital to the real economy by originating loans (King and Levine (1993); Levine and Zervos (1998)). As the full and timely repayment of the owed funds is subject to uncertainty, banks are naturally exposed to credit risk (Ozili and Outa (2017)). In order to account for potential losses from the default of individual borrowers, banks possess two lines of defense. First, Loan Loss Provisions (LLP), which should protect against expected losses, and second, regulatory capital that is intended to safeguard against unexpected losses (Laeven and Majnoni (2003)). While a plurality of econometric techniques has been proposed to calculate the LLPs and the required regulatory capital, there remains a discretionary leeway for banks to estimate LLPs (Koch and Wall (2000)). The underlying rational is that expert judgment employed by the banks allows them to increase the forecasting quality, by addressing borrower specific circumstances. However, this managerial leeway has not exclusively been used with the desired intent. In a speech before the Institute of International Bankers, the acting Comptroller of the Currency criticized the inherent subjectivity in loan loss provisioning under IAS 39 (Dugan (2009)). Indeed, extant literature reveals that LLPs are a formidable instrument for Earnings Management (EM) in banks, and can be used for Income Smoothing or Capital Management (CM) (Anandarajan et al. (2003); Bouvatier et al. (2014); Beatty and Liao (2014)).

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Already criticized for its inherent subjectivity, the incurred loss accounting of IAS 39 became subject to greater scrutiny, after the financial crisis of 2007 revealed further shortcomings (Barth and Landsman (2010); Gebhardt (2016); Hashim et al. (2016); Novotny-Farkas (2016)). Besides the lack of comparability, the delayed and insufficient provisioning of loan losses (“too little, too late”) has urged regulators around the globe to revisit the employed Incurred Credit Loss model (ICL) of IAS 39 (G20 (2009); BCBS (2015)). As of 2018, it is replaced by the Expected Credit Loss model (ECL) of IFRS 9. The most evident change is the forward-looking character of the new model. It classifies exposures in one of three stages, and computes expected losses for the following 12 months, up to the entire lifetime of the loan. The resulting mandatory provisioning for all loans is a fundamental difference to the previous ICL model. Under IAS 39, LLP had to be created if there was “objective evidence” of an impairment at the balance sheet date. IAS 39.59. provides a selection of non-binding, presumably “objective” trigger events that might indicate the existence of an impairment. Besides the clear interest and principal payment defaults, other trigger events such as significant financial difficulty or an increased risk of insolvency appear to be highly subjective in their application. Furthermore, ICL only recognises credit losses that have actually occurred (backward-looking character) and completely ignores expected impairments. In comparison, IFRS 9 minimises the leeway in the initial definition and selection of impairments by using the mandatory, forward-looking three-stages ECL model. Thus the discussion of whether or not an impairment under IAS 39 was warranted, has become obsolete. In addition, IFRS 9 requires the quantification of LLPs through the use of internal models and is computed as the product of the exposure, probability of default and loss given default, or through the application of impairment matrices (Behn and Couaillier (2023)). In contrast to the ICL model, the use of internal models ensures that relevant macroeconomic determinants (e.g. inflation rate, unemployment rate, interest rate level) are adequately taken into account, making the ECL model more objective than its predecessor in this respect. Notwithstanding the different definitions of model parameters in regulatory and accounting standards, banks’ internal estimation methods and underlying assumptions are subject to ongoing supervisory review, which again could lead to a comparatively higher degree of objectivity in the ECL model compared to ICL model. However, the use of internal models also entails model risks and, in particular, a certain degree of subjectivity, e.g. with regard to model assumptions.

On top of the changes to the accounting framework, European banks in general became subject to greater scrutiny after the 2007 financial crisis due to increased regulatory minimum capital requirements (e.g. Basel III) and stricter banking supervision (e.g. stress tests of the European Banking Authority (EBA)). In particular, the coverage of non-performing exposures (NPE) became another focal point of supervisors in the EU that have published dedicated guidelines to this end and further increased capital demand in banks (ECB (2019)).

Figure 3.1: Illustration of the differences between Basel II and Basel III.

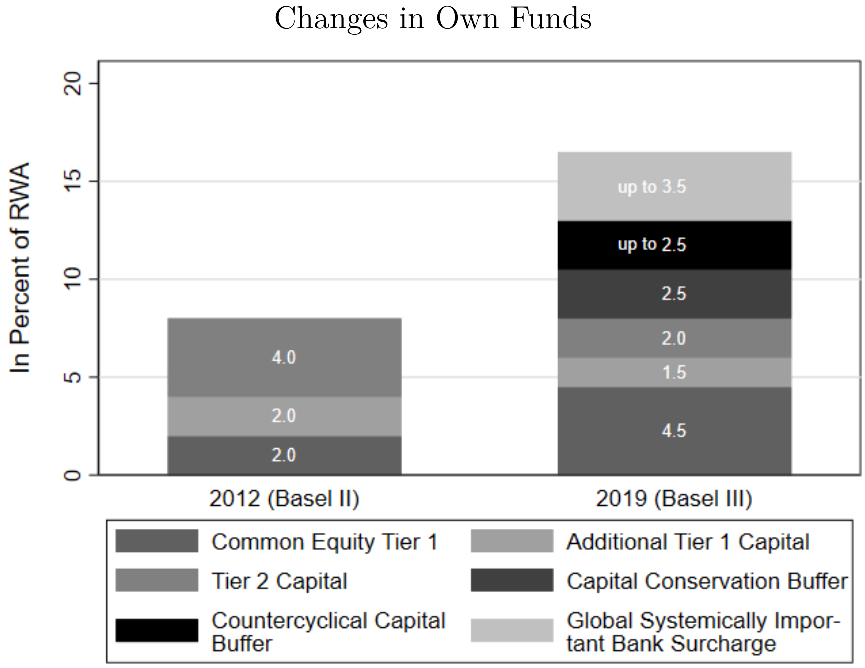

Figure (3.1) depicts the rise in capital adequacy requirements as mandated by the Pillar 1 Requirements of the Basel Accords. On top of that, bank specific capital requirements are postulated through the Pillar 2 Requirements (P2R), and Pillar 2 Guidance (P2G). Taken together, they constitute an indisputable incentive for European banks to engage in EM and CM in order to meet these exogenous thresholds (Curcio et al. (2017)). It becomes even more pronounced, when considering that both, P2R and P2G have to be met by Common Equity Tier 1 (CET1), which can be generated through retaining earnings. In this light, a direct transmission channel opens up, as impairments, which are tangent to the analysed change in accounting, directly contribute towards the annual result, which in turn can be retained. Without a doubt, IFRS 9 changes the scope of creating LLPs and thus the possibilities for EM and CM. However, there are conflicting views on the extent to which ECL reduces or increases the managerial leeway in building LLPs. On the one hand, the definition of impairment based on the three stages and the associated mandatory provisioning of all loans appears to be at least more objective than the use of ambiguous trigger events in ICL. On the other hand, the increased use of internal models for the LLP calculation opens up new managerial leeway, in particular with regard to the classification within the three stages and in the amount calculation of LLPs due to the subjectivity of the model assumptions (e.g. Behn et al. (2022), Behn and Couaillier (2023)). This observation reveals an inherent tension, from which we derive our research question to resolve the underlying controversy. We examine how the transition from IAS 39 to IFRS 9 has changed risk provisioning through LLPs, thereby affecting the extent to which banks can use them for EM and CM. Furthermore, we shed light on the incentives of banks in the stress test setting. Given that the EBA stress test results influence the Supervisory Review and Evaluation Process (SREP), they have a direct transmission channel to the P2R and P2G, and thus ultimately the capital requirements of banks. From this linkage, we theorize that banks that are subject to the EBA stress tests have strong incentives to engage in CM, in order to appear more resilient. Particularly in the adverse scenario of the stress test, the incentives for CM seem to be most pronounced, because an ailing economy challenges the bank in meeting its minimum capital requirements.

We verify our hypotheses through empirical analyses of the EBA bank stress test results. Our sample comprises 43 banks from 15 European countries in the period from 2014 until including 2020. The data set is predestined for this analysis due to a plurality of features, such as a static balance sheet and homogeneous incentives of the participating banks. Furthermore, the analyzed banks are all of comparable size and relevance in the respective financial systems, such that inference can be drawn from a representative sample. Another advantage of our data set stems from the fact that it is unbiased by the COVID-19 crisis, which has led to the majority of countries to enact some form of loan moratorium (EBA (2020)). As a result, the de facto impairments are biased such that the true impact of IFRS 9 cannot be estimated.

Our results establish a link between EM and CM before, and after the introduction of IFRS 9. We find that the introduction of IFRS 9 has generally increased the average impairments per loan, irrespective of the macroeconomic scenario (i.e. in the baseline and adverse scenario). This observation is robust to different models that are employed in order to measure EM. Furthermore, we show, that the effect is more pronounced for heterogeneous portfolios, as they are more likely to be rated by a credit officer, and thus inherently less objective compared to the new accounting standard. Lastly, our results document how EM, as a prerequisite for CM, leads to banks in our sample managing their capital with regards to risk-sensitive capital requirements. Risk-insensitive metrics, such as the Leverage Ratio are not influenced by this observation. A possible explanation may be that it will only be enforced from 2021 forth.

In this way, our results contribute to the intersection of various research areas by investigating the implications of the new ECL model according to IFRS 9 for EM and CM in European banks. On the basis of the identified, inherent tension between subjectivity and objectivity (e.g. Dugan (2009), Dahl (2013)), an evaluation of the new impairment model is conducted. In addition, we extend the established literature by investigating the implications of IFRS 9 in the context of EM and CM as means for managing regulatory capital adequacy (e.g. Moyer (1990); Collins et al. (1995); Kim and Kross (1998); Ahmed et al. (1999); Beatty and Liao (2014)). Whereas these studies focus mainly on the impact of regulatory changes (i.e. Basel Accords), we investigate the effects originated by the enactment of a new accounting standard.

The structure of this paper is as follows: the ensuing second Section represents the previous research and establishes the link between economic theory and the application of EM in banks. Section (3.3) derives the hypotheses, which are tested based on the data described in Section (3.4). The results are presented in Section (3.5). Section (3.6) shows the outcome of several robustness checks, while Section (3.7) concludes.

3.2 Literature Review

3.2.1 Theories of Balance Policy

The term balance policy refers to the usage of accounting leeway within the juridical boundaries in order to shape how an interested third party perceives the firm. In doing so, the balance sheet and income statement of the company are affected through discretionary decisions of the management. The established literature extensively discusses balance policy under the term EM, where it denotes the usage of accounting discretion with the intent to achieve financial or policy objectives (Watts and Zimmerman (1990); Healy and Wahlen (1999); Dechow and Skinner (2000); Fields et al. (2001)). From a company's perspective, EM is a very efficient instrument because it can be applied without major effort and costs. Furthermore, earnings respectively earnings changes are a widely used indicator by various stakeholders due to their low information costs and intuitive interpretation (Burgstahler and Dichev (1997)). The fundamental rationale for EM relates to the Prospect Theory of Kahneman and Tversky (1979), and Signaling Theory as in Spence (1973) and Wahlen (1994).

In their seminal work, Kahneman and Tversky (1979) model the economic behavior of individuals under uncertainty in relation to a given reference point, such as the threshold between profit and loss (Burgstahler and Dichev (1997)). In light of the risk aversion assumption, it can be shown, that the utility function of the management changes at this reference point. While it is concave for the profit zone, it becomes convex in the loss zone (Fiechter and Meyer (2010)). From this observation Burgstahler and Dichev (1997) as well as Degeorge et al. (1999) infer, that the impact of EM is most pronounced, when turning a small loss into a small gain, or stagnating earnings into slowly growing earnings. Shen and Chih (2005) look more closely at the topic, and label these thresholds as zero earnings, respectively zero earnings change, and make similar findings. Likewise, Beatty et al. (2002) show that shareholders evaluate bank performance on the basis of the reported profits or losses, which provides additional evidence of both, the relevance, and application of Prospect Theory in the banking industry.

According to Signaling Theory, information asymmetries between companies and market participants can be reduced by sending out specific signals (Connelly et al. (2011)). In this context, EM can be used to signal financial strength, which suggests the company to be less failure prone, and thus makes amongst other funding opportunities more accessible and cheaper (Kanagaretnam et al. (2003)). Another possible signal has been identified by Beaver et al. (1989), who document the theorized benefits in more prudent banks (i.e. higher risk provisioning). Since then, Wahlen (1994) and Beaver and Engel (1996) have reinstated these findings.

3.2.2 Motives of Earnings Management in Banks

At first glance, Prospect and Signaling Theory appear to suggest that EM should always strives for an improvement in earnings or profit. However, given the heterogeneity of stakeholders, conflicting incentives can arise, and ultimately lead to cases, in which a reduction in earnings or profit is desired. In such instances, it is at the management's discretion, which goal to prioritize. The managerial incentives of real and financial companies for using EM are almost identical. For banks an additional motivation is to comply with sector-specific capital regulations (Leventis et al. (2011)). In the following, we discuss the prevalent motives for EM in banks.

Income Smoothing is comprised of measures that are designed to reduce earnings volatility in the short term, and thereby achieve a long-term smoothing of profit or profit growth (Trueman and Titman (1988)). In line with previous theories, Gebhardt et al. (2001) find higher risk premiums for banks with volatile earnings. Thus, banks can improve their risk perception by investors, supervisory authorities, and legislators through income smoothing (Bhat (1996)). In line with Signaling Theory, stable earnings or profits suggest a lower default risk, and consequently reduce the costs of capital on the bank level (Kanagaretnam et al. (2004), Kanagaretnam et al. (2005)). Their results confirm the observation of Bhat (1996), who documents less volatile share prices in banks with continuous dividends. Further capital market motivated objectives are the avoidance of negative profit surprises or the achievement of analyst forecasts (Beatty and Harris (1999); Beatty et al. (2002)). In addition to the described efficiency-enhancing incentives, income Smoothing can also be applied for opportunistic reasons. As such it constitutes a tool for bank managers to either reduce the risk of being laid off (Kanagaretnam et al. (2003)), or to booster their compensation (Cornett et al. (2009); Cheng et al. (2011)).

Big Bath Accounting describes the accumulation of profit-reducing positions into one reporting period (Walsh et al. (1991), Norden and Stoian (2014)). Such measures lead to lower earnings, and a lower annual result in one specific reporting period, but will also relieve the earnings and annual results in the following reporting periods. The rationale behind it is based on Prospect Theory, and assumes that a large single loss is preferable to several smaller realizations of the same loss. In this way, Big Bath Accounting also lowers the relative earnings or profit benchmark to which the bank is compared in subsequent periods. Big Bath Accounting is often applied in the instance of management changes (e.g. CEO departures), as it offers a convenient approach for shifting blame to departing executives, while lowering the bar for the assessment of the own decisions. The new management may use Big Bath Accounting to clean the balance sheets and books at the beginning of their tenure and thereby relieve future period results. Usually, during the inaugural period, the new manager can pass a weak first annual results to his predecessor or justify them by other grievances. Bornemann et al. (2015) give evidence of this explanation by investigating the case of CEO changes in German savings banks.

In light of their economic importance, banks must comply with specific capital and liquidity requirements such as the Basel Accords. Non-compliance can culminate in regulator mandated bank resolution, which highlights the importance of maintaining regulatory minimum capital requirements at all times (Curcio and Hasan (2015)). In particular, this necessity creates a strong incentive for banks to use Capital Management (CM) to meet the exogenous requirements. CM describes the usage of EM, intended to optimize the regulatory capital base (e.g. Beatty et al. (1995); Collins et al. (1995); Ahmed et al. (1999)). In this way, CM can be understood in line with Prospect and Signaling Theory. Especially the latter is of importance in this context. The capital requirements are easy to obtain and compare between different entities. As such, they are a predestined tool for investors to assess a bank relative to its peers, without incurring unbearable search costs.

The previous explanations underline banks' numerous motives for EM and its practical relevance. In light of the noticeable strengthening of banking regulation and supervision over the past decade, the incentives for CM have only been growing.

3.2.3 Earnings Management Instruments

The two prevalent instruments of EM are accruals and the management of real activities (REM). Due to the business activities, the instruments used by real economy companies and financial companies differ fundamentally from each other (Healy and Wahlen (1999)). Companies of the real sector primarily use REM, which Roychowdhury (2006) defines as "[...] management actions that deviate from the normal business practices, undertaken with the primary objective of meeting certain earnings thresholds." Given the absence of noteworthy inventories or depreciating assets, financial institutions, such as banks, can only conduct REM to a lesser extent by managing the recognition of securities gains and losses (Scholes et al. (1990); Beatty et al. (1995); Cornett et al. (2009); Cheng et al. (2011)). Instead, they revert to accruals, more specifically loan charge-offs (LCO) and LLPs, with the latter being the most prominent (Greenawalt and Sinkey (1988); Leventis et al. (2011); Liu and Ryan (2006)). LLPs reflect future credit losses with the intent of ensuring an adequate risk provision of the bank. To achieve this objective, the creation of LLPs is subject to managerial leeway. It is intended to ensure that borrower-specific characteristics are adequately recognized. Accruals in general, and LLPs in particular, can be further divided in non-discretionary and discretionary elements (Lobo and Yang (2001); Hasan and Wall (2004); Pérez et al. (2008)). According to Jones (1991), Dechow et al. (1995) and Dechow et al. (2012) discretionary accruals are the unexplained part of these total accruals, which rather reflect expected than realized cash flows (Dutillieux et al. (2016)).

The discretionary leeway of LLPs is highly dependent on the underlying impairment model. In this context, the changes made by the ECL model of IFRS 9 are of particular interest. In 2018, the ECL replaced the ICL model under IAS 39, which demonstrated several weaknesses during the financial crisis in 2007 ("too little, too late") (G20 (2009)). First, the backward-looking nature of the model, i.e. the fact that expected future losses are not taken into account, resulted in an insufficient allowance for credit losses (Marton and Runesson (2017)). Second, the discrepancy between the occurrence of the loss event and its recognition in the balance sheet was often criticized (Bischof et al. (2019)). Besides that, key characteristics of the ICL model were the required "objective evidence" of a default event and the sole recognition of impairments at the balance sheet date. However, the standard setter defined the term "objective evidence" only roughly through non-exclusive and non-binding indicators ("trigger events") for impairments (IAS 39.59) (Camfferman (2015); Curcio and Hasan (2015); Novotny-Farkas (2016)). Thus, the impairment definition according to IAS 39 seems to be very subjective (Dugan (2009); Dahl (2013)). In contrast, the ECL impairment definition is based on three stages:[1] the first contains the borrowers

[1]For a more detailed description, see Bischof et al. (2022))

with the lowest credit risk, and necessitates provisions for expected losses in the next 12 months. Should the loan become under- or non-performing, it is allocated to Stage 2, or 3, respectively, where provisions for the expected loan losses until maturity must be realized. This means that LLPs must now be calculated for each exposure. The impairments are calculated in accordance to an impairment matrix or a standardized valuation model, which is the product of the outstanding risk exposure (EAD), the probability of default (PD), and the loss in case of default (LGD) for each loan (i) at every point in time (t). It can thus be formally written as:

$$ECL_{i,t} = EAD_{i,t} \times PD_{i,t} \times LGD_{i,t} \tag{3.1}$$

By the standardisation described above, the definition of impairments has become more objective with the ECL model of IFRS 9, by moving from non-exclusive and non-binding indicators ("trigger events"). Otherwise, internal models also imply an element of subjectivity, as there is a lack of objective assessment regarding parameters such as PD and LGD (e.g. Begley et al. (2017), Plosser and Santos (2018)).

3.3 Hypothesis

In reaction to the 2007 financial crisis, the supervisory framework of banks was fundamentally revised, with a qualitative and quantitative improvement in capital adequacy being the primary objective (Fidrmuc and Lind (2020)). This goal was achieved in 2014 in Europe by implementing the most recent Basel III framework through the Capital Requirements Regulation (CRR) and the national transposition of the Capital Requirements Directive IV (CRD IV). On top of changes to the capital requirements for banks (recall Figure (3.1)), it introduced liquidity ratios and a risk-insensitive Leverage Ratio (LR). Furthermore, the supervision of the European banking system was fostered through tools such as the bank stress test, which is conducted by the EBA and European Central Bank (ECB). They intent to provide an assessment of individual bank capitalization under adverse economic conditions, and as such give an idea on the resilience of the entire European financial system. The additional transparency through the biennial bank stress tests has also helped foster market discipline and reduced the opacity of banks as Petrella and Resti (2013) show. Not only does the capital market require additional risk premia for weakly performing banks, but the ECB also uses it as input for its SREP, which directly impacts the capital requirements of banks. Hence, based on the discussed Prospect and

Signaling Theory, it is of utmost importance to appear most resilient in the regulators eye, in order to prevent capital surcharges through the P2R. As a result, the usage of CM in bank stress tests appears predestine (Curcio et al. (2017)).

Previous research suggests that, depending on the regulatory regime, LLPs can be an excellent choice for EM and CM in banks (i.a. Collins et al. (1995); Kim and Kross (1998); Ahmed et al. (1999); Shrieves and Dahl (2003)).[2] Actualy, one additional unit of LLPs reduces earnings before taxes by exactly one unit. Thus, one unit LLPs lowers earnings after taxes by one unit (1 – tax rate). In terms of regulatory capital, based on the current European capital regulation (CRR), a further unit LLP lowers Tier 1 capital (T1) by one unit times (1 – tax rate), as loan loss reserves are eliminated from T1 capital. Equally, the numerator of the LR is reduced by the same amount. By contrast, Tier 2 capital (T2) is affected by LLPs in various ways, as loan loss reserves can, under certain conditions, be included in T2 capital. For IRBA-banks, under Art. 62 d CRR, if loan loss reserves are less than 0.6 % of risk-weighted assets (RWA), an additional unit of LLPs increases total regulatory capital by one unit multiplied by the tax rate (the add-on refers to a pre-tax basis). However, if a further unit LLP exceeds the loan loss reserves of 0.6 % of RWA, an additional unit of LLP cannot be allocated to total regulatory capital. In this case, it leads to a reduction of one unit of total regulatory capital multiplied by (1 – tax rate) (Beatty and Liao (2014); Ng and Roychowdhury (2014); Jutasompakorn et al. (2021)). As main implication of the regulatory treatment arises, that LLPs influence earnings and regulatory capital almost uniformly.

Given the fact that banks want to report strong capital ratios in stress tests, there is an incentive for banks to keep LLPs as low as possible. However, the impairment model in the relevant accounting standard determines the calculation of LLPs and the discretion for banks. In this context, the changes resulting out of the transition from ICL to ECL are of particular relevance, as the definition of impairments that can be recognised has changed fundamentally: IAS 39.59. specifies a number of non-binding trigger events as objective indicators of impairments. Upon closer analysis, it appears that only default or delayed payment of interest or principal is an objective indicator of impairment. The other indicators provided by the standard setter, such as significant financial difficulties of the debtor, an increased likelihood of insolvency or concessions made by the lender to the borrower, do not appear to be very precise or clear in their practical application. Contrary to IAS 39, IFRS 9.5.5 requires the determination of the expected impairments based on the characteristic three-stages ECL model. A noteworthy difference is the fact that expected credit losses in the next 12 months must now be recognised for every financial

[2] For a detailed description of the impact of LLPs on earnings and capital in the period before and after the introduction of the Basel capital regulation, see Beatty and Liao (2014) and Ozili and Outa (2017)

asset without any exception (Stage 1) (IFRS 9.5.5.5.). If the default risk on the reporting date has increased significantly in comparison to initial recognition, Stage 2 foresees risk provisioning for the entire lifetime of the asset (IFRS 9.5.5.3.). In IFRS 9 B.5.5.17., a list of non-conclusive indicators is provided that may be relevant for assessing an increased default risk. This includes, for example, a significant change in internal pricing indicators of default risk (such as credit spreads) or a significant deterioration in external credit indicators (i.a. ratings, CDS-spreads, price changes in the borrower's debt and equity instruments). Also, if the contractual payments are more than 30 days overdue and the presumption cannot be disproved, this represents an trigger of an significant increase in the default risk. In addition to financial performance data of the borrower (e.g. change in the operating profit), qualitative indicators such as a shift in the borrower's business, financial and economic conditions are also taken into account. IFRS 9 broadly adopts the trigger events of IAS 39 for the classification of a financial asset in Stage 3 and adds a payment delay of more than 90 days as an additional criterion. It is important to note that the term "significant change" in default risk is not precisely defined and therefore provides leeway for practical application. Consequently, the distinction criterion of Stage 1 and Stage 2 of the ECL model does not appear to be more objective than the trigger events of ICL. In this context, Behn and Couaillier (2023) show that a substantial proportion of exposures were not transferred from Stage 1 to Stage 2 in a timely manner ahead of default. In contrast, Kund and Rugilo (2018) also report the "cliff-effect", but to a much lesser extent than under IAS 39. Nevertheless, the ECL definition of impairments seems to be more objective than in ICL as it is mandatory to consider not only realised impairments but also expected impairments. In addition to the definition and clear recognition of impairments, the measurement of loan loss provisions is crucial. Given the well-known leeway in the calculation of regulatory minimum capital requirements (e.g. Begley et al. (2017), Plosser and Santos (2018)), there are concerns about the increased use of internal models in accounting standards. There is no doubt that the use of internal models is associated with a wide leeway in terms of interpretation of standards, modelling assumptions and model specification. For example, Behn and Couaillier (2023) provide evidence that the transition of assets from Stage 1 to Stage 2 is reflected only in a small increase in provisioning. In contrast, Baule and Tallau (2021) conclude that LLPs have not appeared to be inadequate since the financial crisis 2007. However, internal models incorporate macroeconomic factors such as inflation, unemployment and interest rates. Even though the definition of model parameters differs between bank regulation and accounting, the key model parameters are subject to regular supervisory review.

In summary, banks generally have an incentive to keep their risk provisioning as low as possible in order to protect their regulatory capital base. However, the introduction of ECL will counteract this incentive through the stricter and broader recognition of impairments that have not only occurred but are also expected to occur in the future. It is not clear to what extent the stricter definition of impairment will be (over)compensated by the leeway in LLP quantification. Taking up the conflicting positions about the impact of IFRS 9 described above and in conjunction with the incentives in the stress test, we hypothesise:

Hypothesis 1 *IFRS 9 altered the usage of Earnings Management and increases the credit risk provisioning in the European bank stress test.*

According to Collins et al. (1995) and Curcio et al. (2017), banks' demand for capital is high in times of economic crisis, because the economic downturn and the accompanying loan defaults burden the regulatory capital ratios. More concretely, given the mitigating effect of each additional unit of LLPs on earnings and capital, banks try to keep LLPs as low as possible in order to show a resilient regulatory capital base in the stress test. Thus, banks will use all available room for manoeuvre to achieve this goal. In the context of the stress test and the objective of reporting the highest possible capital ratios to supervisors, banks have an incentive to classify as many exposures as possible in Stage 1 and also to minimise the amount of internally calculated LLPs. Thus, we expect that banks will maximise existing leeway in the classification and calculation of impairments in order to achieve strong capital ratios in the stress test.

Hypothesis 2 *European banks optimise their regulatory capital in the stress test.*

3.4 Data

The EBA bank stress tests are a favorable empirical setting for investigating our research questions. Due to the significance criterion, only large, interconnected banks are subject to the stress test. Given the similarities between these banks, they have unanimous incentives to engage in EM and CM. In particular, there is a strong case for engaging to the utmost extent in EM and CM as failing the stress test is a costly signal, which likely leads to a capital surcharge through the SREP. Additionally, there is strong evidence for the disciplining effects of bank stress tests on bank risk taking, which gives further credit to our argument of homogeneous incentives (Ellahie (2013); Morgan et al. (2014); Flannery et al. (2017)). Thus, the application of Big Bath Accounting appears unlikely in the context of stress testing. Furthermore, critiques such as that of Anandarajan et al. (2007), who show that smaller, privately held banks may have different incentives compared to larger, public banks are not applicable, as the latter are not present in this data set. Taken together, the stress test is an excellent setting to investigate the effects of the transition from IAS 39 to IFRS 9, as it nudges comparable banks to appear as resilient as possible by employing EM and CM.

Moreover, the setting of the stress test itself proves valuable to isolating the transitional effect to the ECL model, and answering our research questions. The assumption of a static balance sheet mandates the replacement of maturing or failing assets with comparable assets. As such, it allows us to exclude interference from changes to the business model or mix. Furthermore, the stress test provides a macroeconomic baseline scenario, as well as an adverse scenario, which allows us to investigate, whether the application of EM or CM is more pronounced in the economic downturn. Lastly, the granularity of the stress test data enables us to get an unrestricted view on the fundamentals of interest. Despite these favorable properties, a notable limitation concerns the static balance sheet assumption. It is a double-edged sword as it limits noise in our measurements on the one hand side, but prevents us from including loan charge-offs on the other hand side.

In detail we analyze 43 banks from 15 European countries from 2014 until including 2020. By doing so, we have a pre-treatment and post-treatment period to compare, with the enactment of IFRS 9 being the treatment. The application of the stress test data is a strong differentiator of our paper, as it gives us forecasts until 2020, which allows us to derive time-series data in order to compare the effect of IFRS 9 on banks and their EM and CM. We describe the used variables and their origin in more detail in Table (3.5) in the Appendix. Tables (3.6) and (3.7) in the Appendix yield a correlation matrix, respectively the descriptive statistics for both the baseline and adverse scenario.

3.5 Results

3.5.1 Hypothesis 1

As defined in our first hypothesis, we want to investigate the vigorousness of IFRS 9 as a catalyst for EM. On the basis of the respective literature, LLPs are a suitable indicator for EM (e.g. Ahmed et al. (1999), Kanagaretnam et al. (2010)). In particular, banks have an unlimited incentive to ensure that they have a strong regulatory capital base in the stress test. Given the used ECL impairment model and the regulatory treatment of LLPs, this objective can only be maximised by reporting the lowest possible LLPs. In the literature exists no generally accepted model for measuring LLPs (Beatty and Liao (2014)). Drawing inspiration from the research of Collins et al. (1995), Beatty et al. (1995), Liu and Ryan

(2006) and Bushman and Williams (2012), we derive our regression model.[3] Despite the fact that the mentioned research refers to various regulatory regimes and correspondingly different incentive effects on risk provisioning, the fundamental idea can also be applied to IFRS 9 and the stress test setting. To account for the different accounting standards, we include an IFRS dummy in our regression model, as it is not clear how banks' incentives have changed with the transition from IAS 39 to IFRS 9. In contrast to the models developed by Beatty et al. (1995) and Collins et al. (1995), we examine total LLPs and do not distinguish explicitly between discretionary and non-discretionary components in the regression model.[4] Compared with the model-based distinction between discretionary and non-discretionary components, the consideration of total LLPs is less sensitive to estimation errors, especially with respect to the characteristic nature of stress test data. In addition, the holistic approach appears to be suitable for analysing both the impact of regulatory changes and banks' provisioning practices.

$$\begin{aligned}\text{LLP}_{i,t+1} = {} & \alpha_i + \mu_t \\ & + \underbrace{\beta_1 IFRS}_{\text{Dummy}} \\ & + \underbrace{\beta_2 LLR_{i,t} \cdot IAS + \beta_3 LLR_{i,t} \cdot IFRS + \beta_4 \Delta NPL_{i,t} \cdot IAS + \beta_5 \Delta NPL_{i,t} \cdot IFRS}_{\text{Portfolio quality}} \\ & + \underbrace{\beta_6 ROA_{i,t} + \beta_7 Size_{i,t}}_{\text{Bank level covariates}} \\ & + \underbrace{\gamma_1 \Delta GDP_{i,t} + \gamma_2 UNEMP_{i,t} + \gamma_3 CPI_{i,t} + \gamma_4 HPI_{s,t}}_{\text{Macro controls}}\end{aligned} \tag{3.2}$$

In the model α denotes bank fixed-effects, whereas time fixed-effects are denoted by μ. Following Beatty et al. (1995), loan loss reserves (LLR) are standardized by total loans. In line with Liu and Ryan (2006) and Curcio and Hasan (2015), ΔNPL measures the change in the percentage of non-performing loans (NPL) over total loans. Taking Bushman and Williams (2012) as a starting point, we add bank-specific and macroeconomic control variables to our model. We relate those measures to our dependent variable, LLPs, which are also standardized by total loans. In order to obtain unbiased results, we cluster the standard errors on the bank level, and employ lagged independent variables to disperse endogeneity concerns regarding simultaneity.

[3]Due to the stress test data base, models based on net charge-offs can not be taken into account.
[4]Collins et al. (1995) estimate discretionary LLPs as residuals from a model of non-discretionary LLPs.

We investigate our first hypothesis through a fixed-effect regression, which consists of multiple models that are step-wise amended. In Model 1, the standardized LLP is regressed on a dummy that equals one from the introduction of IFRS 9. We extend our baseline model thereupon to account for individual characteristics. Model 2 introduces measures of the portfolio quality. The interaction terms are used to illustrate the impact of portfolio quality controls on LLPs under the respective accounting standard. More precise, they are interacted with the IFRS dummy, in order to address the different behavior before and after the enactment of the new accounting standard. We control for bank-level covariates in Model 3, as more profitable banks can stem impairments more easily. Likewise, larger banks should have a more diverse loan portfolio, making them less susceptible to economic trends. Ultimately, we control for these very macroeconomic influences in Model 4. In detail, we model the change in GDP (GDP), the unemployed rate (UNEMP), as well as the consumer and housing price inflation (CPI, respectively HPI).

Table 3.1: Investigation into the Effect of IFRS on Earnings Management

	Baseline Scenario				Adverse Scenario			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
IFRS ($\in \{0;1\}$)	-0.0009*	0.0012*	0.0016*	0.0014*	-0.0003	0.0033**	0.0038**	0.0038***
	(0.0177)	(0.0188)	(0.0110)	(0.0163)	(0.6308)	(0.0046)	(0.0024)	(0.0007)
LLR (%) × IAS		-0.0212*	-0.0250**	-0.0261**		-0.0411	-0.0359	-0.0261
		(0.0474)	(0.0052)	(0.0063)		(0.0604)	(0.1045)	(0.2299)
LLR (%) × IFRS		-0.0236	-0.0231	-0.0105		-0.1506***	-0.1453***	-0.0979**
		(0.1614)	(0.1069)	(0.4755)		(0.0000)	(0.0000)	(0.0014)
ΔNPL (%) × IAS		0.1534	0.1775*	0.1985*		0.0433	0.0482	0.0458
		(0.0509)	(0.0275)	(0.0232)		(0.3956)	(0.3945)	(0.3565)
ΔNPL (%) × IFRS		0.0116	0.0107	0.0042		-0.0109	-0.0158	-0.0097
		(0.0893)	(0.1608)	(0.5727)		(0.2041)	(0.0701)	(0.0995)
ROA (%)			-0.0009	-0.0006			0.0010	-0.0007
			(0.5401)	(0.6678)			(0.1585)	(0.3359)
Size (ln)			0.0018	0.0024			0.0034	0.0026
			(0.2104)	(0.1408)			(0.2559)	(0.3463)
GDP (%)				-0.0001				-0.0001*
				(0.6128)				(0.0425)
UNEMP (%)				0.0003*				0.0006*
				(0.0371)				(0.0258)
CPI (%)				0.0018*				0.0000
				(0.0307)				(0.9430)
HPI (%)				0.0001				0.0002*
				(0.2589)				(0.0227)
Intercept	0.0035***	0.0019**	-0.0187	-0.0308	0.0071***	0.0073***	-0.0322	-0.0288
	(0.0000)	(0.0027)	(0.2708)	(0.1282)	(0.0000)	(0.0000)	(0.3501)	(0.3751)
Cluster	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank
N	301	215	215	215	301	215	215	215
R^2_w	0.0562	0.2517	0.2733	0.3812	0.0016	0.2605	0.2740	0.3535

Note: The table above shows a step-wise expansion of the basis model, which relates the introduction of IFRS 9 to LLPs. As the intercept remains significant in the first model, we proceed to add further covariates, that account for the portfolio quality. Doing so leads to a change in the direction of the effect in both the baseline, and the adverse scenario. IFRS 9 increases the impairments per loan, which also holds true for the addition of bank- and macroeconomic-controls in Model 3, and 4, respectively. Significance is denoted at the 5 % (*), 1 % (**), and 0.1 % (***) level.

Table (3.1) depicts the results of Models 1 to 4 separated by the baseline and adverse scenario. In line with first hypothesis, we find for both scenarios, that the introduction of IFRS 9 exerts a superimposing influence on loan loss provisioning in European banks at up to the 99 % confidence level. The IFRS dummy is negative and slightly significant in the baseline scenario (Model 1), while it is also negative but surprisingly not significant in the adverse scenario. In general, the result suggests that in the baseline scenario, banks create comparatively smaller LLPs under IFRS 9 than under IAS 39. Perhaps this result is due to less stringent scenario assumptions compared to the adverse scenario, making it comparatively easier to minimise LLPs. As the significance of the intercept in Model 1 hints at an omitted variable, we proceed to extend our regression to form Model 2, where we account for the quality of the underlying loans under the respective accounting standards. While the dummy for IFRS now becomes positive and significant in both scenarios, we cannot remedy the significant intercept. In general, the intercept represents the average effect on the dependent variable in the model, assuming that all independent variables are equal to zero and that the fixed effects have already been taken into account. It thus appears, as if the loan portfolio cannot exclusively explain the loan loss provisioning in European banks. We thus incorporate bank-level controls as additional explanations for EM in banks (Model 3). In the baseline scenario, the IFRS dummy is positive and slightly significant, whereas in the adverse scenario it shows a slightly stronger positive signficance. The statistically significant negative LLR interaction term for IAS in the baseline scenario and for IFRS in the adverse scenario indicates that a higher level of LLRs leads to lower LLPs. Again, our results are robust to additional covariates and reinstate IFRS 9 as a significant determinant of impairments. Thus, the significantly positive IFRS 9 dummy, considering the bank-specific control variables, suggests that more LLPs are recognised under IFRS 9 than under IAS 39. At the same time, none of the additional variables possesses further explanatory power, as judged by both their insignificance, and only marginal gains in the R^2_w. However, their addition is not in vain, as it allows us to remedy the potential omitted variable bias, as the intercept becomes insignificant. Lastly, we extend our analysis by controls for the macroeconomic environment in Model 4. As it is not at the discretion of the bank's management, it should further reduce unexplained loan loss provisioning, and narrow down the true identification of discretionary leeways. We can reinstate our previous findings in terms of significance and effect size. At the same time the explanatory power of the model increases by orders of magnitude, documenting the transmission channel between the macroeconomic environment and how it affects borrowers potential to repay the outstanding loan. If the economy deteriorates, the repayment potential decreases, too, which ultimately necessitates additional impairments. Our results unsurprisingly show that falling into unemployment is a notable driver of these forces.

In summary, with the exception for Model 1, we find in line with our first hypothesis that IFRS 9 increases the impairments per loan irrespective of the analyzed bank, respectively the macroeconomic environment. The positive and statistically significant IFRS 9 dummy in both scenarios is interpreted in the sense that more LLPs were recognised under IFRS 9 than under IAS 39. While the effect is more pronounced in terms of effect size and significance during an economic downturn (i.e. adverse scenario), it is overall robust to portfolio quality, and issuer resilience. An important observations relates to the stock of loan loss reserves, which have been accumulated in the periods before deteriorating loan quality triggers additional impairments. Our analysis shows that this stock is relevant under IAS in the baseline scenario, and under IFRS in the adverse scenario. This discrepancy can be explained by a decoupling of the impairment process from non-exclusive and non-binding indicators ("trigger events"). In the adverse scenario, the majority of exposures is classified in Stages 2 or 3, such that the lifetime losses are realized at inception of the loans, and hence constitute a noteworthy "front-loading" of exposures (Kund and Rugilo (2018)). Presumably, the assumptions in the baseline scenario offer banks more freedom to allocate as many loans as possible to the low-cost Stage 1. This is also an explanation of the weaker overall effect in the baseline scenario than in the adverse scenario.

3.5.2 Hypothesis 2

We measure CM by computing the distance between the reported capital ratios, and the regulatory minimum requirements. The smaller this difference, the larger the pressure on the bank to engage in CM, in order to not violate the stress test covenants and be sanctioned by the regulator. This relationship is well documented (i.a. Beatty et al. (1995); Kim and Kross (1998)) and proves the incentives to engage in EM as a necessity for CM, as theorized in Section (3.3). To measure capital management, the model of hypothesis 1 is extended by variables reflecting the difference between banks' capital ratios and the regulatory minimum. More precisely, the regulatory capital ratios CET1, T1 and Equity as well as the Leverage Ratio are analysed.

$$
\begin{aligned}
\text{LLP}_{i,t+1} = {} & \alpha_i + \mu_t \\
& + \underbrace{\beta_1 IFRS}_{\text{Dummy}} \\
& + \underbrace{\beta_2 LLR_{i,t} \cdot IAS + \beta_3 LLR_{i,t} \cdot IFRS + \beta_4 \Delta NPL_{i,t} \cdot IAS + \beta_5 \Delta NPL_{i,t} \cdot IFRS}_{\text{Portfolio quality}} \\
& + \underbrace{\beta_6 \text{DI-CET1}_{i,t} \cdot IAS + \beta_7 \text{DI-CET1}_{i,t} \cdot IFRS + \beta_8 \text{DI-T1}_{i,t} \cdot IAS + \beta_9 \text{T1}_{i,t} \cdot IFRS}_{\text{Distance to regulatory min. capital}} \\
& + \underbrace{\beta_{10} \text{DI-EQT}_{i,t} \cdot IAS + \beta_{11} \text{DI-EQT}_{i,t} \cdot IFRS + \beta_{12} \text{LR}_{i,t} \cdot IAS + \beta_{13} \text{LR}_{i,t} \cdot IFRS}_{\text{Distance to regulatory min. capital}} \\
& + \underbrace{\beta_{14} ROA_{i,t} + \beta_{15} Size_{i,t}}_{\text{Bank level covariates}} \\
& + \underbrace{\gamma_1 \Delta GDP_{i,t} + \gamma_2 UNEMP_{i,t} + \gamma_3 CPI_{i,t} + \gamma_4 HPI_{s,t}}_{\text{Macro controls}}
\end{aligned} \tag{3.3}
$$

While the cited research analyses the issues under different regulatory regimes, the underlying idea can also be applied to the current CRR and the IFRS 9 standard. In other words, EU banks can only optimise their capital ratios in the stress test by actively managing LLPs in a way that minimises the number of reported LLPs (each additional unit of LLP has the same negative impact on earnings and capital). Again, an IFRS dummy is used to take account of possible incentive differences resulting from different accounting standards.

Table (3.2) shows the results of the regression analysis of standardized LLPs on risk-sensitive capital requirements (i.e. CET1, T1, and Equity) and risk-insensitive capital requirements (i.e. LR). For brevity, and in light of their insignificance, we have not reinstated the coefficients of our bank and macro controls. They are identical to the variables used in Table (3.1): for the bank controls (i) ROA, and (ii) Size, respectively (iii) GDP, (iv) UNEMP, (v) CPI, and (vi) HPI for the macro controls.

Table 3.2: Investigation into the Effect of IFRS 9 on Capital Management

	Baseline Scenario				Adverse Scenario			
	Model 1	Model 2	Model 3	Model 4	Model 1	Model 2	Model 3	Model 4
IFRS ($\in \{0;1\}$)	0.0000	0.0002	0.0001	-0.0001	0.0020	0.0014	0.0014	0.0016
	(0.9963)	(0.6782)	(0.8942)	(0.6680)	(0.3070)	(0.4664)	(0.4577)	(0.2649)
LLR (%) × IAS	0.0023	0.0014	0.0021	0.0023	-0.0253	-0.0246	-0.0228	-0.0321
	(0.8403)	(0.9035)	(0.8560)	(0.8620)	(0.2672)	(0.2155)	(0.2738)	(0.1969)
LLR (%) × IFRS	-0.0160	-0.0175	-0.0158	-0.0201	-0.1075**	-0.0972**	-0.1030**	-0.1067**
	(0.3149)	(0.2674)	(0.3163)	(0.2228)	(0.0067)	(0.0053)	(0.0074)	(0.0013)
ΔNPL (%) × IAS	0.0198***	0.0206***	0.0214***	0.0191**	0.0027	0.0045	0.0050	0.0036
	(0.0004)	(0.0002)	(0.0002)	(0.0023)	(0.8353)	(0.6721)	(0.6754)	(0.8304)
ΔNPL (%) × IFRS	-0.0013	-0.0013	-0.0008	-0.0020	0.0132	0.0171	0.0110	0.0078
	(0.8549)	(0.8566)	(0.9078)	(0.7812)	(0.3611)	(0.2578)	(0.4510)	(0.6194)
DI_{CET1} × IAS	0.0231*				0.0653			
	(0.0129)				(0.0556)			
DI_{CET1} × IFRS	0.0188*				0.0474			
	(0.0178)				(0.0591)			
DI_{T1} × IAS		0.0200**				0.0969**		
		(0.0069)				(0.0031)		
DI_{T1} × IFRS		0.0148*				0.0748***		
		(0.0166)				(0.0005)		
DI_{EQT} × IAS			0.0179**				0.0739**	
			(0.0070)				(0.0072)	
DI_{EQT} × IFRS			0.0134*				0.0524**	
			(0.0163)				(0.0038)	
DI_{LR} × IAS				0.0081				0.0117
				(0.1571)				(0.3357)
DI_{LR} × IFRS				0.0198				-0.0134
				(0.2645)				(0.7174)
Intercept	-0.0329	-0.0294	-0.0300	-0.0115	-0.0397	-0.0501	-0.0534	-0.0013
	(0.1106)	(0.1124)	(0.1205)	(0.3812)	(0.2350)	(0.1347)	(0.1346)	(0.9599)
Bank Controls	✓	✓	✓	✓	✓	✓	✓	✓
Macro Controls	✓	✓	✓	✓	✓	✓	✓	✓
Cluster	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank
N	215	215	215	215	215	215	215	215
R^2_w	0.3311	0.3320	0.3369	0.3124	0.3282	0.3835	0.3625	0.3033

Note: The table above investigates the extent to which banks engage in CM. We measure the vigorousness of CM by computing the distance between the reported and the required capital levels. The smaller the difference, the larger the pressure to engage in CM, in order to appear more resilient. We document that risk-sensitive measures are especially susceptible to this thinking, as indicated by their significance through all instances, and both, the baseline and adverse scenario. Risk-insensitive measures such as the LR appear to be uninfluenced by CM. We reapply the bank- and macroeconomic controls from Table (3.1). Significance is denoted at the 5 % (*), 1 % (**), and 0.1 % (***) level.

Regarding our hypothesis, we make three notable observations: first, our dummy for IFRS becomes insignificant in all models. At the same time, the significance of LLR under the adverse scenario as in Table (3.1) can be reinstated. Furthermore, deterioation in the quality of the loan portfolio translate into additional impairments in the baseline scenario. Second, we find, that virtually all risk-sensitive capital requirements are significant, whereas the opposite is true for risk-insensitive capital requirements. This finding is surprising, given the mechanic link between the Tier 1 capital as numerator of the Leverage Ratio. However, the LR is only a binding minimum requirement from June 2021, so it is probable that the LR was not actively optimised at that time. It thus suggests that banks employ CM in order to manage risk-sensitive capital requirements, such as the CET1-, T1-, and Equity-ratio. Third, we find that the pressure to engage in CM is prevalent under both accounting regimes, IAS 39 as well as IFRS 9, and thus explains the insignificance of the IFRS dummy. This observation is in line with the logic described in i.a. Section (3.3), which outlines the pressure on banks to meet the capital requirements. It is important to note that the delta between the reported capital ratios and the regulatory minimums is used in the interpretation. The results show that LLPs increase as the delta increases (Table (3.2)). This is reasonable in the sense that better capitalised banks can easily cope with higher LLPs in the stress test. Conversely, this implies that banks with low deltas also have low LLPs. In this context, it seems very unlikely that banks with lower capital ratios have comparatively high portfolio quality. Instead, it can be assumed that banks with low capital ratios are forced to use all available leeway (e.g. classifying many exposures as possible in the inexpensive Stage 1 and using leeway by in the internal calculation of LLPs) in their own interest in order to report the lowest possible LLPs in the stress test. This result is in line with hypothesis 2. Taken together our results illustrate the overarching pressure on bank's to engage in CM, which documented by the insignificant of the IFRS dummy, respectively the significance of the interaction terms for both IAS 39 and IFRS 9. In line with the incentives we lay out, banks engage in CM in order to not violate the covenants of the bank stress test, which would expose them to regulatory scrutiny through the suggested SREP-channel. We will reinstate the robustness of our findings in the following section.

3.6 Robustness

3.6.1 Loan Diversification

Liu and Ryan (1995) and Liu and Ryan (2006) discuss additional measures, which can possibly influence the managerial leeway we examine in this paper in the context of EM. In particular, they differentiate between homogeneous loans, such as small, retail loans, for which LLPs are statistically computed, and heterogeneous loans, such as corporate or commercial loans, with large exposures that are evaluated by credit officers on a case by case basis. It is evident, that the first is inherently more objective, compared to the latter, were individuals are required to use their subjective judgment. As such, it could be the case, that banks, which rely mostly on homogeneous loans are less impacted by the change from IAS 39 to IFRS 9 because they were not exercising their discretionary power in the first place. Vice versa, banks with heterogeneous loans could exercise this right more blatantly before IFRS 9 introduced a standardized formula to compute LLPs. We investigate this theory by employing a sub-sampling approach, which differentiates between homogeneous (share of homogeneous loans above the median), and heterogeneous banks.

Table (3.3) shows the results of our sub-sampling approach. We initially differentiate between the baseline and adverse scenario as in the tables before. Additional, we split the population in subsets, which either have heterogeneous or homogeneous loan portfolios. We find that the stock of LLR is highly explicative of future LLP in heterogeneous portfolios in both, the baseline and the adverse scenario. In homogeneous portfolios, however, this observation is only true for the adverse scenario under IAS 39. As such, these observations are in line with the results of Liu and Ryan (1995) and Liu and Ryan (2006). Impairments in heterogeneous portfolios are decided on a case by case basis, and as such susceptible to (unconscious) biases from the credit officers. In line with the underlying principle of EM, they appear to be too lenient in their loan loss provisioning, as the effect size has grown notably in comparison to Table (3.1). Hence, earnings are managed such that they are rather overstated as impairments are understated.

Taken together, this robustness check documents that in line with our first hypothesis, EM is present in this data set, and even more so, that it is executed unchallenged. With EM being a binding prerequisite for CM, this robustness test also generates additional evidence in favor of CM. We corroborate this deliberation in the next robustness test.

Table 3.3: Regression on LLP for homogeneous and heterogeneous Loan Portfolios

	Baseline Scenario		Adverse Scenario	
	Heterogeneous	Homogeneous	Heterogeneous	Homogeneous
IFRS ($\in \{0;1\}$)	-0.0002	-0.0006	-0.0001	0.0000
	(0.4768)	(0.3778)	(0.9007)	(0.9810)
LLR (%) × IAS	-0.0336*	-0.0277	-0.0713**	-0.1227*
	(0.0231)	(0.2837)	(0.0038)	(0.0109)
LLR (%) × IFRS	-0.0348*	0.0441	-0.0868***	-0.2035
	(0.0443)	(0.0906)	(0.0002)	(0.0561)
ΔNPL (%) × IAS	0.0251	0.0050	0.0099	-0.0068
	(0.2553)	(0.7934)	(0.7296)	(0.5393)
ΔNPL (%) × IFRS	0.0103	0.0044	0.0063	0.0278
	(0.1050)	(0.3430)	(0.6227)	(0.2973)
ROA (%)	-0.0018	-0.0013	-0.0007	-0.0007
	(0.1138)	(0.2888)	(0.4648)	(0.7145)
Size (ln)	0.0010	-0.0003	-0.0007	-0.0049
	(0.5410)	(0.8528)	(0.6968)	(0.4604)
GDP (%)	-0.0001	0.0003	-0.0001***	-0.0001
	(0.7598)	(0.4701)	(0.0001)	(0.1934)
UNEMP (%)	-0.0001	0.0008	-0.0000	0.0003
	(0.1646)	(0.0638)	(0.8838)	(0.4821)
CPI (%)	0.0003	0.0024*	-0.0001	0.0009
	(0.3911)	(0.0291)	(0.8129)	(0.2443)
HPI (%)	0.0001	0.0001	0.0002	-0.0000
	(0.0987)	(0.4143)	(0.0607)	(0.9662)
Intercept	-0.0075	-0.0038	0.0170	-0.0469
	(0.6867)	(0.8319)	(0.3980)	(0.5327)
Cluster	Bank	Bank	Bank	Bank
N	102	102	102	102
R_w^2	0.5137	0.4205	0.5296	0.5032

Note: The table above shows the loan loss provisioning for a homogeneous and heterogeneous portfolio before and after the introduction of IFRS 9. We find that homogeneous exposures (i.e. retail loans) were unaffected by the change in accounting, whereas heterogeneous exposures (i.e. corporate loans) have been affected. Significance is denoted at the 5 % (*), 1 % (**), and 0.1 % (***) level.

3.6.2 OSII Capital Buffer

After having reinstated the existence of EM in the previous robustness checks, we proceed to verify the presence of CM in this robustness check. In order to do so, we use the capital buffer for Other Systemically Important Institutions (OSII), which varies on the bank level, compared to the uniform Pillar 1 requirements we assessed earlier. Every year, the EBA evaluates on the basis of 12 principles, which banks meet the definition of OSII, and as a result are subject to additional capital buffers of up to two percent. As it has to be made up entirely of CET1 capital, we focus on comparing the distance to the regulatory minimum of CET1 in line with the Pillar 1 requirements, as in Table (3.2) to the new distance, which also accounts for P2R. 35 out of the 43 banks in our sample are obliged to maintain additional CET1, relative to their RWA.

Table (3.4) reinstates the findings of Table (3.2) at large. Including the bank specific Pillar 2 surcharges has no impact on our results. Again, we find that banks manage their capital in the baseline scenario, and in the adverse scenario, as well, when expanding the significance level to 7 %. A pairwise comparison of the coefficients in the first column with the Pillar 1 requirements (P1) to the combined requirements (P1 + P2), shows that the differences are marginal at best. A possible explanation for this observation relates to the fact, that the majority of banks in the stress test is well capitalized. As such, the additional obligations on CET1 do not substantially increase the distance to the regulatory minimum capital. Our previous results are thus reaffirmed.

Table 3.4: Impact of Pillar 2 Requirements

	Baseline Scenario		Adverse Scenario	
	P1	P1 + P2	P1	P1 + P2
IFRS ($\in \{0;1\}$)	0.0000	-0.0001	0.0020	0.0015
	(0.9663)	(0.8042)	(0.3070)	(0.3676)
LLR (%) × IAS	0.0023	0.0025	-0.0253	-0.0252
	(0.8403)	(0.8313)	(0.2672)	(0.2796)
LLR (%) × IFRS	-0.0160	-0.0149	-0.1075**	-0.1042**
	(0.3149)	(0.3562)	(0.0067)	(0.0079)
ΔNPL (%) × IAS	0.0198***	0.0197***	0.0027	0.0023
	(0.0004)	(0.0004)	(0.8353)	(0.8577)
ΔNPL (%) × IFRS	-0.0013	-0.0016	0.0132	0.0131
	(0.8549)	(0.8172)	(0.3611)	(0.3681)
ROA (%)	-0.0005	-0.0005	-0.0020	-0.0020
	(0.7472)	(0.7463)	(0.0593)	(0.0519)
Size (ln)	0.0026	0.0026	0.0035	0.0031
	(0.1135)	(0.1110)	(0.2063)	(0.2258)
GDP (%)	-0.0002	-0.0002	-0.0001*	-0.0001*
	(0.2509)	(0.2116)	(0.0347)	(0.0344)
UNEMP (%)	0.0002	0.0002	0.0004	0.0004
	(0.2522)	(0.2596)	(0.1969)	(0.2016)
CPI (%)	0.0017*	0.0017*	0.0000	0.0000
	(0.0356)	(0.0359)	(0.9048)	(0.9193)
HPI (%)	-0.0001	-0.0001	0.0002	0.0002
	(0.3968)	(0.4159)	(0.0836)	(0.0809)
DI_{CET1} × IAS	0.0231*	0.0224*	0.0653	0.0592
	(0.0129)	(0.0120)	(0.0556)	(0.0580)
DI_{CET1} × IFRS	0.0188*	0.0188*	0.0474	0.0456
	(0.0178)	(0.0162)	(0.0591)	(0.0662)
Intercept	-0.0329	-0.0321	-0.0397	-0.0346
	(0.1106)	(0.1098)	(0.2350)	(0.2639)
Cluster	Bank	Bank	Bank	Bank
N	215	215	215	215
R_w^2	0.3311	0.3296	0.3282	0.3224

Note: The table above depicts the distance to the Pillar 1, respectively combined Pillar 1 and 2 capital requirements, differentiated by the baseline and adverse scenario. We can reinstate the results from Table (3.2) at large. It is particularly noteworthy that banks manage their risk-sensitive capital (i.e. CET1) under both accounting standards in the adverse scenario. If one is to apply more generous confidence levels, the results also become significant at the 10 % level in the adverse scenario. As a result the IFRS 9 dummy becomes insignificant. We thus document the pressure that banks are susceptible to, in order to window dress themselves for the stress tests. Significance is denoted at the 5 % (*), 1 % (**), and 0.1 % (***) level.

3.7 Conclusion

The prudent management of credit risks is of utmost importance to a sound bank. In safeguarding themselves against the risk of default, banks employ two lines of defense: LLPs, which protect against expected losses, and regulatory capital, which protects against unexpected losses. An accurate estimation of both is vital in order to protect the bank against possible capital shortfalls, which may culminate in the bank's failure. Banks were allowed discretionary power in estimating their loan loss provisions, in order to account for the specifics of their loan portfolio. However, the financial crisis of 2007 has shown in unparalleled ways that this managerial leeway was not always used with the best intent. To the contrary, banks identified the impairment process as an excellent tool for Earnings and Capital Management. With the shift from the previous Incurred Loss Credit model of IAS 39 to the Expected Credit Loss model of IFRS 9, the impairment process has been fundamentally changed: while the definition of impairments under ICL was linked to objective evidence using non-mandatory and incomplete triggers, the three-stages ECL model requires provisioning for all loans without exception. IFRS 9 relies on internal models to quantify LLPs. On the one hand, the incorporation of macroeconomic factors in the models contributes to an adequate risk assessment. On the other hand, an inherent model risk cannot be completely avoided.

Against this background we investigate in two separate hypotheses the impact of IFRS 9 on the Earnings and Capital Management in European banks. We analyse data from the EBA bank stress tests, in order to remedy several caveats. First, using the stress test data allows us to overcome data scarcity due to the only recent enactment of IFRS 9. Furthermore, the assumption of stress test limit inference (e.g. static balance sheet assumption), and allows us to measure the true impact of IFRS 9. Lastly, the differentiation between a baseline and an adverse scenario allows us to derive meaningful inference for both, normal times, as well as crises.

In our first hypothesis we differentiate between the time before and after IFRS 9, in order to get a clearer understanding of the underlying mechanisms. We find that indeed, IFRS 9 increases the average impairments per loan on the bank level, irrespective of idiosyncratic factors, respectively the macroeconomic environment as an overarching component. Stringently, we postulate hypothesis two, where we investigate the presence of CM, in light of having confirmed the existence of EM before. Combined with the importance of the risk-sensitive capital requirements, it can be interpreted that banks use the existing leeway to report the lowest possible LLPs in the stress test and thus optimise their capital ratios. However, the opposite is true for the risk-insensitive measures. A possible explanation could be that violations of the latter have not yet been sanctioned.

In summary, our paper makes multiple points. While we can show the existence of EM in general, we find that the introduction of IFRS 9 has increased the average LLP. We point this observation to the growing objectivity, which stems from the stricter definition of impairments or the change in the calculation method for LLPs. Furthermore, we generate evidence that banks in the stress test manage their regulatory capital. Our results show that this observation is independent of the accounting standard. A possible explanation lies in the incentives of the agents. In light of the stress test setting, banks want to appear as resilient as possible, in order to prevent being subject to additional Pillar 2 capital requirements through the SREP process.

We challenge our results through dedicated robustness tests. In a first step, we investigate whether the homogeneity of the loan portfolio biases our results. A strand of the literature has developed, which argues that homogeneous portfolios (i.e. small, standardized loans) have historically been evaluated through algorithms, and should thus be less susceptible to the growing objectivity under IFRS 9. Indeed, we find that homogeneous portfolios are less severely impacted by the transition from IAS 39 to IFRS 9. This observation is true for both, the baseline and adverse scenario. Lastly, we challenge our results by estimating the presence of CM against not only the Pillar 1, but also the P2R. We can undoubtedly reinstate the previous results, hence attesting to having measured CM.

Our results are of particular interest for supervisors, standard setters and the banking industry. While they show that banks employ EM and CM in the stress test in order to appear as resilient as possible, they also point to the higher objectivity of the IFRS 9 ECL model, compared to its predecessor. As a result, banks face new obstacles in employing EM and CM, in order to meet the growing capital demands of the regulator. At the same time, the comparability between banks has increased, as the loan loss provisioning has become more uniform.

Future research should try to reinstate our findings using actual data. In light of the recency of the IFRS 9 introduction, these data are not available, yet, which is why we reverted amongst other reasons to the stress test data. It may also be interesting to examine the shift in the discretionary component of LLPs. Furthermore, it would be prudent to make an effort in comparing the results of the IFRS 9 introduction in Europe to the introduction of the CECL model in the United States.

3.8 Appendix

Table 3.5: Used Variables and their Sources

Variable	Description	Source
T1	Percentage of Tier 1 Capital	Item 993442[1], Item 1690848[2], Item 183766[3]
EQT	Percentage of Total Equity	Item 993401[1], Item 1690801[2], Item 183701[3]
Size	Logarithm of Total Assets	Own Computation: Size $= ln\left(\frac{\text{T1 Capital}}{\text{Leverage Ratio}}\right)$
NI	Net Income	Item 993014[1], Item 1690715[2], Item 183615[3]
ROA	Return on Assets	Own Computation: ROA $= \frac{\text{Net Income}}{\text{Total Assets}}$
LLPs	Amortized Impairments	Item 993007[1], Item 1690710[2], Item 183610[3]
LR	Leverage Ratio	Item 1690858[2], Item 183112[3]
IFRS	Dummy that equals one if IFRS 9 is applicable	Own Computation: 1 if Year $\geq$ 2018
LLR	Percentage of Loan Loss Reserves	$\text{LLR}_{it} = \frac{\text{Default Stock}}{\text{Total Loans}}$
PORTDIV	Portfolio Diversification	$\text{PORTDIV}_{it} = 1 - \left\lvert \frac{\text{homogen}-\text{heterogen}}{\text{homogen}+\text{heterogen}} \right\rvert$
DI_{CET1}	Distance to minimum CET1 requirements	$\text{DI}_{\text{CET1}} = \text{CET1}_{i,t} - \text{CET1}_{minimum}$
DI_{T1}	Distance to minimum Tier 1 requirements	$\text{DI}_{\text{T1}} = \text{T1}_{i,t} - \text{T1}_{minimum}$
DI_{EQT}	Distance to minimum Equity requirements	$\text{DI}_{\text{EQT}} = \text{EQT}_{i,t} - \text{EQT}_{minimum}$
DI_{LR}	Distance to minimum Leverage Ratio	$\text{DI}_{\text{LR}} = \text{LR}_{i,t} - \text{LR}_{minimum}$
CPI	Consumer Price Inflation	ESRB[4]
GDP	Gross Domestic Product	ESRB[4]
HPI	Housing Price Inflation	ESRB[4]
UNEMP	Unemployment Rate	ESRB[4]

Note: (1) as obtained from the 2014 Stress Test Results website. (2) as obtained from the 2016 Stress Test Results website. (3) as obtained from the 2018 Stress Test Results website. (4) as obtained from the macroeconomic scenario diffused by the ESRB. Total Assets for 2014 were extrapolated from the actual values, in line with the "static balance sheet" assumption of the bank stress test.

Table 3.6: Correlation Matrix of used Variables

	LLP	IFRS	LLR	ΔNPL	ROA	Size	GDP	UNEMP	CPI	HPI	PORTDIV	DI_{CET1}	DI_{T1}	DI_{EQT}	DI_{LR}
LLP	1.0000														
IFRS	-0.0533	1.0000													
LLR	0.7697	-0.0380	1.0000												
ΔNPL	-0.0407	-0.0548	0.1069	1.0000											
ROA	0.2233	0.1048	0.1183	-0.0642	1.0000										
Size	-0.1665	0.0160	-0.2281	0.0244	-0.0357	1.0000									
GDP	0.1605	-0.0160	0.1895	-0.1732	0.1972	-0.2719	1.0000								
UNEMP	0.3485	-0.2908	0.3474	-0.0420	0.1348	0.1784	-0.1157	1.0000							
CPI	0.0144	0.3173	-0.0839	0.0302	0.3051	-0.1149	0.0425	-0.5176	1.0000						
HPI	0.0821	0.0243	0.1073	-0.1531	0.1153	-0.2379	0.5603	-0.2076	0.1883	1.0000					
PORTDIV	0.1227	0.0766	0.0637	-0.1332	0.4248	0.1540	0.1194	0.1921	0.0733	-0.1690	1.0000				
DI_{CET1}	-0.3047	0.2812	-0.3032	0.0066	0.0683	-0.3763	0.1213	-0.3573	0.2446	0.1609	-0.1117	1.0000			
DI_{T1}	-0.3467	0.2515	-0.3500	0.0140	0.0879	-0.3080	0.0887	-0.3431	0.2633	0.1346	-0.0992	0.9784	1.0000		
DI_{EQT}	-0.3578	0.3315	-0.3743	-0.0247	0.0704	-0.2707	0.0682	-0.4264	0.3084	0.1528	-0.1060	0.9566	0.9652	1.0000	
DI_{LR}	0.1851	0.0078	0.1630	-0.0134	0.1148	-0.4156	0.1373	-0.0497	0.0310	0.1658	0.0099	0.4341	0.3600	0.3624	1.0000

Note: The table above depicts the correlation between the used regressors throughout our analyses. The majority of correlations is rather small, such that multicollinearity appears unproblematic. High correlations coincide with economic explanations. A notable example could be the correlation between the distance measures for CET1, T1, and Equity. Given that CET1 constitutes a part of T1, which in turn makes up the going concern capital attributable to Equity, these high correlations are logical. at the other end, the largest negative correlation exists between unemployment and CPI. Again, this observation appears logical, given the both go up during the economic downturn.

Table 3.7: Descriptive Statistics

	Panel A						
	Baseline Scenario						
	Min	$Q_{0.25}$	Mean	Median	$Q_{0.75}$	Max	σ
LLP	0.0001	0.0012	0.0030	0.0021	0.0037	0.0218	0.0029
IFRS	0.0000	0.0000	0.4286	0.0000	1.0000	1.0000	0.4957
LLR	0.0001	0.0083	0.0270	0.0156	0.0351	0.1967	0.0310
ΔNPL	-0.1488	-0.0101	-0.0056	0.0030	0.0078	0.0383	0.0264
ROA	-0.4470	0.1464	0.2987	0.2747	0.4351	1.1238	0.2372
Size	10.4411	12.0036	12.7744	12.5413	13.6462	14.7581	1.0472
GDP	0.2000	1.6000	1.9844	1.8000	2.4000	4.5000	0.6789
UNEMP	2.9000	5.0000	7.6671	6.7000	9.6000	25.7000	4.1190
CPI	0.3000	1.2000	1.5449	1.5000	1.8000	2.9000	0.4504
HPI	-4.3000	2.2000	3.5724	3.8000	4.9000	12.6000	2.6134
PORTDIV	0.0000	0.4665	0.6015	0.6719	0.7925	0.9982	0.2770
DI_{CET1}	0.0383	0.0772	0.1110	0.0987	0.1263	0.3619	0.0526
DI_{T1}	0.0376	0.0691	0.1044	0.0921	0.1198	0.3469	0.0548
DI_{EQT}	0.0366	0.0745	0.1125	0.1004	0.1360	0.3628	0.0566
DI_{LR}	-0.0331	-0.0060	0.0101	0.0020	0.0129	0.3237	0.0380

	Panel B						
	Adverse Scenario						
	Min	$Q_{0.25}$	Mean	Median	$Q_{0.75}$	Max	σ
LLP	0.0003	0.0031	0.0067	0.0051	0.0086	0.0371	0.0055
IFRS	0.0000	0.0000	0.4286	0.0000	1.0000	1.0000	0.4957
LLR	0.0002	0.0118	0.0347	0.0231	0.0442	0.2430	0.0357
ΔNPL	-0.2110	-0.0161	-0.0036	0.0060	0.0128	0.1026	0.0356
ROA	-2.5804	-0.2742	-0.1495	-0.0856	0.0423	0.4941	0.3372
Size	10.4411	12.0036	12.7744	12.5413	13.6462	14.7581	1.0472
GDP	-31.0000	-1.7000	-1.4821	-1.1000	-0.4000	1.9000	3.6463
UNEMP	3.8000	6.5000	9.4322	8.8000	10.9000	26.8000	3.9935
CPI	-3.9000	-0.1000	0.2907	0.4000	1.0000	2.7000	1.0555
HPI	-31.1000	-10.1000	-7.0508	-6.0000	-3.0000	10.0000	6.1882
PORTDIV	0.0000	0.4665	0.6012	0.6692	0.7925	0.9982	0.2771
DI_{CET1}	0.0115	0.0464	0.0755	0.0624	0.0910	0.3213	0.0483
DI_{T1}	0.0092	0.0378	0.0672	0.0515	0.0815	0.3063	0.0500
DI_{EQT}	-0.0039	0.0442	0.0747	0.0641	0.0927	0.3188	0.0505
DI_{LR}	-0.0340	-0.0133	0.0010	-0.0062	0.0023	0.3237	0.0374

Note: The panels A and B of the table above depict the descriptive statistics of the two economic scenarios in the bank stress tests. We report a multitude of statistical measures in order to give the informed reader an idea of how the variables in our data set are distributed. Notable coefficients are the minima of GDP and HPI in the adverse scenario, which indicate that GDP and housing prices contract by almost a third, in the most severe instance.

Chapter 4

Effects of Income Diversification on Bank Profitability and Risk ◆

Empirical Evidence of German Savings Bank

4.1 Introduction

In recent decades, the global banking industry has undergone a trend towards diversification. In the U.S., the liberalisation of the banking market preceded this development with the abolition of the interstate banking ban (McFadden Act) and the Glass-Steagall Act by the Gramm-Leach-Bliley Act in 1999, which opened up new business opportunities for banks (Altunbas et al. (2011)). Meanwhile, in Europe, the Second Banking Directive of the late 1980s deregulated the market and opened the door to investment and other financial services. At this time, major universal banks in Germany began to move away from traditional lending and became global players in the world's capital markets with a strong focus on investment banking (Wahrenburg (2010)). However, the global financial crisis of 2007 showed highly interconnected financial institutions that non-interest income is more volatile and risky than traditional interest income. On the contrary, German savings banks and cooperative banks are largely barred by their specific regulations from risky investment banking activities. Thus, on the one hand, regionally focused banks were less affected by the financial crisis (Köhler (2014)), but on the other hand, these banks remain heavily dependent on interest income given their limited diversification options. In particular, the period of low interest rates, lasting more than 10 years after the financial crisis, has seriously challenged the future prospects of these banks. At the same time, with the introduction of Basel III, the market environment has become even more challenging,

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as capital requirements have increased both quantitatively and qualitatively. In general, the challenges following the financial crisis have heavily challenged the business model of regional banks, such as savings banks. The resulting doubts about bank profitability have prompted banks to step up their efforts to diversify into non-interest activities in order to reduce their dependence on interest income. However, for savings banks the scope of diversification is rather limited. First, the regional principle ("Regionalprinzip") forbids business activities outside the region of the guarantor, making extensive geographical diversification in the classical sense impossible. Second, the combination of the typical association structure of savings banks ("Verbundorientierung") and their public mission ("öffentlicher Auftrag") excludes non-interest activities such as investment banking. Therefore, the benefits of diversification for savings banks are relatively limited. This means, savings banks can diversify their sources of income mainly by providing services to third parties (e.g. the brokerage of products from alliance partners e.g. insurances, building loan contracts, investment shares, stocks and shares). Even for savings banks, focussing on fee-generating business lines is associated with substantial personnel and training costs. Given the rather limited diversification potential, the costs will not be lowered to the same extent. This raises the key research question of this paper, namely to what extent diversification to non-interest income affects the risk-return profile of German savings banks in the post financial crisis area.

Previous research has investigated the impact of diversification on profitability and risk in different ways and across different regions, but has not reached a consensus on the results (e.g DeYoung and Roland (2001); Stiroh (2010); Zouaoui and Zoghlami (2022)). Most studies focus on the Anglo-Saxon region (e.g. Stiroh (2004a); Stiroh and Rumble (2006); Goddard et al. (2008)). Studies of European banks usually cover listed banks from various EU countries (e.g. Baele et al. (2007); Lepetit et al. (2008a); De Jonghe (2010)). Only Köhler (2014) and Busch and Kick (2015) explicitly examines diversification effects for the German banking sector. Köhler (2018) focusses exclusively on German savings banks in the period 2002 to 2013 and finds a positive relationship of diversification on risk-adjusted profitability, in addition to a risk-reducing effect. This indicates, that the impact of diversification on the risk and return profile for the lage number of non-listed German savings banks seems to be under-researched.

Building on this research, this paper improves the approach of Köhler (2018) in the following ways: First of all, the data set covers the post-crisis years and the period of the sovereign debt crisis (2010-2013). Particularly in the context of the low interest rate period, it is appropriate to examine to what extent savings banks can benefit from a stronger focus on non-interest income sources in order to stabilise their earnings situation. Second, regional effects are considered at the level of the respective savings bank associations and macro-economic developments at the level of the federal states. Third, mergers are treated in a way that avoids any loss of data and the data is not winsorised.

By analysing a panel data set of 459 German savings banks over the period 2009-2018, the results indicate a negative impact of income diversification on profitability and a enhancing effect on bank risk. Therefore, the results are consistent with the work of Mercieca et al. (2007); Lepetit et al. (2008a), but contrary to research of (e.g. Chiorazzo et al. (2008); Köhler (2014); Busch and Kick (2015); Köhler (2018)). In doing so, this study contributes to the diversification-profitability-risk literature by providing empirical evidence on non-listed European banks in the post-crisis period (e.g. DeYoung and Rice (2004); Stiroh and Rumble (2006); Berger et al. (2010); Elsas et al. (2010)).

The paper is structured as follows: Section (4.2) describes theories of diversification, reviews the literature and derives research hypotheses. The dataset and the empirical approach are described in Section (4.3), followed by the results in Section (4.4). Section (4.5) shows the outcome of several robustness checks, while Section (4.6) concludes.

4.2 Literature Review and hypotheses

4.2.1 Definition, motives and theory of diversification

In the context of organisations, the term "diversification" is not uniformly defined. Typically, the concept of diversification is understood as an increase or expansion of business activities (Mulwa et al. (2015)). For financial institutions, Mercieca et al. (2007) distinguishes three forms of diversification, namely, first, business diversification through new types of products and services ("income diversification"), second, "geographic diversification", and third, diversification through a combination of business and geographic diversification. The underlying motivation for banks to diversify business activities is undoubtedly the intention to reduce dependency on a single or limited number of income sources and thereby to stabilize income streams, especially in times of economic downturn (Busch and Kick (2015)). In addition, diversification can help to leverage existing competitive advantages, such as strong bank-customer relationships. Also, specific non-interest activities, such as investment banking, are seen as more profitable than traditional interest-based businesses. However, increased exposure to non-interest activities can lead to higher volatility and risk, particularly in investment banking. Finally, the broader range of activities may also hamper business operations and increase compliance and regulatory costs (Sanya and Wolfe (2011)).

The fundamental rationale for diversification is related to portfolio theory and financial intermediation theory. From the investor's perspective, portfolio theory suggests that diversification can reduce the overall risk of a portfolio, insofar as the correlation between the individual financial assets is low. Applied to financial institutions, such as banks, which are typically highly leveraged, diversification can lower risk by expanding into businesses that are not perfectly correlated (Stiroh (2010)). The impact of combining non-interest activities with traditional banking activities cannot be fully captured by assessing the risk of individual non-interest activities. From a portfolio theory perspective, the risk of a bank depends on the return variances of its activities and their correlations. Even if investment banking is inherently riskier, a commercial bank can reduce its overall risk through diversification if the returns from the two activities are weakly or negatively correlated. But if the returns are perfectly positively correlated, diversification into riskier activities will only linearly increase overall risk (Wyss (2018)).

Diversification is also supported by the theory of financial intermediation. While portfolio theory is based on risk diversification effects, the rationale for diversification is based on the realisation of economies of scope, such as cross-selling opportunities and cost synergies. Thus, diversified banks can achieve efficiency gains, such as economies of scope, leading to an increase in performance and market valuation (Berger et al. (1999), Laeven and Levine (2007b)).

Contrary to the previously presented theories, corporate finance theory recommends a focus on single businesses to maximise managerial skills and minimize agency problems among shareholders and bank managers (Myers and Rajan (1998), Wyss (2018)). Along these lines, Boot and Thakor (1997), using a theoretical model to show that universal banks are less efficient than specialist banks due to their comparatively lower financial innovation power. In addition, Nicoló et al. (2004) found that the risk reduction from diversification is overcompensated by a higher risk appetite of bank managers.

4.2.2 Literature Review

The impact of diversification on both real economy and the financial sector is extensively discussed in the literature (Stiroh (2010); Erdorf et al. (2013)). Numerous studies have analysed the determinants of corporate diversification and identified a diversification discount in the real economy (e.g. Lang and Stulz (1994), Berger and Ofek (1996), Servaes (1996)). In contrast, the literature on financial firms is mixed (e.g. Asif and Akhter (2019); Zouaoui and Zoghlami (2022)). The following literature review focuses on research assessing the effects of diversification in terms of bank performance and risk.

In their seminal work, Laeven and Levine (2007b) examine the impact of diversification on the market values of financial conglomerates in 43 countries during 1998-2002 and find evidence for a diversification discount. More specifically, conglomerates that diversify their activities are less valued by the market than financial intermediaries that are divided into single activities (diversification discount). The findings can be explained by enhanced agency problems as a consequence of the engagement in multiple activities. This means that the potential benefits of diversification, in particular the potential economies of scope, are offset by the costs associated with agency problems. On the contrary, Elsas et al. (2010) identify a diversification premium meaning that diversification improves bank profitability without reducing shareholder value. The discrepancies can be attributed to different methods of measuring bank value and the diversification indicator, such as the lack of profitability controls in the study by Laeven and Levine (2007b). Demirgüç-Kunt and Huizinga (2010) analyse global data covering 101 different countries over the period 1995-2007 and provide evidence that increased diversification is associated with higher risk and lower returns for banks. Nonetheless, starting at low diversification levels, expansion into non-interest activities increases profitability and leads to incremental risk-reducing effects. For China's banking sector, Berger et al. (2010) report a diversification discount, driven by the fact that Chinese banks lack managerial expertise and suffer diversification discounts due to misaligned incentive systems that don't favour shareholder wealth. Stiroh (2004a) results for the US banking sector over the period 1984-2001 indicate that an increase in non-interest income does not necessarily lead to diversification benefits, but rather increases the volatility of bank earnings and reduces risk-adjusted profits. Moreover, banks with a higher share of non-interest income tend to be riskier. Stiroh (2004b) using US commercial bank data 1984-2000, confirms that diversification into non-interest businesses reduces both profitability and risk, but indicates positive impacts of diversification within a business. Empirical evidence by Stiroh and Rumble (2006) shows that diversifying revenue sources does not automatically lead to higher returns or lower risk for US Financial holding companies, arguing that the cost of increased participation in volatile activities exceeds the diversification benefits. While for US commercial banks DeYoung and Roland (2001) find that rising net-interest income enhances earnings volatility, DeYoung and Rice (2004) document a significant positive relationship of non-interest income with profitability, but a negative effect on risk-adjusted profitability. Additionally, they point out a common misunderstanding of non-interest income by identifying payment services, a traditional banking service, as the main component of non-interest income. Contradicting the findings described above, Shim (2013) studies data on US bank holding companies and concludes that more diversified banks with a broader range of income sources tend to be less exposed to insolvency risk. Regarding capital, income diversification allows banks to save capital by reducing portfolio risks. According to Goddard et al. (2008) income diversification was found to be particularly beneficial for large US credit unions.

Besides the US evidence, Kim et al. (2020) use a dataset of global commercial banks from 34 OECD countries covering a ten-year period from 2002 and identify a non-linear relationship (inverted U-shape), implying that excessive diversification negatively affects banks' financial stability, while increasing low levels of diversification improves stability. Additionally, diversification has a differential impact on financial stability during financial crisis periods compared to non-crisis periods. Sanya and Wolfe (2011) study 226 listed banks from 11 emerging markets and reveal that diversification increases risk-adjusted profitability and reduces the risk of insolvency. In particular, both diversification across and within interest and non-interest activities generated these benefits. The study of Meslier et al. (2014) confirms a significant positive impact of diversification on bank profitability for emerging market banks.

Looking at the European banking sector, Mercieca et al. (2007) find no clear diversification benefits for small European banks in the period 1997-2003, but rather a negative relationship between non-interest income and risk-adjusted performance. Consequently, small banks are advised to focus on existing businesses where they have a comparative advantage. Lepetit et al. (2008a) show a significant risk-enhancing effect for the European banking sector, measured by an increase in fee and commission income. Nonetheless, the results cannot be generalised to other non-interest income, as trading can reduce risk even for small institutions. Based on the analysis of 412 French banks over the period 2002-2012, Jouida et al. (2017) report a negative impact of income diversification on profitability. Examining the impact of diversification on the systemic risk of European banks, De Jonghe (2010) finds that diversified banks with higher non-interest income are more exposed to systemic risk in adverse economic conditions. Thus, income diversification does not automatically increase the stability of the banking sector in times of crisis. In contrast, Baele et al. (2007) confirm a positive effect of diversification on the market valuation of EU banks over the period 1989-2004, but find a significant negative relationship between diversification and idiosyncratic bank risk, while showing a positive effect in terms of systemic bank risk. The study by Brighi and Venturelli (2016) examines the impact of income and geographic diversification on profitability and bank risk during the financial and sovereign debt crises for 491 banks in Italy over the period 2006-2012. The results suggest that income diversification has a negative impact on bank profitability. In contrast, the evidence on bank risk suggests that greater diversification of functions is associated with lower risk for banks, particularly in the period of the financial and debt crisis. This effect can be explained by the massive drop of interest margins in the wake of the financial crisis 2008. Chiorazzo et al. (2008) find a significant positive effect for interest income generating activities in terms of risk-adjusted profitability for Italian banks. However, diversification gains decrease as bank size increases. Using data from 15 European banks over the period 2002-2011, Köhler (2015) shows that an increase in non-interest income can stabilise small banks, such as savings banks, while decreasing the stability of investment-oriented banks. However, the underlying business model of a bank must be taken into account when assessing diversification effects. Busch and Kick (2015) illustrate for the German banking sector in the period 1995-2011 a significant positive effect on the profitability of the commercial, savings and cooperative banking sector. However, the growth in profitability is associated with higher earnings volatility – it should be mentioned that this is mainly true for commercial banks and that the effect is much smaller for savings banks and cooperative banks. Köhler (2014) examines the impact of income diversification on bank risk for German banks between 2002 and 2012 and identifies the bank's business model as a crucial factor. In particular, traditional retail banks that focus on lending and deposit-taking activities can increase their stability by increasing non-interest income activities. Thus, investment-oriented banks become more risky by further increasing their non-interest income activities. In addition, Köhler (2018) confirms the risk-reducing effect and reports further a significant positive relationship between fee and commission income and risk-adjusted profitability for the German savings bank sector over the period 2002 to 2014. In contrast, the loan portfolio analyses of 983 German bank in the period 1996-2002 reveals a significant negative relationship of diversification and profitability (Hayden et al. (2007)).

The literature review suggests that the impact of income diversification on banks' profitability and risk has been studied across a wide range of countries and business models. Surprisingly, given the large number of banks headquartered in Germany, particularly the regional savings banks and credit unions, little research has been done on the impact on the German banking sector. Additionally, recent developments following the financial crisis 2007 and the European sovereign debt crisis, namely regulatory reforms (Basel III) and falling interest rates, are not fully reflected in the studies described above. As a result, there is a lack of research using recent data in the area of income diversification of German banks. To address this research gap, the study focuses on the effects of income diversification for German savings banks.

4.2.3 Hypothesis

The business activities of the savings banks are regulated by the four identity characteristics, described briefly in the following. First, the public mandate is the fundamental principle of the Savings Banks Act and characterises the business activities of savings banks. The basic idea of the pubic mandate is to provide banking services to the wider public. Initially, these included mainly the provision of traditional investment opportunities such as savings deposits and the granting of loans. Over the years, services such as cashless payment transactions and the distribution of supranational capital market products were added.

Secondly, profit generation is not defined as the main purpose of the business activity, but rather ensures the fulfilment of the public mandate (Reinhard (2018)). Thirdly, the regional principle limits the scope of action of savings bank to avoid competition between savings banks (Stiele (2009)).[1] Fourth criterion is the so-called "association orientation" ("Verbundorientierung"). This defines the organisational structure of the Sparkassen-Finanzgruppe. In concrete terms, each savings bank is member of a respective savings banks association and shareholder of their leading institut ("Landesbank"). This association structure supports savings banks in fulfilling their public mandate according to the principle of subsidiarity. The above-mentioned identity characteristics restrict business activities both geographically and in terms of business areas (e.g. capital market transactions). However, notwithstanding the described savings bank-specific barriers in terms of diversification opportunities and effects, the diversification topic is still important for savings banks.

Over the past decade, many challenges confronted German banks in general and savings banks in particular: historically low interest rates, increasing regulatory requirements and changes in customer behaviour due to the ongoing digitalisation process are putting pressure on the profitability (Willeke (2018)). However, the previous named four identity characteristics limit the range of countermeasures that can be taken. Savings banks can only try to overcome their profitability deficits by improving their efficiency through mergers as well as by generating new sources of non-interest income. In this context, it should be noted that the number of savings banks in Germany has more than halved since the early 1990s, from 782 to 385 institutions in 2018. However, the internet and associated digital payment platforms have limited the ability to increase fees for payment transactions (Köhler (2014)). For example, savings banks face increasing competition from direct banks such as ING Diba, which offer basic banking services at a lower cost or even free-of-charge because these banks operate without a costly branch network. Moreover, within the non-interest income sources, the commission business (e.g. corporate and investment banking) has historically been less profitable for savings banks than for large capital market-oriented banks. Naturally, it seems attractive to use existing business relationships to promote cross-selling in the form of securities or insurance products and to increase fee and commission income, but the efforts to raise non-interest income are costly e.g. hiring qualified staff is essential to work in the non-interest business (DeYoung and Roland (2001)). On top of that, non-interest income tends to be more volatile than traditional income sources (Stiroh and Rumble (2006)).

[1] The well-known exceptions to the regional principle, such as in the case of Sparkasse KölnBonn and Kreissparkasse Köln, are not discussed further at this point.

In summary, it appears that the legal requirements do not allow savings banks to fully realise potential diversification benefits. Also, worth noting are the costs of complying with regulatory requirements relating to investment advice and the related training of staff. Especially, violations against the extensive investment advice regulations could result in compensation payments. Thus, the small diversification benefits achieved are offset by significant costs. As a consequence, theoretical frameworks favouring diversification such as portfolio and financial intermediation theory seems to be inapplicable. Thus, I expect a negative relationship of diversification and profitability for savings banks, leading to the following hypothesis:

Hypothesis 1 *An increase in the share of non-interest income lowers the profitability of German savings banks.*

Lepetit et al. (2008b) find out that banks with a higher share of fee based business tend to issue loans with a lower interest rate. The rational behind this “loss leader hypothesis” is to attract new customers and enhance cross-selling potential. As a result, this leads to a rising underestimation of risk with an increasing exposure to non-interest income. Additionally, the empirical evidence of higher earnings volatility associated with non-interest income highers bank risk. These considerations result in the following hypothesis:

Hypothesis 2 *An increase of the non-interest income share raises the risk of German savings banks.*

4.3 Data, Variables and Empirical Approach

4.3.1 Sample and data

The database consists of annual balance sheet and income statement information. Focussing on savings banks provides a noticeable advantage as all institutions are reporting in accordance with the national accounting standards (HGB), ensuring the comparability of the results. Given the high standard and quality of the information published in the financial statements, the data base is not winsorised. Following Chiorazzo et al. (2008), in order to ensure the comparability of the diversification measure, negative values of net-interest income and net non-interest income are eliminated. Thus, if the value is negative, the bank is not included in the regression in the respective year. This is required to ensure that the diversification indicator is comparable and ranges between 0.0 and 0.5. Moreover, the savings bank sector has also been affected by a number of mergers in recent years. In order to take the merger situation into account, the procedure of Busch and Kick (2015) is applied. More specifically, the merging banks are included separately until the year before the merger and the resulting institution is included as from the merger year onwards. This approach guarantees that mergers are adequately captured and that the dataset is not affected by a survivorship bias. Nevertheless, this leads to an unbalanced panel structure, as it is not possible to observe each bank over the entire period. In total, the database comprises 459 German savings banks over the period 2009-2018.

4.3.2 Diversification measure

Income diversification is the key independent variable for the analysis. In line with Stiroh and Rumble (2006), a modified Herfindahl-Hirschman index is used, distinguishing between interest income and non-interest income. Net-interest income (NET) includes interest income from loans, fixed-income securities, minus interest expenses. Non-interest income (NON) consists of net provisioning income, net trading income and other net non-interest income such as profit transfer agreements ("Gewinnabführungsverträge"). Based on this, the share of net-interest income SH_{NET} and the share of non-interest income (SH_{NON}) are calculated as follows:

$$SH_{NET} = \frac{NET}{NET + NON} \tag{4.1}$$

$$SH_{NON} = \frac{NON}{NET + NON} \tag{4.2}$$

The diversification index (DIV) is used to measure the diversification level of a bank. While DIV ranges from 0 to 0.5, a value of 0.5 indicates a high degree of diversification, while 0.0 means that the bank is completely dependent on a single source of income.

$$DIV = 1 - (SH_{NET}^2 + SH_{NON}^2) \tag{4.3}$$

4.3.3 Dependent variables

Bank's profitability is measured by Return on Assets (ROA). ROA is defined as net income before taxes divided by total assets.[2] Net income is defined as the operating result from ordinary activities.

[2]The calculations have also been checked with previous year's assets in the denominator and average assets over the year. As a result, it becomes obvious that the composition of the ROA denominator has no significant impact on the results of the study.

$$\text{ROA}_{i,t} = \frac{Net\ Income_{i,t}}{Total\ Assets_{i,t}} \tag{4.4}$$

Bank risk is proxied by the regulatory z-score (*Reg-z-score*), which is a accounting based risk measure and a modified version of the well-known z-score (e.g. Boyd et al. (1993), Houston et al. (2010)). The amendment is intended to reflect the importance of regulatory capital in banking practice. Regulatory z-score is calculated as ROA plus the excess to regulatory capital ratio (ERC) divided by the standard deviation of ROA (Esho et al. (2005)). ERC is defined as total capital ratio minus the regulatory solvency ratio of 8%. Total capital ratio is the ratio of own funds to total risk-weighted assets (RWA). Total RWA is the sum of risk-weighted exposure amounts for credit risk, counterparty risk, operational risk, market risk and other risk types (Hartmann-Wendels et al. (2013)). Following the transposition of Basel II into German law by the Solvency Regulation (SolvV), German savings banks are required to publish their total capital ratio in accordance with Section 325 (2) No. 5 SolvV since 2007. The standard deviation of ROA is calculated on a five-year rolling basis. To sum up, this measure indicates the risk that a bank falls below its regulatory capital requirements and runs the danger of regulatory intervention. Thus, the higher the z-score, the more stable the bank.

$$Reg\text{-}z\text{-}score_{i,t} = \frac{(ROA_{i,t} + ERC_{i,t})}{\boldsymbol{\sigma}(ROA_{i,t})} \tag{4.5}$$

4.3.4 Empirical Approach

By combining the approaches of Stiroh and Rumble (2006), Chiorazzo et al. (2008) and Busch and Kick (2015) the following fixed-effects regression model is used to test the effects of income diversification on bank profitability (first hypothesis). Y represents the profitability proxy for bank i at time $t+1$ and is measured by ROA:

$$\begin{aligned} Y_{i,t+1} = {} & \beta_1 DIV_{i,t} + \beta_2 SH^{NON}_{i,t} \\ & + \underbrace{\sigma_1 Asset\ growth^2_{i,t} + \sigma_2 Equity_{i,t} + \sigma_3 LLP_{i,t} + \sigma_4 Loans_{i,t} + \sigma_5 ROA_{i,t} + \sigma_6 Size_{i,t}}_{\text{Bank controls}} \\ & + \underbrace{\gamma_1 \Delta GDP_{s,t} + \gamma_2 CPI_{s,t} + \gamma_3 C2GDP_{s,t} + \gamma_4 HPI_{s,t} + \gamma_5 UNEMP_{s,t}}_{\text{Macro controls}} \\ & + \alpha_t + \mu_v + \epsilon_{i,t} \end{aligned} \tag{4.6}$$

The indices indicate $i = bank$; $t = year$; $s = federal\ state$ ($Bundesland$); $v = Savings\ bank\ association$.

Following the approach of Stiroh and Rumble (2006), β_1 estimates show the effects of income diversification (measured by DIV) on bank profitability. β_2 measures the isolated impact of a SH_{NON}[3] variation on bank profitability, holding the diversification effects (DIV) constant. SH_{NON} is included separately in the regression to account for different bank strategies which would not be visible by considering DIV solely (for example two banks with different SH_{NON} could have the same DIV). In addition, the model includes the following bank controls: in line with Stiroh (2004b) ${Asset_{growth}}^2$ (AG^2) and Equity ratio ($Equity$) are used to account for unseen risk preferences and the financial leverage of banks. Loan Loss Provisions (LLP) are standardized by total loans and indicate the quality of the loan portfolio, while the differences in loan portfolios are captured by loan to assets ratio ($Loans$). ROA reflects the profitability of the previous period. To minimise multicollinearity problems, bank size is approximated by the log of full-time employees ($Size$). Macro-specific control variables are used at the federal state level for GDP growth ($\Delta\ GDP$) measured by the percentage change between to periods. Consumer price inflation (CPI) is a proxy for inflation and house price inflation is captured by the HPI. Financial imbalances such as massive credit expansion is coved by Credit to GDP gap ($C2GDP$) following Kund et al. (2023). Finally, the unemployment rate of the federal state is represented by $UNEMP$.

To avoid unobserved heterogeneity, the model is specified with year (α_t) and savings bank association (μ_v) fixed effects. To ensure unbiased results, one-year lagged independent variables are used to reduce potential endogeneity problems and standard errors are clusterd at bank level. ϵ denotes the error term. The intercept in a fixed-effects model represents the average impact of the independent variables on the dependent variable, assuming that all independent variables are equal to their mean and that the fixed effects are included in the model. This provides a reference point for interpreting the effects and ensures the accuracy of the model.

In order to measure the impact of income diversification on bank risk (second hypothesis), a minor modification of the model presented in Eq. 4.7 is required. In line with the approach of Neitzert and Petras (2022), ROA is replaced by Return on Equity (ROE) as a bank-specific control variable to proxy profitability. X in the following model is the proxy of bank risk, measured by *Reg-z-score*, for bank i at time $t+1$. However, despite the fact that *Reg-z-score* contains ROA, the measure seems suitable for the analysis, because

[3] $SH_{i,t}^{NON}$ is equal to SH_{NON}.

it also accounts for the bank's regulatory capital adequacy and indirectly for the risk adjusted performance.[4] Irrespective of the model extension, the connotations described above remain unchanged.

$$\begin{aligned} X_{i,t+1} = {} & \beta_1 DIV_{i,t} + \beta_2 SH^{NON}_{i,t} \\ & + \underbrace{\sigma_1 Asset\ growth^2_{i,t} + \sigma_2 Equity_{i,t} + \sigma_3 LLP_{i,t} + \sigma_4 Loans_{i,t} + \sigma_5 Size_{i,t} + \sigma_6 ROE_{i,t}}_{\text{Bank controls}} \\ & + \underbrace{\gamma_1 \Delta GDP_{s,t} + \gamma_2 CPI_{s,t} + \gamma_3 C2GDP_{s,t} + \gamma_4 HPI_{s,t} + \gamma_5 UNEMP_{s,t}}_{\text{Macro controls}} \\ & + \alpha_t + \mu_v + \epsilon_{i,t} \end{aligned} \tag{4.7}$$

In the appendix, Table (4.6) describes the variables and their sources in detail. Table (4.7) in the appendix reports the correlation between the regressors and the regressands (ROA, *Reg-z-score*) used in the analysis. The majority of the correlation coefficients are small and uncritical from an econometric point of view. Nevertheless, the strong correlation of 0.8130 between SH_{NON} and DIV arises from the fact that non-interest income is a key determinant of the diversification measure. This implies that banks with a higher share of SH_{NON} are more diversified. Considering this correlation, multicollinearity cannot be completely ruled out. Figure 4.1 in the appendix shows the trend in the mean values of SH_{NET}, SH_{NON} and DIV for all banks over time. In particular, it can be seen that SH_{NET} has been decreasing since 2010, accompanied by an increase in SH_{NON}. Given the distribution of SH_{NON} and SH_{NET} on average, it is not surprising that the mean value of DIV is consistently above 0.40. The descriptive statistics of the variables used in this paper is provided in Table (4.8) in the appendix. As the data is collected from audited annual reports, it has not been subject to winsorisation. The variability of some macroeconomic controls is partially limited because these variables are broken down to the level of the federal states.

[4] A similar choice of dependent variables is applied in e.g. Stiroh and Rumble (2006), Mercieca et al. (2007) and Köhler (2014).

4.4 Results

4.4.1 Hypothesis 1

Table (4.1) summarises the results of the fixed-effects regressions investigating the impact of income diversification on banks' profitability proxied by ROA (Model (1-3)). Model (1) runs without any controls. The statistically significant and negative coefficient indicates a decrease in profitability. An omitted variable is suggested in view of the significant constant. In Model (2) the baseline regression is extended with additional bank control variables. The coefficient of DIV remain negative, however with a slightly lower statistical significance. The significant negative coefficients of SH_{NON} suggest a profitability reducing effect by increasing non-interest income activities for German savings banks. In the next step, controls for the macroeconomic environment are included in the regression (Model (3)). In this way, the previous findings are confirmed in terms of effect size and significance. The significant and positive coefficient of lagged ROA, indicates that the increased diversification of savings banks is not a direct consequence of a weak profitability in the previous period. This significant positive correlation between bank size and profitability could be interpreted as economies of scale. Taken together, the results provide empirical evidence of a negative impact of income diversification on the profitability of German savings banks. These findings confirm Hypothesis 1 and are in line with evidence for European banks (e.g. Mercieca et al. (2007), Brighi and Venturelli (2016)) and US studies by Stiroh (2004b) and Jouida et al. (2017). One explanation for this finding may be that savings banks are unable to establish non-interest businesses on a permanent basis in the presence of increasing digital competition. Compared to the traditional interest business, the lack of expertise can be another reason for a negative impact on performance. Thus, it seems reasonable to conclude that potential synergies are not fully exploited and that the cost of diversification exceeds the benefits. In sum, the results provide empirical evidence for a negative impact of income diversification on profitability of German savings banks on average.

Table 4.1: Results of the regressions on ROA

	ROA		
	Model 1	Model 2	Model 3
DIV	-0.0034**	-0.0015*	-0.0020**
	(0.0170)	(0.0842)	(0.0131)
SH_{NON}		-0.0011**	-0.0010**
		(0.0260)	(0.0452)
AG^2		-0.0001	-0.0001
		(0.5466)	(0.4463)
Equity		0.0381***	0.0383***
		(0.0000)	(0.0000)
LLP		-0.0021	-0.0065
		(0.8752)	(0.5848)
Loans		-0.0006	-0.0002
		(0.2234)	(0.7393)
ROA		0.3168***	0.3064***
		(0.0001)	(0.0002)
Size		0.0003***	0.0003***
		(0.0000)	(0.0000)
ΔGDP			0.0001**
			(0.0116)
CPI			0.0000
			(0.9159)
C2GDP			0.0005***
			(0.0005)
HPI			-0.0000
			(0.6121)
UNEMP			-0.0000
			(0.4419)
Cons	0.0056***	0.0000	-0.0003
	(0.0000)	(0.9247)	(0.9818)
N	3745	3690	3596
R^2_{adj}	0.0618	0.2595	0.2669

Note: The table above shows the stepwise extension of the regression model examining the impact of income diversification on profitability. Diversification effects on ROA as the dependent variable are shown in Models 1-3. Model 1 depict the univariate regression of the variable of interest, while Models 2 incorporate bank controls, and Models 3 include macroeconomic controls. All independent variable are lagged by 1 year. Results are reported to the 10 % (*), 5 % (**), and 0.1 % (***) significance level. P-values are given in brackets below the coefficients.

Considering that the standard savings bank diversifies by improving SH_{NON}, the approach of Stiroh and Rumble (2006) is used to evaluate the effect in detail. By calculating the first derivative of Y (Eq. 4.7) with respect to SH_{NON}, the following equation is obtained.

$$\frac{\partial Y}{\partial SH_{NON}} = \widehat{\beta_1} \frac{\partial DIV}{\partial SH_{NON}} + \widehat{\beta_2} \tag{4.8}$$

The right-hand side term $\widehat{\beta_1}$ in Equation (4.9) captures the "indirect effect", meaning the impact of a change in the non-interest share (SH_{NON}) induced by a shift in diversification. The effect depends on the sign of $\widehat{\beta_1}$ and the level of SH_{NON}. If the initial level of SH_{NON} is below 0.50, an increase in SH_{NON} will have a diversifying effect, vice versa if the initial level of SH_{NON} is above 0.50. $\widehat{\beta_2}$ captures the "direct effect" on profitability through an increase of SH_{NON}. The total effect, consisting of indirect and direct effect, indicates the overall impact of an increase in SH_{NON} on profitability (Meslier et al. (2014)).

Table (4.2) presents the results for the direct, indirect and net effect on ROA evaluated at the 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} percentiles of SH_{NON}. On average, a 1% increase in SH_{NON} leads to a linear decrease in bank profitability by -0.0009%. The reported indirect effects decrease with the higher level of diversification, but remain negative. In other words, for savings banks with more concentrated revenue sources (10^{th} percentile), the statistically significant negative net effect shows that an increase in SH_{NON} reduces profitability by a larger amount on average compared to savings banks with a higher level of diversification (90^{th} percentile). This evidence supports the explanation that the costs of diversification exceed the financial benefits and indicates that synergies are not fully materialised.

Table 4.2: Impact of a non-interest share change on ROA

	Non-interest share percentile				
	10th	25th	50th	75th	90th
Direct effect	-0.000009**	-0.000009**	-0.000009**	-0.000009**	-0.000009**
	(0.0452)	(0.0452)	(0.0452)	(0.0452)	(0.0452)
Indirect effect	-0.000023**	-0.000020**	-0.000017**	-0.000012**	-0.000007**
	(0.0131)	(0.0131)	(0.0131)	(0.0131)	(0.0131)
Net effect	-0.000033***	-0.000029***	-0.000026***	-0.000021***	-0.000017***
	(0.0002)	(0.0002)	(0.0001)	(0.0001)	(0.0004)

Note: The table above reports the results of the direct, indirect and net effect of ROA regression (Table (4.1) in Model (3)), evaluated at the 10^{th}, 25^{th}, 50^{th}, 75^{th} and 90^{th} percentiles of SH_{NON}. The direct effect is the estimated impact of a 1% increase in the share of non-interest income, whereas the indirect effect represents the estimated impact of a 1% increase in non-interest income on the change in income diversification. Results are reported to the 10 % (*), 5 % (**), and 0.1 % (***) significance level. P-values are given in brackets below the coefficients.

4.4.2 Hypothesis 2

Table (4.3) reports the results for bank risk as dependent variable, proxied by *Reg-z-score*. In the first place, the univariate Model (1) reveals a negative and significant relationship between DIV and bank risk. Integrating bank controls (Model (2)) and macro controls (Model (3)) reinstates the previous finding. These findings suggest that more diversified sources of income increases bank risk measured by the *Reg-z-score*. Additionally, the negativ significant coefficient of SH_{NON} in Models (2) and (3) imply that a shift to non-interest income is associated with a decrease in bank stability. This finding is in line with the research of Stiroh and Rumble (2006) and Baele et al. (2007), who showed that greater diversification increases bank risk.[5] The result can be interpreted and explained in several ways. First of all, the observed effect can be attributed to the characteristic volatility of non-interest income. An alternative explanation could be that the profit-reducing effect of increased non-interest activities, as shown in Hypothesis 1, reduces the stability of savings banks on average. Another possible reason is the moral hazard risk of diversification, as theorised by Dewatripont and Mitchell (2005) and Freixas et al. (2007). According to their models, diversification provides an incentive for banks to extend the protection of deposit insurance to riskier activities. The incentive becomes clear in the light of the institutional protection scheme for the Savings Banks Group. The deposit guarantee scheme ensures unlimited depositor protection and a de facto inability of institutions to become insolvent. Taken together, the evidence suggests that, on average, the risk of German savings banks increases as it becomes more diversified into non-interest activities.

This creates an inherent incentive for savings banks to grant riskier loans or to offer aggressive investment advice. In particular, the statistically highly significant and negative coefficients on LLP and *Loans* suggest that savings banks tend to issue comparatively riskier loans, which might also have an negative impact on bank stability.

[5] Given the previously mentioned variation of the *Reg-z-score* variable, a detailed effect-breakdown into direct and indirect effects will not be analysed here. An alternative effect decomposition is carried out in the robustness checks (Section 4.5).

Table 4.3: Results of the regressions on the regulatory z-score

	Reg-z-score		
	Model 1	Model 2	Model 3
DIV	-169.9933**	-152.1337*	-170.7363**
	(0.0394)	(0.0549)	(0.0313)
SH_{NON}		-81.4767***	-67.2402**
		(0.0098)	(0.0292)
AG^2		18.6281	18.2793
		(0.2525)	(0.2605)
Equity		276.0309	320.1677
		(0.4972)	(0.4529)
LLP		-2872.9863***	-2926.9179***
		(0.0001)	(0.0003)
Loans		-249.4749***	-232.4840***
		(0.0001)	(0.0001)
ROE		-75.8089	-109.4530
		(0.4094)	(0.2733)
Size		7.0376	7.8529*
		(0.1077)	(0.0834)
ΔGDP			-3.1723
			(0.3047)
CPI			25.9617*
			(0.0866)
C2GDP			6.7389
			(0.6024)
HPI			-6.6300
			(0.1842)
UNEMP			6.5393
			(0.4123)
Cons	202.8268***	337.2142***	-2142.0266
	(0.0000)	(0.0000)	(0.1356)
N	3745	3690	3596
R^2_w	0.1110	0.1283	0.1247

Note: The table above shows the stepwise extension of the regression model examining the impact of income diversification on bank risk. Diversification effects on *Reg-z-score* as the dependent variable are shown in Models 1-3. For the variables of interest, Models 1 depict the univariate regression of the variable of interest, while Models 2 incorporate bank controls, and Models 3 include macroeconomic controls. All independent variable are lagged by 1 year. Results are reported to the 10 % (*), 5 % (**), and 0.1 % (***) significance level. P-values are given in brackets below the coefficients.

4.5 Robustness

Testing Hypothesis 1 showed a statistically significant negative relationship of income diversification and profitability. Further, a negative and significant effect of income diversification on the risk of German savings banks is observed by testing hypothesis 2. In order to verify the robustness of the previous results, a series of additional robustness checks are conducted.

First, the variables of interest are replaced by the identical variable both with and without a two-year lag. This procedure should ensure that the results are not driven by the selection of the lag. Table (4.4) illustrates the results for ROA and Reg-z-score as dependent variable. DIV remains negative and highly significant in the ROA regression without lag (Model 1), while the significance is slightly lower in the two-year lagged ROA model (Model 2). SH_{NON} remains negative and significant. Similar results are found for bank risk measured by *Reg-z-score*. Here, a significant negative effect is observed for the model without a lag (Model 4) and the two-years lag model (Model 5). Notably, the significance of SH_{NON} is at the 5% level in both models. To conduct further robustness checks, the database is extended in a second step. The regression for ROA is extended by three-years and covers the period 2006-2018 including the financial crisis of 2007 (Model 3). With the implementation of Basel II in German law via the Solvency Regulation (Section 325 (2) No. 5), the disclosure of the total capital ratio becomes mandatory from 2007 onwards. Nevertheless, 67 savings banks did not fulfil the publication requirement in 2007 (disclosure rate of approx. 85%). To compensate missing data of institutions, the growth rate of the total market and the growth rate of each institution's total capital ratio started at the time of the first publication. To calculate the growth rates of all published total capital ratios, the average value of the total capital ratios for each year was calculated to derive an annual growth rate. By using the calculated growth rates, it is possible to estimate the missing ratios on an institution-specific basis. The first published ratio for each institution is used as a starting point, and the calculated growth rate for the year is applied retrospectively. This allows to perform robustness tests for the *Reg-z-score* in the years 2007-2018 (Model 6). By doing so, the previous results for ROA and *Reg-z-score* are also confirmed by the expansion of the database. It should be noted that the retrospective calculation of institution-specific capital ratios using the average growth rate carries the risk of smoothing out institution-specific variations. This means the assumption that institutions will behave like on average might reduce the validity of the results in Model (6). In sum, the presented robustness checks indicate a profitability reducing effect of an increased reliance on non-interest income, in line with hypothesis 1, and a risk-enhancing effect on bank risk (hypothesis 2).

Table 4.4: Robustness I

	ROA	ROA	ROA	Reg-z-score	Reg-z-score	Reg-z-score
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
DIV	-0.0038***	-0.0014*	-0.0019**	-175.7862**	-210.1280***	-127.2129**
	(0.0003)	(0.0662)	(0.0128)	(0.0138)	(0.0055)	(0.0476)
SH_{NON}	-0.0013**	-0.0012**	-0.0007*	-75.8897**	-62.2063**	-68.7349***
	(0.0320)	(0.0263)	(0.0647)	(0.0256)	(0.0463)	(0.0087)
AG^2	-0.0000	0.0000	-0.0001	-26.7834***	-11.9322*	21.6954
	(0.8838)	(0.7739)	(0.3759)	(0.0008)	(0.0763)	(0.1875)
Equity	0.0776***	0.0314***	0.0358***	324.4215	371.2123	482.4846
	(0.0000)	(0.0000)	(0.0000)	(0.4339)	(0.3842)	(0.2032)
LLP	-0.0888***	0.0155	0.0077	-2352.0862***	-2898.2937***	-2934.2180***
	(0.0000)	(0.2012)	(0.4235)	(0.0036)	(0.0002)	(0.0024)
Loans	-0.0011*	-0.0003	0.0000***	-233.3716***	-200.3619***	-170.2184***
	(0.0823)	(0.5688)	(0.9290)	(0.0001)	(0.0012)	(0.0023)
ROA		0.3781***	0.3251***			
		(0.0000)	(0.0000)			
ROE				-77.9728	-29.5021	-107.3978
				(0.4825)	(0.7319)	(0.1630)
Size	0.0004***	0.0003***	0.0002***	7.0669	6.0199	5.5919
	(0.0000)	(0.0000)	(0.0000)	(0.1218)	(0.1701)	(0.1331)
ΔGDP	-0.0000	-0.0000	0.0001***	-0.7527	-1.3133	-2.0850
	(0.9888)	(0.2056)	(0.0010)	(0.6150)	(0.3053)	(0.4811)
CPI	0.0002	0.0002	-0.0002**	9.4263	12.4156	-23.1456
	(0.3672)	(0.1125)	(0.0179)	(0.5100)	(0.4139)	(0.4154)
C2GDP	0.0001	-0.0005	0.0003**	8.7419	23.5672**	52.3997
	(0.5087)	(0.1487)	(0.0255)	(0.4673)	(0.0260)	(0.1461)
HPI	-0.0001	-0.0001*	0.0000	-6.1677	-4.5853	-2.7984
	(0.1103)	(0.0982)	(0.8943)	(0.1938)	(0.3690)	(0.6513)
UNEMP	0.0001	0.0001	0.0000	5.4267	7.2784	8.2697
	(0.4847)	(0.4547)	(0.6013)	(0.4930)	(0.3266)	(0.2482)
Cons	-0.0142	-0.0209	-0.0203**	-548.4453	-831.1845	2499.5573
	(0.3943)	(0.1220)	(0.0170)	(0.6906)	(0.5612)	(0.3406)
N	3699	3526	4755	3667	3526	4755
R^2_{adj}	0.2739	0.2800	0.3271	0.1458	0.1822	0.0841

Note: The results of the robustness checks are shown in the table above. For ROA as the dependent variable, Model 1 is estimated without lagged independent variables, while Model 2 is specified with a two-year lag. The ROA regression in Model 3 is prolonged to the period 2006-2018. Regarding Reg-z-score Model 4 is fitted without lags, whilst Models 5 includes a two-year lag. In Model 6 the analysed data covers the period 2006-2018. Results are reported to the 10 % (*), 5 % (**), and 0.1 % (***) significance level. P-values are given in brackets below the coefficients.

Secondly, following Schulte and Winkler (2019) and Neitzert and Petras (2022), the Reg-z-score is divided into changes associated with ROA and changes with ERC. The first part can be interpreted as risk-adjusted ROA.

$$Reg\text{-}z\text{-}score^{ROA}_{i,t} = \frac{ROA_{i,t}}{\boldsymbol{\sigma}(ROA_{i,t})} \tag{4.9}$$

Therefore, the second part of Reg-z-score is a measure of risk-adjusted ERC.

$$Reg\text{-}z\text{-}score^{ERC}_{i,t} \frac{ERC_{i,t}}{\boldsymbol{\sigma}(ROA_{i,t})} \tag{4.10}$$

Third, for example, Houston et al. (2010) and Köhler (2014) logarithmise the dependent variable z-score to avoid possible biases due to scatter of values. Consequently, to reduce possible problems of heteroscedasticity, the variable Reg-z-score is logarithmised and used to verify the robustness of the results.

Table (4.5) reports the results of splitting Reg-z-score into risk-adjusted ROA (Model 1) and risk-adjusted ERC (Model 2) as well as the logarithmising of Reg-z-score (Model 3). A negative and statistically significant impact of DIV can be recognised in all three models and confirms the results of the initial regressions. In sum, the presented robustness checks indicate a profitability reducing effect of an increased reliance on non-interest income, in line with hypothesis 1, and a risk-enhancing effect on bank risk (hypothesis 2).

Table 4.5: Robustness II

	Reg-z-score^{ROA}	*Reg-z-score*^{ERC}	*ln*(*Reg-z-score*)
	Model 1	Model 2	Model 3
DIV	-4.9784**	-165.7579**	-1.2296**
	(0.0364)	(0.0322)	(0.0172)
SH_{NON}	-2.2295**	-65.0106**	-0.4357
	(0.0345)	(0.0311)	(0.1470)
AG^2	0.7172	17.5622	0.0252
	(0.3834)	(0.2549)	(0.5933)
Equity	37.1504**	283.0173	-0.1980
	(0.0206)	(0.4924)	(0.9390)
LLP	-53.3537**	-2873.5642***	-22.2637***
	(0.0201)	(0.0002)	(0.0000)
Loans	0.3858	-232.8698***	-1.7475***
	(0.8500)	(0.0001)	(0.0000)
ROE	14.9358***	-124.3888	-1.0121
	(0.0002)	(0.1994)	(0.2274)
Size	0.6701***	7.1827	0.0469
	(0.0000)	(0.1033)	(0.1686)
ΔGDP	-0.0124	-3.1599	0.0008
	(0.8822)	(0.2941)	(0.9240)
CPI	0.7421	25.2196*	0.1921**
	(0.1207)	(0.0869)	(0.0220)
C2GDP	0.2391	6.4998	-0.0087
	(0.6073)	(0.6043)	(0.9022)
HPI	-0.0012	-6.6288	0.0293
	(0.9927)	(0.1741)	(0.2458)
UNEMP	0.1409	6.3984	0.0750**
	(0.4212)	(0.4144)	(0.0265)
Cons	-71.5619	-2070.4645	-13.3361*
	(0.1166)	(0.1380)	(0.0962)
N	3596	3596	3596
R^2_w	0.0922	0.1272	0.2759

Note: The results of the robustness checks are shown in the table above. Model 1 includes the ROA term of *Reg-z-score*, while Model 2 includes the EHC term. In Model 3 the natural logarihm of *Reg-z-score* is applied. Results are reported to the 10 % (*), 5 % (**), and 0.1 % (***) significance level. P-values are given in brackets below the coefficients.

Taken together, the presented robustness checks highlight a profitability reducing effect of an increased reliance of non-interest income and a enhancing effect on bank risk.

4.6 Conclusion

The financial crisis of 2007 marked a turning point for the global financial and banking system. The regulatory framework for banks was adjusted in response to the financial crisis. In 2014, the Basel III framework was introduced and banks faced much higher regulatory capital requirements, in terms of quantity and quality. Nearly at the same time, the decade-long period of low interest rates began, putting even more pressure on banks' profits. In order to stabilise their earnings, most banks diversified their income sources by expanding into non-interest activities such as commissions and fees. Whilst this approach seems intuitive, there is no guarantee that diversification will lead to the desired effect in terms of profitability and risk. This tendency is confirmed by mixed results in this research area.

Build on the literature on the benefits and costs of diversification in the banking sector, this paper investigates the impact of income diversification on the profitability and risk of German savings banks. While most research is based on a supranational dataset, this analysis focuses specifically on German savings banks and uses a sample of 459 banks over the period 2009-2018. The analysis shows a significant negative effect of income diversification on profitability on average, which is consistent with corporate finance theory that prefers specialisation over diversification. In addition, the shift to non-interest activities is associated with lower profits. This result is confirmed by a battery of robustness checks. On this basis, the impact of income diversification on bank risk is explored using hypothesis 2. The results show a significant risk-increasing effect, which is robust to a number of additional checks. Again, an increase in non-interest income reduces the stability of savings banks on average. Altogether, the study provides empirical evidence for a diversification discount. One reason for the negative relationship between diversification and profitability can be explained by the specific characteristics of savings banks. Firstly, the scope of action for savings banks is limited by their regulations. As a result, savings banks primarily offer their diversified product portfolio to their core customers, which increases their reliance on one client group. Also, the regional nature of savings banks limits their cross-selling potential. On top of this, the opportunity for geographical diversification in the traditional sense is completely eliminated. Lastly, savings banks do not exploit the full range of non-interest businesses, such as investment banking. Taken together, these effects can result in costs of diversification exceeding benefits for savings banks, which lowers profitability and increases bank risk.

These findings will be of interest to the banking industry and supervisors. In line with Köhler (2015), this paper shows that the diversification strategy cannot be chosen independently of the business model. Regulators and supervisors are mainly interested in the risk implications in order to ensure the long-term stability of the financial system.

Potential limitations of the study are identified. First, multicollinearity problems cannot be completely eliminated. Second, potential biases arising due to the unbalanced panel structure cannot be fully avoided. Finally, due to the lack of data, it was not possible to assess banks' risk using other indicators such as external ratings.

Future research in this field could attempt to verify the findings by using more recent data. This could be of particular relevance in the light of the COVID-19 crisis and the latest interest rate turnaround. In doing so, an in-depth analysis should be carried out in order to identify specific sources of income, such as commission business, as effect drivers for savings banks.

4.7 Appendix

Table 4.6: Used Variables and their Sources

Variable	Description	Source
ROA	Return on Assets	Own Computation:[1]; $\text{ROA} = \frac{\text{Net Income}}{\text{Total Assets}}$
Reg-z-score	Regulatory z-score	Own Computation:[1]; $\text{Reg-z-score}_{i,t} = \frac{(ROA_{i,t} + ERC_{i,t})}{\boldsymbol{\sigma}(ROA_{i,t})}$
DIV	Income Diversification	Own Computation:[1]; $\text{DIV} = 1 - (\text{SH}^2_{NET} + \text{SH}^2_{NON})$
SH_{NET}	Share of net-interest income	Own Computation:[1]; $\text{SH}_{NET} = \frac{\text{NET}}{\text{NET + NON}}$
SH_{NON}	Share of non-interest income	Own Computation:[1]; $\text{SH}_{NON} = \frac{\text{NON}}{\text{NET + NON}}$
NON	Net non-interest income	Own Computation.[1]
AG^2	Asset-growth square	Own Computation:[1]; $\text{AG}^2 = \text{Asset}^2_{growth}$
Equity	Equity ratio	Own Computation:[1]; $\text{Equity} = \frac{\text{Equity}}{\text{Total Assets}}$
LLP	Loan Loss Provisions	Own Computation:[1]; $\text{LLP} = \frac{\text{Loan Loss Provisions}}{\text{Total Loans}}$
Loans	Loans to Asset ratio	Own Computation:[1]; $\text{Loans} = \frac{\text{Loans}}{\text{Total Assets}}$
ROE	Return on Equity	Own Computation:[1]; $\text{ROE} = \frac{\text{Net Income}}{\text{Equity}}$
Size	Company size	Own Computation:[1]; $\text{Size} = \ln\Big(\text{Full-Time Employees}\Big)$
ΔGDP	Annual growth rate of GDP per federal state	Statistische Ämter der Länder (Reihe 1 Band 1)[2]
CPI	Consumer Price Inflation	Destatis (Code 6111-0010)[3]
C2GDP	Credit to GDP gap	BIS credit-to-GDP gap statistics[4]
HPI	Housing Price Inflation	Own Computation:; Destatis (Code 61261-0015)[3]
UNEMP	Unemployment Rate of the federal state	Destatis (Code 13211-0007)[3]

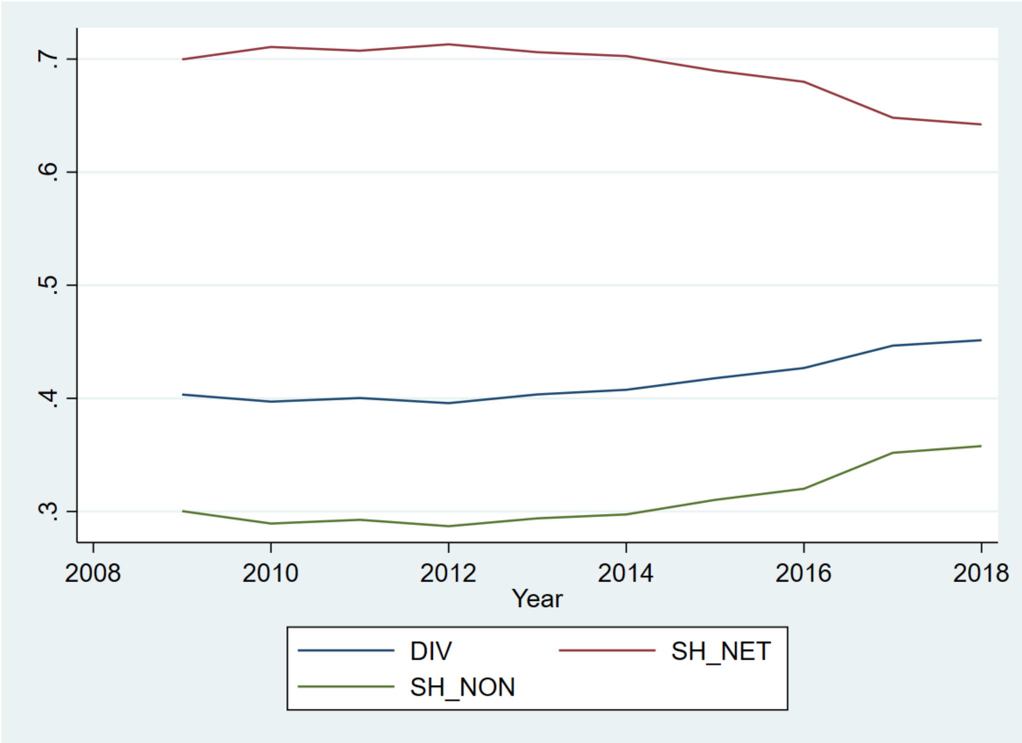
Note: (1) as obtained from annual financial statements. (2) as obtained from the website of Statistische Ämter der Länder. (3) as obtained from the Statistisches Bundesamt (Destatis). CPI of Hamburg and Schleswig-Holstein were extrapolated from 2006 to 2015. The value of Housing Price Inflation for Germany has been allocated in proportion to the population share of the federal states in the total population of Germany. (4) as obtained from the BIS website. The value of C2GDP for Germany has been allocated in proportion to the population share of the federal states in the total population of Germany.

Table 4.7: Correlation Matrix of used Variables

	ROA	Reg-z-score	DIV	SH_{NON}	AG^2	Equity	LLP	Loans	ROE	Size	ΔGDP	CPI	C2GDP	HPI	UNEMP
ROA	1.0000														
Reg-z-score	0.0095	1.0000													
DIV	-0.1408	0.0239	1.0000												
SH_{NON}	-0.1602	0.0149	0.8130	1.0000											
AG^2	-0.0094	-0.0075	0.0054	0.0030	1.0000										
Equity	0.3379	0.0213	-0.0655	-0.1128	-0.0066	1.0000									
LLP	-0.0927	-0.0973	-0.0764	-0.0517	-0.0010	-0.0754	1.0000								
Loans	-0.0754	-0.1413	-0.0773	-0.1406	-0.0006	0.2519	-0.2537	1.0000							
ROE	0.8525	0.0163	-0.1237	-0.1308	-0.0079	-0.1289	-0.0683	-0.2177	1.0000						
Size	0.1473	0.0070	0.0928	0.0310	0.0155	0.0978	-0.0496	0.1087	0.1173	1.0000					
ΔGDP	0.0729	0.0713	0.0532	0.0238	-0.0110	0.0804	-0.3222	0.0424	-0.0376	0.0188	1.0000				
CPI	-0.0821	0.2541	0.2878	0.2265	-0.0030	0.0937	-0.4227	0.1690	-0.1268	0.0048	0.3629	1.0000			
C2GDP	0.0296	0.2267	0.1120	0.0698	0.0163	0.0329	0.1093	-0.2645	0.0394	0.0579	-0.1224	0.2660	1.0000		
HPI	-0.1347	0.1500	0.0820	0.1050	-0.0188	-0.0338	-0.1356	0.3961	-0.1565	-0.0540	0.0393	0.1034	-0.7344	1.0000	
UNEMP	0.0442	-0.0359	-0.0363	-0.0047	0.0020	-0.1962	0.2457	-0.2548	0.1585	-0.1232	-0.2379	-0.3338	0.0025	-0.1345	1.0000

Note: In the table above the correlations between the regressors used in the analyses are shown. The high correlation of DIV and SH_{NON} is noteworthy, indicating that multicollinearity cannot be completely ruled out. Other correlations are relatively small, suggesting that multicollinearity is not a increasingly occuring issue.

Figure 4.1: Descriptive statistics of DIV and its components.



The graph illustrates the development of the variables DIV, SH_{Non} and SH_{Net} over time.

Table 4.8: Descriptive Statistics

	N	Min	$Q_{0.25}$	Median	$Q_{0.75}$	Max	σ
ROA	4,121	-0.0219	-0.0066	0.0042	0.0299	0.0413	0.0022
Reg-z-score	4,086	-1.3440	3.9459	94.3931	1693.0800	3673.0020	161.2532
DIV	3,839	0.0433	0.1332	0.4148	0.4999	0.5000	0.0543
SH_{NON}	3,839	0.0833	0.1218	0.3097	0.9283	0.9779	0.0801
AG^2	4,121	0.0000	0.0000	0.0103	1.4346	14.0641	0.2485
EQ	4,121	0.0208	0.0262	0.0566	0.1069	0.1103	0.0128
LLP	4,118	0.0000	0.0000	0.0015	0.0334	0.0512	0.0044
Loans	4,121	0.1845	0.2209	0.6116	0.9027	0.9224	0.0171
ROE	4,119	-0.2606	-0.1216	0.0514	2.8590	9.3327	2.0345
Size	4,060	3.6109	3.6889	5.9089	8.5759	8.6526	0.8565
ΔGDP	4,121	-9.4464	-9.4464	2.7651	8.3273	8.3273	2.8096
CPI	4,031	91.9000	91.9000	98.1383	104.2000	104.2000	3.5194
C2GDP	4,121	-2.7739	-2.7739	-1.0798	-0.0215	-0.0148	0.7576
HPI	4,121	0.6844	0.7015	11.8667	23.9551	23.9551	6.7815
UNEMP	4,121	2.9000	2.9000	6.4567	13.5417	13.5417	2.2856

Note: The descriptive statistics of the variables used in this paper are presented in the table above. The statistics are based on original non-winsorised data. Note that the macroeconomic control variables were allocated at the level of the federal states, thus limiting the variation as reflected in the statistics.

Chapter 5

Corporate Social Responsibility and Bank Risk ◆

5.1 Introduction

Sustainability has become one of the most pressing issues for society (United Nations (2015)). Movements such as 'Fridays for Future' have recently contributed to the publicly perceived relevance of this topic in the context of climate change. However, the actual meaning of the term 'sustainability' remains unclear. A widely recognised definition of sustainability is a broad understanding of the term, one that is not only limited to ecological issues. For companies, sustainability is often operationalised as their corporate social responsibility (CSR), which is a management concept that integrates environmental, social, and ethical aspects of business operations into decision-making processes (Sassen et al. (2016)). Companies' CSR activities can be assessed on the basis of scores for environmental, social, and governance (ESG) performance (Chollet and Sandwidi (2018), Nofsinger et al. (2019)).

Aside from companies' responsibility to society, integrating ESG aspects into business activities can be seen as a form of risk management, whereby companies can reduce their vulnerability to sustainability risks and related financial risks. Due to its distinctive financial intermediation role, the banking industry is particularly exposed to sustainability risks. Banks are not only affected by ESG risks as companies themselves but also by the ESG risks of their clients (Bank of England (2018), EBA (2020)). These risks are

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also reflected in banks' traditional risk categories. In terms of environmental aspects, physical climate risks (e.g. extreme weather events) are comparatively negligible for banks, whereas transitory risks are of utmost interest. For instance, the intended transition to a resource-efficient circular economy provides well-established industries (e.g. brown coal industry) with an uncertain future. As a result, bank financing for these industries is exposed to inherent credit and market price risks ('stranded assets'). Furthermore, neglecting social and ethical standards bears the risk of reputational damage, fines, and consequently higher probabilities of default. Also, well-functioning governance structures ensure suitable business conduct. Risk management theory indicates that CSR activities have a risk-reducing effect (e.g. Godfrey et al. (2009), Bouslah et al. (2013), Sassen et al. (2016)).

Empirical evidence for non-financial companies shows a negative relationship between CSR and firm risk (i.a. Sharfman and Fernando (2008), Jo and Na (2012), Bouslah et al. (2018)). At the same time, especially for banks, the interdependencies of CSR and risk have been sparsely investigated so far (Gangi et al. (2019)). Focussing on banks is relevant, however, because the financial system plays a pivotal role in the economic transformation process to a resource-efficient economy. Financial institutions provide the economy with capital and thus foster long-term economic growth (King and Levine (1993), Levine and Zervos (1998), Beck and Levine (2004)). In this way, financial institutions are essential for the transformation process. What remains unclear is why risk is reduced and what determines the risk reduction.

We address these research gaps by analysing the effects of CSR activities on bank risk in detail. Our study is based on a data set of 582 banks from 2002 to 2018. We use Thomson Reuters' ESG scores to measure banks' CSR, and the granular data enable us to analyse the effects at different levels. Bank-specific characteristics are addressed by using different accounting-based risk measures. In detail, we quantify a bank's default risk as well as its portfolio risk. Our analysis indicates a statistically significant risk-reducing effect for the overall CSR comprising all three pillars. Further, we conduct an in-depth analysis of the relationship between CSR and bank risk by separating CSR into three pillars (ESG) and ten sub-components. By doing so, we provide empirical evidence that the environmental pillar significantly determines the risk reduction. Analysing the effect of the environmental pillar in more detail yields that also individually, all sub-components of the environmental pillar (Environmental Innovation, Emissions, and Resource Use) reduce bank risk. In contrast, the findings for the social and governance pillar are equivocal. Therefore, we conclude that environmental engagement (rather than all three CSR dimensions) influences bank risk. Our results are robust to different model specifications, variable definitions, and winsorisation levels. By analysing the effects of CSR on bank risk in detail, we respond to the suggestions of Gramlich and Finster (2013) by providing specific evidence for the banking sector. In this way, we generate novel insights and contribute to both the strand of bank-specific CSR literature (e.g. Wu and Shen (2013), Cornett et al. (2016), Finger et al. (2018)) and the literature on CSR and firm risk in general (e.g. Oikonomou et al. (2012), Gramlich and Finster (2013), Sassen et al. (2016), Albuquerque et al. (2018)).

The rest of the paper is structured as follows. The subsequent section presents bank-specific CSR literature, enabling us to highlight that the relationship between CSR and bank risk has been a blank spot on the research map so far. Based thereon, we elaborate on the relevant theory to explain the connection between CSR and bank risk. Consequently, we develop our research hypotheses. Section 3 provides a summary of the sample, the dataset, and the methodology applied, while Section 4 presents the results. The findings of several robustness checks are presented in Section 5. Section 6 summarises the main insights and aspects of further research areas.

5.2 Literature and hypotheses

5.2.1 Bank related literature

In times of globalisation and climate change, CSR attracts increasing public interest. However, the term CSR is not universally defined.[1] According to the United Nations, CSR is a “management concept whereby companies integrate social and environmental concerns in their business operations and interactions with their stakeholders. CSR is generally understood as being the way through which a company achieves a balance of economic, environmental, and social imperatives (’Triple-Bottom-Line-Approach’), while at the same time addressing the expectations of shareholders and stakeholders.” (United Nations Industrial Development Organization (2020)).

For banks, CSR is even more important, first, because of their specific business activities and, second, due to the loss of confidence in the wake of the global financial crisis in 2007 (Nandy and Lodh (2012), Marie Lauesen (2013), Hurley et al. (2014)). In contrast to the manufacturing industry, banks primarily offer services (i.e., intangible products). Given the fact that the majority of clients have limited financial literacy, banks’ reputation and trust are valuable assets (Soana (2011)). The grievances that emerged more than ten years ago in the wake of the financial crisis play a crucial role in this context. During that period, governments around the world rescued banks from bankruptcy with taxpayers’ money to avert further negative effects on the financial stability, the real economy, and the society (Bayazitova and Shivdasani (2012), Iannotta et al. (2013), Hryckiewicz (2014)). In this

[1] Related concepts such as e.g. corporate sustainability, corporate social performance, or social performance are subsumed under the term CSR.

light, the business practices of banks with an intention of short-term profit maximisation were at the center of criticism (Wu and Shen (2013)). Nevertheless, even in the post-crisis years, large capital market-oriented banks attracted attention again due to scandals such as the Libor manipulation (Fouquau and Spieser (2015), Köster and Pelster (2017)). Altogether, this resulted in a historical loss of reputation for and trust in the banking sector (Esteban-Sanchez et al. (2017)). For these reasons, there is a particular public interest in banks' CSR.

CSR is also a 'hot topic' in scientific research. A large number of studies have examined the manifold facets and implications of CSR for non-financial companies (Orlitzky and Benjamin (2001), Margolis et al. (2007), Friede et al. (2015)), yet meta- and survey studies state that research on CSR in the financial sector is comparatively rare (Goyal et al. (2013), Gramlich and Finster (2013), Wang et al. (2016)). The majority of these bank-specific CSR studies focus on financial performance.[2] Wu and Shen (2013) examine the impact of CSR on banks' financial performance as well as the deeper motives of the underlying CSR engagement. Based on the bank profit function, which reflects both costs and possible benefits of CSR, they find a positive influence on banks' financial performance. In this context, strategic motives are seen as the primary driving force behind banks' commitment to CSR, whereas CSR activities motivated by greenwashing or altruistic motives generate costs that are not offset by additional financial benefits. In line with these findings, Shen et al. (2016) report empirical evidence that CSR increases the financial performance of banks worldwide. Taking up this research, Cornett et al. (2016) analyse the CSR effects on financial performance for banks around the financial crisis (2007) and report also a significant positive effect on financial performance. Their results are robust to different CSR definitions and performance measures. According to Scholtens and Dam (2007), the financial performance of banks that apply the Equator Principles[3] does not differ significantly from that of non-adopters. Finger et al. (2018) study the effects of the adoption of the Equator Principles on banks' financial performance in industrialised and developing countries, finding no significant improvement in financial performance for banks in developed countries in the short and medium term, but observe a decline in financial performance in the long run for banks in developing countries. In addition, Chen et al. (2018) demonstrate that banks adopting the Equator Principles are stronger in terms of liquidity than non-applying banks.

[2]Financial performance can be measured in different ways. For example, return on assets, return on equity, net interest income, and non-interest income are widely used as indicators of banks' financial performance.

[3]The Equator Principles is a voluntary risk management framework that establishes a commitment of banks to integrate environmental and social aspects into project finance decisions. Since the first application in 2003, almost 100 financial institutions have implemented the Equator Principles.

Aside from the manifold literature on financial performance, from a risk perspective, only Gangi et al. (2019) postulate that banks' insolvency risk decreases as a consequence of their environmental commitment. Obviously, the effects of CSR on bank risk have so far been only sparsely investigated.

5.2.2 Theoretical framework and hypotheses

The relation of CSR and firm risk[4] builds on theory and empirical evidence. From a conceptual point of view, risk management theory provides a framework that suggests the risk-reducing effects of CSR. In general, risk management includes actions like the identification, measurement, control, and mitigation of risks related to business activities. CSR comprises the management of ecological, social, and ethical aspects and influences firm risk in this way (Bouslah et al. (2013), Vishwanathan et al. (2019)).

Given its increasing importance, central banks, the European Commission, and supervisory authorities have continuously called for better integration of sustainability risks[5] in financial institutions' risk management (European Commission (2018), Bank of England (2018), EBA (2019)). In the environmental context, most evident are the numerous risks related to climate change that occur in the transition to a resource-efficient circular economy. This risk category can be subdivided into 'environment-related' risks and 'climate-related' risks. The former category is defined as risks arising from environmental degradation such as pollution, water scarcity, or land contamination, whereas the latter includes physical risks (e.g. extreme weather events) and transitory risks (i.e. policy and legal risks or regulatory changes) (NGFS (2019)). Because of banks' intermediary function, climate-related risks represent additional financial risks. Some examples of transitory risks that affect the traditional bank risk categories would be new political requirements for the transition from brown to green business, the ongoing technological progress, or changes in customer preferences. All of them are associated with potential disruptions that threaten the existence of established technologies and business models (e.g. the replacement of the combustion engine ('brown' business models)) (TCFD (2017), Mies and Menk (2019)). In extreme cases, investments or entire industries lose their earning capacity before the end of their useful life and become 'stranded assets' (e.g. nuclear power plants) (NGFS (2019)). This jeopardises the loan repayment ability of borrowers (credit risk channel). To cope with the additional credit and market price risks, banks can integrate voluntary guidelines (e.g. the Equator Principles, which ensure a closer consideration of sustainability aspects) in their lending practices, adjusting the risk exposures on the balance sheet. Complementary

[4]The term 'firm risk' is generally defined as "risk inherent in a firm's operations as a result of external or internal factors that can affect a firm's profitability" (Jo and Na (2012)).

[5]The term 'sustainability risks' comprises the ESG aspects equally.

to this, natural disasters like the flooding of branches pose an operational risk in the banking context. Moreover, a massive outflow of customer deposits as a consequence of such environmental catastrophes represents an inherent liquidity risk (Bank of England (2018), BaFin (2020)). Banks should be aware of such risks and establish a suitable risk provision.

Besides that, banking yields a social risk dimension as well, involving banks' interaction with employees and customers as well as the social perception of their business activities. Further, banks have to balance the pursuit of profitability with the preservation of ethical aspects (e.g. anti-money laundering, prevention of corruption and terrorism financing, and tax compliance). Specific actions could be the rejection of funding for disreputable sectors such as the arms industry or companies that violate labour and human rights standards, as well as the protection of highly sensitive customer data.

The financial crisis of 2007 was an important reminder of the necessity of functioning governance structures (Laeven and Levine (2009), Srivastav and Hagendorff (2016)). For example, the misbehavior of traders like Kweku Adoboli (UBS) or Jérôme Kerviel (Société Générale) resulted in the loss of billions of euros for their respective banks (Rafeld et al. (2019)). In this way, individual employees can constitute an operational as well as reputational risk. By the adaptation of business ethics policies (like the UN Principles for Responsible Banking), banks could reduce product and business ethics controversies and mitigate the risk of lawsuits and compensation payments (Bouslah et al. (2018)). Beyond this, effective governance structures also comprise clear cut responsibilities and proper compensation models, in a sense to minimise the incentives for misconduct by individual employees, constituting operational as well as reputational risk. Also, for the integration of ESG factors into the bank's daily business, effective governance structures are essential (EBA (2020)).

The examples described above highlight the theoretical relation of bank risk and CSR-related actions. Besides banking, research on non-financial companies has found that higher CSR is associated with lower financial risk (Orlitzky and Benjamin (2001)). Likewise, Luo and Bhattacharya (2009) find empirical evidence for the risk management hypothesis and confirm a negative relationship between CSR and firm risk. Moreover, CSR creates moral capital and goodwill. Particularly in times of crisis, moral capital acts as a protection mechanism and alleviates the negative feedback effects of external events (Godfrey et al. (2009)). In sum, risk management theory indicates that banks anticipate risk at an early stage. Consequently, CSR reduces a bank's vulnerability to financial, operating, environmental, and social risks (McGuire et al. (1988), Feldman et al. (1997), Sharfman and Fernando (2008)).

Based on risk management theory and the empirical evidence for non-financial companies, in Hypothesis 1 we assume that CSR and bank risk are related as follows:

Hypothesis 1 *Overall CSR reduces bank risk.*

Bank risk interacts differently with the various CSR elements, and so a more granular analysis is warranted (Bouslah et al. (2013), Girerd-Potin et al. (2014), Chollet and Sandwidi (2018)). Specifically, this includes the effects of the single CSR pillars (ESG) and the sub-components the three pillars consist of.

As previously described, environmental aspects are associated with bank risk. The environmental pillar is determined by the usage of exhaustible resources, the release of emissions in the business process, and an innovative and sustainable product portfolio. For instance, banks can link their lending practices to environmental criteria. Following risk management theory, a restrictive and selective lending process reduces banks' credit and portfolio risk (Nandy and Lodh (2012)). A lower portfolio risk also implies a lower default risk of the bank, because of more stable income streams. By adjusting the bank's portfolio early to future environmental expectations by law-makers and society, banks can anticipate future needs for adjustment and pre-empt associated costs.

Social aspects are similarly relevant. Components of the social pillar such as working conditions or qualification measures indicate the quality of the bank's endeavors to promote and appreciate its employees and society. Because banking is a servicing business and therefore reliant on good relationships with the workforce and customers, the social performance can have direct implications for the bank's portfolio management performance and risk. As an expression of social responsibility, banks in the United States deferred interest and principal payments for affected borrowers in the aftermath of Hurricane Sandy (BusinessWire (2012)). Similar to environmental engagement, and in line with risk management theory, banks can prevent costly controversies by ensuring social principles in business practice.

Besides, governance practices are seen as particularly important in the context of bank risk (John et al. (2008)). The governance pillar comprises effective management, efficient and transparent decision-making processes, and the involvement of shareholders. Management and shareholders are key actors in the implementation of a sustainability philosophy and strategy. Therefore, consistent with risk management theory, we expect banks with good governance to be less failure-prone and behave in a more disciplined manner concerning their business practices (e.g. portfolio composition and individual misbehavior).

In sum, this raises the following hypothesis:

Hypothesis 2 *Each single CSR-pillar (environmental – social – governance) has a reducing effect on bank risk.*

5.3 Empirical approach

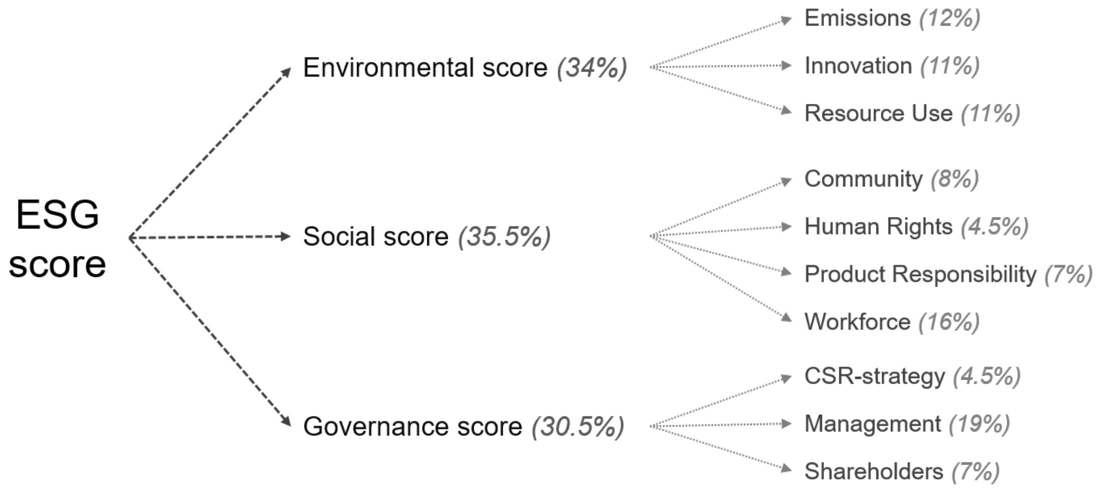
5.3.1 Sample and data

We perform an empirical analysis in order to test the hypotheses stated above. Our initial sample consists of 2,452 banks worldwide, provided by Thomson Reuters' Eikon for the TRBC-sector 'Banking Services'. In total, the sample comprises banks from 115 countries around the world, with nearly a third headquartered in the United States. From the same data source, we collected fundamental data as well as ESG scores on an annual level.

ESG scores are used to quantify banks' CSR. The Thomson Reuters ESG database offers data on 400 different ESG metrics for more than 7,000 companies worldwide, including banks, since 2002. The overall ESG score – indicating the total ESG performance – is composed of three pillars (Environmental – Social – Governance), respectively ten sub-components. The composition of the ESG score is illustrated in Figure 5.1. In contrast to the methodology used for the previous product ASSET 4, the pillars and sub-components are not equally weighted. Instead, their weights depend on the number of available metrics to calculate each sub-component. In total, 178 metrics are considered to calculate the overall ESG score. Because only eight metrics are available for Human Rights and CSR-strategy, these sub-components have the lowest weights in the total score (4.5%). With 34 metrics, information on Management is the most transparent and gets the largest weight in the total score (19%). Each metric is calculated as a percentage rank score (in relation to an industry benchmark). As a data source, Thomson Reuters uses publicly available company-reported information (Refinitiv (2021)).

The availability of the ESG scores is the restricting factor of our time series since they were not available before 2002. In order to enable the calculation of metrics like the standard deviation of return on assets (ROA), we collected additional fundamental data from 1997 to 2002. To control for country-specific effects, we retrieved macroeconomic data from the WorldBank database. Our final dataset comprises longitudinal data on 582 banks from 2002 to 2018. Figure 5.2 in the appendix provides information about the origin of the banks. To ensure that our results are not driven by severe outliers and single erroneous data points, the data is winsorised at the 1^{st} and the 99^{th} percentile. Winsorisation is not applied to dummy variables and data on ESG scores, because they are subject to multiple checks and controls by Thomson Reuters.

Figure 5.1: Composition of the Thomson Reuters ESG score



The graph shows the breakdown of the ESG score into its three pillars and its ten sub-components, as well as their weightings in the total score.

5.3.2 Dependent variable and risk measures

In order to measure the impact of CSR on bank risk, we focus on accounting-based risk measures. This allows us to analyse listed and unlisted banks. In particular, we consider both banks' default risk and portfolio risk.

We approximate default risk by different specifications of the z-score, which compares a bank's ROA plus its capital adequacy ratio (CAR) with the standard deviation of ROA (Boyd et al. (1993), Laeven and Levine (2009)). The CAR is defined as the ratio of equity to total assets (Houston et al. (2010)). We calculate the standard deviation of ROA for rolling windows of five years in our baseline scenario.[6] Thus, the z-score is defined as the number of standard deviations the ROA has to drop below its mean until equity is entirely depleted. In this way, the z-score represents a measure of the risk that a bank becomes insolvent. The higher the z-score, the more secure the bank.

$$z\text{-}score_{i,t} = \frac{(ROA_{i,t} + CAR_{i,t})}{\boldsymbol{\sigma}(ROA_{i,t})} \tag{5.1}$$

Portfolio risk is approximated by the risk density (RD), which is calculated as the amount of risk-weighted assets (RWA) over total assets reported on the balance sheet (Le Leslé and Avramova (2012), Baule and Tallau (2016)). RWA are reported by the banks as a

[6]There is no consensus about the adequate time frame of the rolling window in the literature (Schulte and Winkler (2019)). Five years, however, is a widely recognised horizon. We apply a time frame of ten years in the robustness section as well.

key regulatory indicator necessary to compute risk-sensitive regulatory CARs. In order to compute RWA, banks multiply each asset with a regulatory risk weight. RD is therefore supposed to reflect the total riskiness of a bank's assets.

$$RD_{i,t} = \frac{Risk\text{-}weighted\text{-}assets_{i,t}}{Total\text{-}assets_{i,t}} \tag{5.2}$$

Table (5.10) in the appendix summarises all the variables used in this study. Descriptive statistics on the risk measures based on non-winsorised data are provided in Panel A of Table (5.1).

5.3.3 ESG scores and control variables

We approximate the CSR of a bank by its Thomson Reuters ESG score. Thereby, we differentiate the three pillars constituting the overall score, as well as for each sub-component within each pillar. This enables us to perform an determinant analysis for each of the ten sub-components in order to study the relationship of CSR and risk in more detail.

Descriptive statistics on the ESG score and its three pillars are provided in Panel B of Table (5.1). All the scores, as well as the sub-components, are standardised between 0 and 100. A visible and important insight for the statistical analysis is that the distributions of the scores have variation and are not static. Table (5.11) in the appendix provides additional information on the correlation of the three pillars and the risk measures.

In order to mitigate omitted variable bias, we use several bank- and country-specific control variables in the multivariate regression models. Bank specifics are variables that characterise a particular bank, while macroeconomic variables are not specific to a particular bank but rather to a group of banks (e.g. country-specific). On the bank level, we control for size, capital structure, profitability, and the business model of banks. We approximate size by the natural logarithm of full-time employees (logFTE). We use full-time employees instead of total assets in order to reduce issues with multicollinearity.[7] The bank's capital structure is approximated by the leverage ratio (LR) calculated as liabilities over equity and profitability as return on equity (ROE). Based on the differentiation of business models by Ayadi et al. (2016), we also consider the loans to assets ratio (LoanRatio) and the deposits to assets ratio (DepRatio). On the country level, we control for inflation, GDP-growth ($\text{GDP}_{\text{Cap}}^{\text{Growth}}$), and GDP per capita ($\text{GDP}_{\text{Cap}}$).

[7]The choice of the proxy for size does not affect our results. The explanatory power of our model and the significance of the variables included does not differ substantially compared with the use of log total assets.

Table 5.1: Summary Statistics of Variables Included

VARIABLES	(1) N	(2) min	(3) 25%	(4) 50%	(5) mean	(6) 75%	(7) max	(8) sd
Panel A:								
z-score	4,143	-0.39	16.34	31.10	46.31	57.92	959.86	50.42
RD	2,980	0.06	48.43	63.96	62.59	76.83	579.31	25.56
Panel B:								
ESG score	4,143	12.30	35.20	48.09	50.86	66.46	93.53	18.94
EnvPillar	4,143	7.67	29.29	45.91	51.00	73.75	98.10	24.83
SocPillar	4,143	2.65	34.32	49.40	50.72	66.81	98.01	21.54
GovPillar	4,143	1.72	32.94	51.27	50.85	69.13	99.52	21.81
Panel C:								
logFTE	3,787	1.39	7.80	9.20	9.10	10.36	12.15	1.66
LR	4,143	-16,986,120.31	718.68	1,025.58	-11,862.49	1,569.98	21,030.75	392,593.30
LoanRatio	3,654	0.02	51.15	62.52	60.29	70.19	93.51	14.25
DepRatio	3,661	0.23	60.38	72.17	68.71	80.36	98.76	15.53
ROE	4,143	-10,271.65	9.46	14.20	71.42	19.83	49,600.56	1,556.94

Note: This table provides summary statistics on the variables and data considered in our analyses. The restricting factor is the availability of the ESG scores. The data is winsorised at the 1^{st} and the 99^{th} percentile. Panel A shows the statistics of the risk measures, Panel B of the ESG score and its pillars, and Panel C of the bank specific control variables included

5.3.4 Methodology

In order to study the effect of CSR on bank risk, we apply a series of univariate and multivariate linear fixed effects (FE) regression models. The model is specified as follows:

$$Risk_{i,t+1} = \alpha_i + \boldsymbol{\delta} * ESG_{i,t} + \boldsymbol{\beta} * X_{i,t} + \boldsymbol{\gamma} * Y_{j,t} + \mu_t + \epsilon_{i,t}, \tag{5.3}$$

while X comprises the bank specific variables and Y comprises the macroeconomic variables. The indices indicate: $i = bank$; $j = country$; $t = fiscalyear$.

$Risk_{i,t}$ indicates the observation of one of the risk measures used at time t at bank i. $ESG_{i,t}$ approximates the CSR of bank i at time t, and is specified as the ESG score, one of its three pillars, or one of the ten sub-components. The baseline models consider one year lagged independent variables in order to mitigate endogeneity by a potential reverse causality or simultaneity bias. In Section 5, we consider a two-year lag as well.

The regression models are specified with bank and time FEs, to account for unobserved heterogeneity that may be correlated with the explanatory variables. The Hausman tests suggest that coefficient estimates in fixed and random effects models are not alike (with p-values $< 1\%$), therefore suggesting the rejection of random effects. Robust Huber-

White-sandwich estimates of variance are used for the statistical analysis to account for group-wise heteroscedasticity in the residuals of the regression models (Froot (1989), Williams (2000)).

5.4 Results

Table 5.2: Multivariate Robust FE Regressions of Risk on the ESG score

	(1)	(2)	(3)	(4)	(5)	(6)
	z-score	z-score	z-score	RD	RD	RD
	Coef./se	Coef./se	Coef./se	Coef./se	Coef./se	Coef./se
L.ESG score	0.8061***	0.7749***	0.6176***	-0.1598***	-0.1368*	-0.1572**
	(0.09)	(0.09)	(0.10)	(0.05)	(0.07)	(0.07)
L.logFTE		0.1783	2.2885		-3.9859	-3.2291
		(4.19)	(4.12)		(5.57)	(5.74)
L.LR		-0.0000***	-0.0000***		0.0000	0.0000**
		(0.00)	(0.00)		(0.00)	(0.00)
L.LoanRatio		0.1448	0.1201		0.2757**	0.2782**
		(0.16)	(0.16)		(0.12)	(0.12)
L.DepRatio		0.3383***	0.2507**		-0.0977	-0.1013
		(0.11)	(0.11)		(0.13)	(0.14)
L.ROE		-0.0010***	-0.0006**		-0.0001	0.0000
		(0.00)	(0.00)		(0.00)	(0.00)
L.Inflation			-0.0277			0.0333
			(0.35)			(0.10)
L.GDP_{Cap}^{Growth}			1.2607***			0.3616*
			(0.36)			(0.19)
L.GDP_{Cap}			0.0016			0.0000
			(0.00)			(0.00)
Constant	6.3560	-24.7530	-91.1087*	70.3927***	96.1081	87.9577
	(4.75)	(39.97)	(47.32)	(2.78)	(60.31)	(61.69)
N	3,949	3,200	3,117	2,904	2,674	2,635
R^2_{adj}	0.0413	0.0450	0.0611	0.0059	0.0107	0.0119

Note: The table shows the coefficients and standard errors (in parenthesis) of multivariate robust FE regressions. The dependent variables are the bank risk measures z-score and RD. The independent variables are the ESG score and bank and country specific control variables. The independent variables are 1 year lagged. Significance is denoted at the 10% (*), 5% (**), and 1% (***) significance level. Data is winsorised at the 1^{st} and the 99^{th} percentile.

Table (5.2) summarises the results of panel regressions of bank risk on the overall ESG score as a measure for banks' total CSR. Models 1-3 show the results for the z-score as a measure for default risk, while Models 4-6 illustrate the results for RD as a measure for portfolio risk. Models 1 and 4 depict univariate regression results, without any control variables. The coefficient in Model 1 is positive and statistically significant at the 1% level. This indicates that the ESG score in the previous year increases the z-score and therefore lowers the default risk of the bank. Model 2 includes additional bank-specific control variables, while Model 3 includes country-specific control variables as well. Both coefficients remain positive and highly statistically significant, supporting the result that the ESG score increases the z-score, thereby reducing banks' default risk. Concerning the economical relevance, we interpret that an increase of the ESG score by one unit is associated with a 0.62 higher z-score. The coefficients in Models 4-6 for the effect on RD are all negative and statistically significant. This indicates that CSR reduces the RD (i.e., the portfolio risk of a bank). Model 4 for the univariate results implies significance at the 1% level. The results remain negative and statistically significant if bank-specific control variables are included (Model 5) and if country-specific variables are included (Model 6). An increase of one unit of the ESG score is associated with a decrease of the RD of 0.16 percentage points. Taken together, the results indicate that banks' CSR activities on aggregate reduce the default and portfolio risk. Overall, the results are in line with risk management theory and provide empirical evidence for our first hypothesis.

In Hypothesis 2, we examine the interaction of the various CSR components with bank risk. Tables (5.3)-(5.5) provide the multivariate regression results for each of the three pillars of the total ESG score. For the environmental pillar (Table (5.3)), we find highly statistically significant effects in the univariate Model 1 and Model 4. These results are robust to bank-specific controls (Model 2 and Model 5) and country-specific controls (Model 3 and Model 6) at the 1% level. Consequently, the environmental pillar has a risk-reducing effect on bank risk, as measured by both risk indicators. This is in line with Hypothesis 2.

Table (5.4) illustrates that for the social pillar of the ESG score, the results are not as unanimous as for the environmental pillar. Instead, the results depend on the bank risk proxies. As for the environmental pillar, we find highly significant coefficients in Models 1-3 for the social pillar on the z-score that approximates the banks' default risk. For the coefficients for RD in Models 4-6 approximating portfolio risk, however, we cannot find statistical significance, even though the direction of the coefficients is in line with expectation.

Table 5.3: Multivariate Robust FE Regressions of Risk on the Environmental score

	(1)	(2)	(3)	(4)	(5)	(6)
	z-score	z-score	z-score	RD	RD	RD
	Coef./se	Coef./se	Coef./se	Coef./se	Coef./se	Coef./se
L.EnvPillar	0.5589***	0.5415***	0.4393***	-0.1359***	-0.1296***	-0.1436***
	(0.07)	(0.07)	(0.08)	(0.04)	(0.04)	(0.04)
L.logFTE		0.8016	2.5585		-3.5049	-2.7782
		(4.23)	(4.13)		(5.29)	(5.43)
L.LR		-0.0000***	-0.0000***		0.0000	0.0000**
		(0.00)	(0.00)		(0.00)	(0.00)
L.LoanRatio		0.1412	0.1150		0.2854**	0.2880**
		(0.16)	(0.16)		(0.12)	(0.12)
L.DepRatio		0.3986***	0.2990***		-0.1142	-0.1204
		(0.11)	(0.11)		(0.13)	(0.13)
L.ROE		-0.0010***	-0.0006**		-0.0000	0.0000
		(0.00)	(0.00)		(0.00)	(0.00)
L.Inflation			-0.0440			0.0220
			(0.35)			(0.10)
L.GDP_{Cap}^{Growth}			1.2126***			0.3633*
			(0.36)			(0.19)
L.GDP_{Cap}			0.0016			0.0001
			(0.00)			(0.00)
Constant	18.7935***	-22.5995	-88.3094*	69.2300***	91.9350	83.2806
	(3.52)	(41.21)	(47.69)	(1.94)	(58.49)	(59.38)
N	3,949	3,200	3,117	2,904	2,674	2,635
R^2_{adj}	0.0402	0.0451	0.0622	0.0088	0.0138	0.0153

Note: The table shows the coefficients and standard errors (in parenthesis) of multivariate robust FE regressions. The dependent variables are the bank risk measures z-score and RD. The independent variables are the ESG environmental pillar score (EnvPillar) and bank and country specific control variables. The independent variables are 1 year lagged. Significance is denoted at the 10% (*), 5% (**), and 1% (***) significance level. Data is winsorised at the 1^{st} and the 99^{th} percentile.

Table (5.5) provides the results for the governance pillar of the ESG score. Again, we find highly significant coefficients in Models 1-3 for the governance pillar of the ESG score, while for the RD, we only find statistical significance in the univariate Model 4. The results in Models 5-6, including bank-specific and country-specific control variables, show no statistical significance.

Table 5.4: Multivariate Robust FE Regressions of Risk on the Social score

	(1)	(2)	(3)	(4)	(5)	(6)
	z-score	z-score	z-score	RD	RD	RD
	Coef./se	Coef./se	Coef./se	Coef./se	Coef./se	Coef./se
L.SocPillar	0.5181***	0.4579***	0.2958***	-0.0549	-0.0342	-0.0441
	(0.08)	(0.08)	(0.09)	(0.04)	(0.05)	(0.05)
L.logFTE		4.1909	6.2426		-5.3885	-4.7190
		(4.48)	(4.43)		(5.37)	(5.53)
L.LR		-0.0000***	-0.0000***		0.0000	0.0000**
		(0.00)	(0.00)		(0.00)	(0.00)
L.LoanRatio		0.1876	0.1566		0.2643**	0.2680**
		(0.16)	(0.17)		(0.12)	(0.12)
L.DepRatio		0.3390***	0.2475**		-0.1040	-0.1070
		(0.11)	(0.12)		(0.13)	(0.13)
L.ROE		-0.0009***	-0.0005**		-0.0001	0.0000
		(0.00)	(0.00)		(0.00)	(0.00)
L.Inflation			-0.2096			0.0802
			(0.35)			(0.11)
L.GDP_{Cap}^{Growth}			1.1619***			0.3823**
			(0.36)			(0.19)
L.GDP_{Cap}			0.0018*			-0.0000
			(0.00)			(0.00)
Constant	21.2068***	-48.0482	-119.3424**	64.8943***	104.8033*	99.2207*
	(3.81)	(43.38)	(50.89)	(1.87)	(58.73)	(59.85)
N	3,949	3,200	3,117	2,904	2,674	2,635
R^2_{adj}	0.0236	0.0278	0.0480	0.0006	0.0073	0.0079

Note: The table shows the coefficients and standard errors (in parenthesis) of multivariate robust FE regressions. The dependent variables are the bank risk measures z-score and RD. The independent variables are the ESG social pillar score (SocPillar) and bank and country specific control variables. The independent variables are 1 year lagged. Significance is denoted at the 10% (*), 5% (**), and 1% (***) significance level. Data is winsorised at the 1^{st} and the 99^{th} percentile.

So far, we found that the risk-reducing effect differs between the pillars. In general, all pillars reduce default risk measured by the z-score. In addition, the environmental pillar also affects the portfolio risk with statistical significance. Taken together, the environmental pillar shows the strongest effects in magnitude and significance and is the only pillar with clear and unequivocal effects. However, the identification of single risk drivers within the three pillars is not possible at this stage, thus we explore the risk-reducing effects of the ten sub-components of the total ESG score in the following step. Considering the different

Table 5.5: Multivariate Robust FE Regressions of Risk on the Governance score

	(1)	(2)	(3)	(4)	(5)	(6)
	z-score	z-score	z-score	RD	RD	RD
	Coef./se	Coef./se	Coef./se	Coef./se	Coef./se	Coef./se
L.GovPillar	0.2886***	0.2710***	0.2264***	-0.0727*	-0.0474	-0.0502
	(0.06)	(0.06)	(0.06)	(0.04)	(0.05)	(0.05)
L.logFTE		8.9838*	8.8121**		-5.4582	-4.9101
		(4.57)	(4.40)		(5.15)	(5.30)
L.LR		-0.0000***	-0.0000**		0.0000	0.0000**
		(0.00)	(0.00)		(0.00)	(0.00)
L.LoanRatio		0.2188	0.1741		0.2614**	0.2638**
		(0.16)	(0.17)		(0.12)	(0.12)
L.DepRatio		0.3234***	0.2268*		-0.0936	-0.0959
		(0.11)	(0.12)		(0.14)	(0.14)
L.ROE		-0.0007***	-0.0004**		-0.0001	-0.0000
		(0.00)	(0.00)		(0.00)	(0.00)
L.Inflation			-0.2330			0.0768
			(0.36)			(0.11)
L.GDP^{Growth}_{Cap}			1.2033***			0.3689**
			(0.36)			(0.19)
L.GDP_{Cap}			0.0019*			-0.0000
			(0.00)			(0.00)
Constant	32.8002***	-83.2546*	-141.8616***	65.7275***	105.5128*	100.7562*
	(3.14)	(45.56)	(48.49)	(2.00)	(57.35)	(58.12)
N	3,949	3,200	3,117	2,904	2,674	2,635
R^2_{adj}	0.0098	0.0203	0.0476	0.0021	0.0079	0.0084

Note: The table shows the coefficients and standard errors (in parenthesis) of multivariate robust FE regressions. The dependent variables are the bank risk measures z-score and RD. The independent variables are the ESG governance pillar score (GovPillar) and bank and country specific control variables. The independent variables are 1 year lagged. Significance is denoted at the 10% (*), 5% (**), and 1% (***) significance level. Data is winsorised at the 1^{st} and the 99^{th} percentile.

weights of the ten sub-components, this procedure contributes to the validity of our results and leads to a profound understanding of the effects of the three pillars. The findings for multivariate regressions are depicted in Table (5.6).

The environmental pillar consists of the sub-components Emissions, Environmental Innovation, and Resource Use. The Emissions score reflects a bank's self-commitment to emissions reduction, while Environmental Innovation reflects a bank's capacity to develop and support eco-friendly products and processes, thereby reducing ecological costs for its customers. In the case of banks, this can be the integration of ecological factors into their lending practice (e.g. the Equator Principles) that leads to lower credit risk, which explains the risk reduction (credit risk channel). Lastly, Resource Use measures the efficiency of a firm's resource usage. Given the significances, all three sub-components show a risk-reducing effect, considering the default and portfolio risk. The results are also in line with risk management theory, and the three variables can be interpreted as indicators of managerial sophistication to reduce operative costs and contribute to higher and more stable income. They are also related to lower operational transformation risk and reputation risk. In this way, the sub-components of the environmental pillar reflect aspects of a forward-looking risk management approach. This also confirms our major finding that the environmental pillar as a whole has a risk-reducing effect on bank risk.

The sub-components Community, Human Rights, Product Responsibility, and Workforce are part of the social pillar. The Community score is a proxy of companies' ethical behavior and involvement with the society. However, we find no significance in any model, which means that the sub-component does not affect bank risk. Instead, we find high statistical significance for Human Rights in all six models. Human Rights, therefore, reduces both default risk as well as portfolio risk, and reflects the compliance with human rights and labour protection requirements. By renouncing the financing of, for example, the arms industry or companies with doubtful working standards (e.g. child labour in mines), banks, in particular, can contribute to the worldwide compliance with human rights. Otherwise, disregard potentially causes lawsuits constituting operational risk and severe reputational damage. The interaction is in line with risk management theory. Moreover, Product Responsibility is determined by product quality control programs, a high-quality complaint management service, and the protection of sensitive customer data. However, we find conflicting results for this sub-component. The Workforce score only affects the z-score with high statistical significance. This underlines the value of good working conditions as well as ongoing employee qualification training. Nonetheless, it has no significance for RD. Notably, except for Human Rights, the sub-components of the social pillar do not statistically influence banks' portfolio risk. A reason for this could be the operationalization of the single sub-components by several indicators, which have no or only little influence on banks' RWA. For instance, most of the considered indicators

Table 5.6: Multivariate Robust FE Regressions of Risk Measures on the ten ESG sub-components

	(1)	(2)	(3)	(4)	(5)	(6)
	z-score	z-score	z-score	RD	RD	RD
	Coef./se	Coef./se	Coef./se	Coef./se	Coef./se	Coef./se
L.Env. Innovation	0.3282***	0.3296***	0.2310***	-0.1302***	-0.1315***	-0.1465***
	(0.06)	(0.06)	(0.06)	(0.04)	(0.05)	(0.05)
L.Emissions	0.4007***	0.3618***	0.2880***	-0.0839***	-0.0733**	-0.0800**
	(0.05)	(0.05)	(0.06)	(0.03)	(0.03)	(0.03)
L.Resource Use	0.4639***	0.4279***	0.3644***	-0.0816***	-0.0688**	-0.0726***
	(0.06)	(0.06)	(0.07)	(0.02)	(0.03)	(0.03)
L.Community	0.0808	0.0322	-0.0391	-0.0202	-0.0131	-0.0157
	(0.05)	(0.06)	(0.05)	(0.03)	(0.03)	(0.03)
L.Human Rights	0.3037***	0.2674***	0.1602***	-0.1269***	-0.1165***	-0.1227***
	(0.05)	(0.06)	(0.06)	(0.02)	(0.03)	(0.03)
L.Product Respon.	0.1749***	0.1294**	0.0385	0.0360	0.0509**	0.0510*
	(0.06)	(0.06)	(0.06)	(0.02)	(0.03)	(0.03)
L.Workforce	0.3435***	0.3182***	0.2486***	-0.0396	-0.0310	-0.0374
	(0.05)	(0.05)	(0.06)	(0.03)	(0.04)	(0.04)
L.CSR-strategy	0.2440***	0.1742***	0.0890*	-0.0624**	-0.0482*	-0.0557**
	(0.05)	(0.05)	(0.05)	(0.02)	(0.03)	(0.03)
L.Management	0.1859***	0.1853***	0.1615***	-0.0307	-0.0164	-0.0178
	(0.04)	(0.04)	(0.04)	(0.02)	(0.03)	(0.03)
L.Shareholders	0.0150	0.0096	0.0116	-0.0423*	-0.0326	-0.0031
	(0.04)	(0.05)	(0.05)	(0.02)	(0.03)	(0.03)
Bank controls	No	Yes	Yes	No	Yes	Yes
Country controls	No	No	Yes	No	No	Yes
N	3,949	3,200	3,117	2,904	2,674	2,635

Note: The table shows the coefficients and standard errors (in parenthesis) of multivariate robust FE regressions of risk on the ten different sub-components of the ESG score. Column (1) and (4) provide univariate results. The regression coefficients in column (2) and (5) account for bank specific control variables. Those in column (3) and (6) account for bank and country specific controls. The table shows only the coefficients of the variables of interest. Those of the control variables are not depicted. The independent variables are 1 year lagged. Significance is denoted at the 10% (*), 5% (**), and 1% (***) significance level. Data is winsorised at the 1^{st} and the 99^{th} percentile.

do not influence the lending practice, thus the credit risk channel remains ineffective. Altogether, we find a strong dependence on the specific sub-components considered in the social pillar, even though we do not find any contradicting and significant effects. The inconclusive results for the Workforce score determine the effect of the aggregate social score. Workforce accounts for 16 of 35.5 percentage points, while the unambiguously significant sub-component Human Rights accounts for only 4.5 percentage points.

The governance pillar consists of the sub-components for CSR-strategy, Management, and Shareholders. The CSR-strategy score measures the extent to which a bank communicates its consideration of social and environmental aspects in its decision-making processes and is the only sub-component within the governance pillar that has statistical significance in all six models. This result provides two implications: first, to the extent that talk corresponds with action, the effect can be interpreted as an active approach to managing risk, considering also environmental and social risks in day-to-day business. Second, through CSR reporting, which is part of the CSR-strategy, information asymmetries will be further reduced and risks mitigated. This finding is in line with the literature (Cui et al. (2018)). For the sub-component Management, we observe high statistical significance for the z-score. However, we cannot find any statistical significance for the RD. The Management score measures the extent to which banks' corporate governance follows best practices. Our results indicate that such compliance affects default risk significantly but not portfolio risk. This indicates that good management practices reduce vulnerability to misconduct, which exposes the bank to additional default risk, but is not necessarily reflected in its RWAs. Moreover, the Shareholders score does not have statistical significance concerning the effects on the z-score. Also, it has no statistical significance on RD in Models 5-6, and only in the univariate Model 4 do we observe a low significance at the 10% level. This sub-component identifies the degree of fair treatment and protection of shareholders by the bank, including anti-takeover action. In particular, anti-takeover actions can serve as an intuitive explanation that this sub-component does not have a clear risk-reducing effect. Considering extreme actions like so-called 'poison pills' explains how such action can indeed lead to an increase in portfolio risk as well as default risk. In conclusion, we find mixed results for the sub-components of the governance pillar. The aggregate effect of the governance pillar is, however, dominated by the Management score, which accounts for 19 of 30.5 percentage points. In this way, the Management score explains why the effect of the aggregate governance score is not unambiguously risk reducing.

5.5 Robustness

In order to test the robustness of the results provided above, we perform a battery of additional tests. First, we re-estimate our aforementioned results by substituting all the variables of interest by the same variables with a two-year lag, respectively without any time lag. This should ensure that the effects measured do not depend on the specific time lag considered. Table (5.7) provides the results for the ESG score and its three pillars. As illustrated, the results do not significantly change, and the ESG score remains highly significant for the z-score. For the RD, the ESG score has an even higher significance considering a two-year lag, and the significance for the ESG score without a time lag is slightly lower. The environmental pillar remains significant in all models, independent of the time lag considered. The social pillar remains highly significant for the z-score. For the RD, the social pillar has no significance considering one-year lagged variables, yet it is surprisingly weakly significant at the 10% level in two of three models if the variables are considered without time lag. The governance pillar remains highly significant for the z-score, although for RD it remains insignificant, except for the univariate model.

Second, we apply different levels of winsorisation to the data. We use winsorisation at 5^{th} and the 95^{th} %-percentage levels to account for a broader definition of outliers. Alternatively, we abandon winsorisation and use the original data. These alternative procedures have no material effects on the coefficients of the variables of interest. As Tables (5.12)-(5.15) in the appendix show, however, the explanatory power of the models is higher considering a winsorisation at the 5^{th} and the 95^{th} %-percentage levels. Some control variables gain additional significance as well.

Third, for the regression models performed throughout the study, we used panel OLS regression models with bank and time FEs following the Hausman test. However, the results hold as well if a maximum likelihood estimation model or a random effects estimation model is applied. In the latter case, we also consider the inclusion of additional time-invariate, country-specific control variables like those used by Laeven and Levine (2009): an index of the shareholder rights by Porta et al. (1998), a dummy variable that captures if the country has deposit insurance (from Laeven et al. (2008)), and an index of regulatory oversight of bank capital as well as an index of regulatory restrictions on the activities of banks, both from Barth et al. (2008). Their inclusion does not materially affect the regression models or the effects of our variables of interest – the ESG scores. As another alternative, we specify our regression models with country-FEs instead of bank-FEs. The results are similar to those of our baseline models (Tables (5.2)-(5.5)).

Table 5.7: Multivariate Robust FE Regressions of Risk on CSR. Robustness Tests for Different Time Lags

	(1)	(2)	(3)	(4)	(5)	(6)
	z-score	z-score	z-score	RD	RD	RD
	Coef./se	Coef./se	Coef./se	Coef./se	Coef./se	Coef./se
Without lag						
ESG score	0.7169***	0.6900***	0.5526***	-0.1211***	-0.0838	-0.1020*
	(0.09)	(0.10)	(0.11)	(0.04)	(0.06)	(0.06)
EnvPillar	0.5274***	0.5015***	0.4175***	-0.1100***	-0.1224***	-0.1341***
	(0.07)	(0.07)	(0.08)	(0.03)	(0.03)	(0.03)
SocPillar	0.4465***	0.3495***	0.2013**	-0.0685*	-0.0695	-0.0813*
	(0.07)	(0.08)	(0.09)	(0.04)	(0.05)	(0.05)
GovPillar	0.2366***	0.2235***	0.1798***	-0.0242	-0.0089	-0.0092
	(0.06)	(0.06)	(0.06)	(0.03)	(0.04)	(0.04)
2 years lagged						
L2.ESG score	0.7421***	0.6945***	0.5589***	-0.1700***	-0.1359**	-0.1544***
	(0.09)	(0.09)	(0.10)	(0.05)	(0.06)	(0.06)
L2.EnvPillar	0.5214***	0.4962***	0.4041***	-0.1292***	-0.1082***	-0.1180***
	(0.07)	(0.07)	(0.07)	(0.04)	(0.04)	(0.04)
L2.SocPillar	0.4971***	0.4472***	0.3208***	-0.0817*	-0.0576	-0.0661
	(0.08)	(0.08)	(0.09)	(0.05)	(0.04)	(0.04)
L2.GovPillar	0.2217***	0.2067***	0.1588**	-0.0705***	-0.0402	-0.0388
	(0.07)	(0.07)	(0.07)	(0.03)	(0.03)	(0.03)
Bank controls	No	Yes	Yes	No	Yes	Yes
Country controls	No	No	Yes	No	No	Yes

Note: The table shows the coefficients and standard errors (in parenthesis) of multivariate robust FE regressions of risk on the ESG score, respectively its three pillars. Column (1) and (4) provide univariate results. The regression coefficients in column (2) and (5) account for bank specific control variables, in column (3) and (6) account for bank and country specific controls. The first panel provides results for variables of interest without time lag. The second panel provides results for variables of interest with a 2 years time lag. Significance is denoted at the 10% (*), 5% (**), and 1% (***) significance level. Data is winsorised at the 1^{st} and the 99^{th} percentile.

Fourth, we consider additional country-specific control variables in our baseline models with bank-FEs. In this way, we investigate country specifics and further eliminate potential omitted variable bias. A prerequisite for the inclusion of additional country controls is a certain degree of variance over time, otherwise, they are already absorbed and controlled by the bank-FEs. Following Wu and Shen (2013), we enhance our FE models shown in Tables (5.2)-(5.5) by corruption and banking market concentration. We measure corruption as the perceived corruption provided by Transparency International's Corruption Perception Index. We capture banking market concentration as the share of the assets of the three largest banks per country in the countries' total amounts of banking assets (Bikker and Haaf (2002)). Both variables increase the explanatory power of the regression models. While banking market concentration has no significant effects on the risk measures, corruption significantly increases portfolio risk. That means that the higher the corruption in a country, the higher the share of RWAs on the balance sheet. The effects of the ESG scores or the remaining variables in the regression models are, however, not materially affected by the addition of corruption and banking market concentration. The results that are not depicted here are available upon request.

Fifth, we further investigate whether the effects depend on invariate differences between the banks considered. In this way, we run our FE regression models separately for different sub-samples of our full sample. Our original sample was global, but following Demirgüç-Kunt and Levine (1999), we analyse sub-samples of banks from bank- versus market-based economies. Furthermore, we investigate whether a sub-sample of civil law countries yields different results compared with common law countries, motivated by the results of Miralles-Quirós et al. (2019). In both cases, we do not find elementary differences. These results are also available upon request.

Sixth, we perform specific robustness checks for the measurement of the z-score. In particular, we calculate the z-score using standard deviations of ROA for rolling windows of ten instead of only five years. Even though five years is a widely appreciated window, ten years should yield more reliable inputs. The results are robust to such an alternative calculation as well.

Seventh, analogous to Schulte and Winkler (2019), we separate the z-score into changes associated with ROA and changes associated with the CAR. Such a decomposition yields a measure of the z-score that relates only the ROA to the standard deviation of ROA. This can be interpreted as a risk-adjusted ROA.

$$z\text{-}score_{i,t}^{ROA} = \frac{ROA_{i,t}}{\boldsymbol{\sigma}(ROA_{i,t})} \tag{5.4}$$

On the other hand, the decomposition yields a z-score measure relating only the CAR to the standard deviation of ROA. This can be interpreted as a risk-adjusted CAR.

$$z\text{-}score_{i,t}^{CAR} = \frac{CAR_{i,t}}{\boldsymbol{\sigma}(ROA_{i,t})} \tag{5.5}$$

Table (5.8) illustrates the results for the separate regressions of the risk-adjusted ROA on the overall ESG score in Model 1-3 and for the risk-adjusted CAR in Model 4-6. The effect of the ESG score remains significant in all models. This implies that CSR affects bank default risk through both channels. Table (5.9) provides the coefficients of regressions of the risk-adjusted ROA in Model 1-3, respectively of the risk-adjusted CAR in Model 4-6, on the three pillars of the ESG score and its ten sub-components. Control variables are not depicted.

Table 5.8: Multivariate Robust FE Regressions of the Two Channels of the z-score on the ESG score

	(1) z-score (ROA) Coef./se	(2) z-score (ROA) Coef./se	(3) z-score (ROA) Coef./se	(4) z-score (CAR) Coef./se	(5) z-score (CAR) Coef./se	(6) z-score (CAR) Coef./se
L.ESG score	0.0866***	0.0888***	0.0744***	0.7193***	0.6860***	0.5431***
	(0.01)	(0.01)	(0.02)	(0.08)	(0.08)	(0.09)
L.logFTE		-0.0743	0.1626		0.2593	2.1525
		(0.77)	(0.78)		(3.53)	(3.46)
L.LR		-0.0000***	-0.0000*		-0.0000***	-0.0000***
		(0.00)	(0.00)		(0.00)	(0.00)
L.LoanRatio		0.0207	0.0176		0.1224	0.1013
		(0.02)	(0.02)		(0.13)	(0.14)
L.DepRatio		0.0397**	0.0283		0.3004***	0.2234**
		(0.02)	(0.02)		(0.09)	(0.09)
L.ROE		-0.0001***	-0.0000		-0.0009***	-0.0006**
		(0.00)	(0.00)		(0.00)	(0.00)
L.Inflation			-0.0217			-0.0056
			(0.05)			(0.31)
L.GDP_{Cap}^{Growth}			0.2431***			1.0090***
			(0.05)			(0.31)
L.GDP_{Cap}			0.0002			0.0014
			(0.00)			(0.00)
Constant	2.6238***	-0.6165	-7.884	3.7116	-24.2422	-83.4566**
	(0.70)	(6.95)	(7.57)	(4.13)	(33.98)	(40.96)
N	3,949	3,200	3,117	3,953	3,203	3,120
R^2_{adj}	0.0231	0.0283	0.0427	0.0432	0.0466	0.0626

Note: The table shows the coefficients and standard errors (in parenthesis) of multivariate robust FE regressions. The dependent variables are the different sub-components of the z-score, i.e. the risk-weighted ROA and the risk-weighted CAR. The independent variables are the ESG score and bank and country specific control variables. The independent variables are 1 year lagged. Significance is denoted at the 10% (*), 5% (**), and 1% (***) significance level. Data is winsorised at the 1^{st} and the 99^{th} percentile.

Table 5.9: Multivariate Robust FE Regressions of the Two Channels of the z-score on the Pillars and Sub-Components of the ESG score

	(1)	(2)	(3)	(4)	(5)	(6)
	z-score (ROA) Coef./se	z-score (ROA) Coef./se	z-score (ROA) Coef./se	z-score (CAR) Coef./se	z-score (CAR) Coef./se	z-score (CAR) Coef./se
L.EnvPillar	0.0629***	0.0649***	0.0555***	0.4958***	0.4766***	0.3837***
	(0.01)	(0.01)	(0.01)	(0.06)	(0.06)	(0.07)
L.SocPillar	0.0530***	0.0517***	0.0356***	0.4654***	0.4061***	0.2602***
	(0.01)	(0.01)	(0.01)	(0.07)	(0.07)	(0.08)
L.GovPillar	0.0300***	0.0286***	0.0247***	0.2581***	0.2420***	0.2016***
	(0.01)	(0.01)	(0.01)	(0.05)	(0.06)	(0.05)
L.Env. Innovation	0.0379***	0.0405***	0.0309***	0.2900***	0.2894***	0.2000***
	(0.01)	(0.01)	(0.01)	(0.05)	(0.06)	(0.06)
L.Emissions	0.0460***	0.0441***	0.0370***	0.3544***	0.3177***	0.2511***
	(0.01)	(0.01)	(0.01)	(0.04)	(0.05)	(0.05)
L.Resource Use	0.0500***	0.0495***	0.0437***	0.4138***	0.3782***	0.3205***
	(0.01)	(0.01)	(0.01)	(0.05)	(0.05)	(0.06)
L.Community	0.0009	-0.0037	-0.0114	0.0798*	0.0360	-0.0275
	(0.01)	(0.01)	(0.01)	(0.04)	(0.05)	(0.05)
L.Human Rights	0.0347***	0.0343***	0.0240***	0.2690***	0.2332***	0.1361***
	(0.01)	(0.01)	(0.01)	(0.05)	(0.05)	(0.05)
L.Product Respon.	0.0182**	0.0164**	0.0064	0.1564***	0.1129*	0.0320
	(0.01)	(0.01)	(0.01)	(0.05)	(0.06)	(0.05)
L.Workforce	0.0371***	0.0374***	0.0310***	0.3069***	0.2809***	0.2176***
	(0.01)	(0.01)	(0.01)	(0.04)	(0.05)	(0.05)
L.CSR-strategy	0.0303***	0.0248***	0.0167**	0.2127***	0.1495***	0.0723*
	(0.01)	(0.01)	(0.01)	(0.04)	(0.04)	(0.04)
L.Management	0.0202***	0.0205***	0.0184***	0.1653***	0.1644***	0.1430***
	(0.01)	(0.01)	(0.01)	(0.04)	(0.04)	(0.04)
L.Shareholders	-0.0025	-0.0037	-0.0031	0.0176	0.0134	0.0145
	(0.01)	(0.01)	(0.01)	(0.04)	(0.05)	(0.04)
Bank controls	No	Yes	Yes	No	Yes	Yes
Country controls	No	No	Yes	No	No	Yes
N	3,949	3,200	3,117	3,953	3,203	3,120

Note: The table shows the coefficients and standard errors (in parenthesis) of multivariate robust FE regressions. The dependent variables are the different sub-components of the z-score, i.e. the risk-weighted ROA and the risk-weighted CAR. The independent variables are the ESG score, its three pillars, and ten sub-components. Control variables are not depicted. Column (1) and (4) provide univariate results. The regression coefficients in column (2) and (5) account for bank specific control variables. Those in column (3) and (6) account for bank and country specific controls. The independent variables are 1 year lagged. Significance is denoted at the 10% (*), 5% (**), and 1% (***) significance level. Data is winsorised at the 1^{st} and the 99^{th} percentile.

5.6 Conclusions

CSR has gained a lot of attention in recent years. Our study examines the relationship between CSR activities and bank risk. We contribute to the literature in the following ways: whereas the majority of studies explore the effects of CSR on firm risk for non-financial companies, our focus is specifically on banks. For this purpose, we use a data set of 582 banks worldwide, covering the period from 2002 to 2018. In order to address the bank specifics, we analyse the CSR effect on both default risk and portfolio risk. Namely, we use the z-score as a proxy for default risk and RD to measure portfolio risk. We examine the effect of CSR on bank risk at an aggregate CSR level, both individually for the three CSR pillars as well as for the pillars' ten sub-components. Our first hypothesis addresses the impact of overall CSR on banks' default risk and portfolio risk. We find strongly significant risk-reducing effects for both risk measures. The breakdown of the default risk measure z-score into individual components indicates that CSR has a positive association with both risk-adjusted ROA and risk-adjusted CAR. On this basis, our second research question analyses the isolated effects of the environmental, social, and governance pillars on a bank's risk. In contrast to the overall results, the analysis of the individual pillars presents a slightly different picture. The risk-reducing effect of the environmental pillar still applies to both risk measures, yet for the social and governance pillars, there is only a statistically significant risk-reducing effect on default risk, but not on portfolio risk. In order to understand the reasons for these results, we conducted an analysis of the pillars' sub-components. The observed effects of all the sub-components of the environmental pillar are consistent with previous results. Thereby, it appears that all sub-components of this pillar (Emissions, Environmental Innovation, Resource Use) have a strongly significant impact on z-score and RD. This implies that the environmental pillar and its sub-components determine the risk reduction. Considering the social pillar and the governance pillar, we do not find unambiguous results. Only the sub-components Human Rights and CSR-strategy have unequivocally risk-reducing effects on both risk measures. To conclude, our empirical analysis supports our second hypothesis entirely concerning the environmental pillar, whereas only for specific sub-components of the social and the governance pillar, and so it can be unambiguously inferred that they reduce both bank risk measures. This means, as an implication for the risk management of banks, that integrating ESG factors into day-to-day business and lending activities reduces default and portfolio risk.

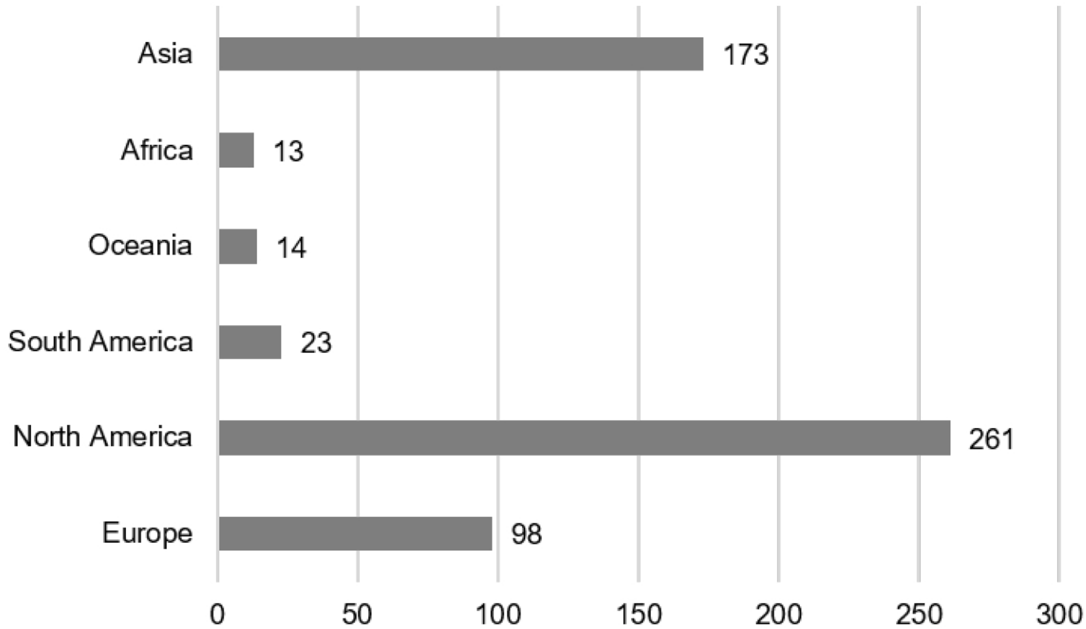
Our results have relevant theoretical and practical implications. From a scientific and analytical point of view, we contribute additional insights on influencing factors of banks' default and portfolio risk. From the bank management perspective, we provide an additional rationale to consider environmental aspects in particular. The association with lower bank risk should serve as encouragement and additional argument in internal decision-making processes. Because of the identified association, it is in the bank's own interest to improve its environmental CSR. From a regulator's and law maker's perspective, our results support attempts to foster CSR-compliant behavior.

We are aware of the limitations of our study. Certainly, one issue is the unbalanced panel structure. In addition, the unique use of the Thomson Reuters database carries the inherent risk of selection bias. Moreover, it could be interesting to use additional risk measures to enhance the validity of the results. However, due to a lack of data availability (e.g. Credit Default Swap spreads or non-performing loans), this is not feasible. Also, we are aware that we are not in a position to draw final conclusions about the suitability of a 'Green Supporting Factor', because we only have evidence on the relationship between environmental engagement and risk, but not on the average risk weight of a 'green' investment.

The following aspects could be interesting for further investigation. First, the validity of our results could be verified by using other risk measures, in particular market-based measures. Likewise, it might be useful to decompose the risk measure RD into single risk types (credit, market, and operational risk) to examine the impact of the ESG pillars and the sub-components on these different types of risk. In the same way, natural disasters like Fukushima or Hurricane Sandy could be used as a reference for natural experiments to investigate the relationship and test our results. These would, also, provide evidence on the perceived risk of market participants. Second, it is highly relevant to examine the interaction of CSR and bank risk with respect to widely known CSR motives, namely strategic, altruistic, and greenwashing. Third, it would be a promising undertaking to perform a detailed analysis of banks' asset structures. In this way, we could further analyse the effect on the RD. Fourth, our study provides first exploratory insights into relevant determinates of the effects of CSR on bank risk. Further research should focus on the specific cause-effect relations between bank risk and the sub-components.

5.7 Appendices

Figure 5.2: Origin of the Banks



The graph above provides information on the regional origin of the banks. Depicted are the absolute numbers of banks per continent. The total number of banks with available ESG scores in the sample is 582.

Table 5.10: Description of Variables

Variable	Description
Panel A:	
z-score	Measure of default risk. It is calculated as the sum of ROA and CAR over the 5 year standard deviation of ROA.
RD	Measure of portfolio risk. It is calculated as risk-weighted assets over total assets and measures the risk on the balance sheet.
Panel B:	
ESG score	Measure of the overall corporate social responsibility. It is calculated as weighted average of the Environmental score, Social score, and Governance score.
Environmental score	Measure of company‘s environmental performance that indicates the impact on natural systems.
Social score	Measure of company‘s social performance about the confidence with employees, customers and society.
Governance score	Measure of company‘s governance practice that indicates the systems and processes installed to guarantee that the management acts in the interests of stakeholders.
Emissions	Measures company‘s emission efficiency in the context of its business activities.
Env. Innovation	Reflects company’s commitment to sustainability e.g. by offering an innovative sustainable product portfolio.
Resource Use	Reflects company‘s eco-efficiency in terms of materials, energy or water.
Community	Reflects company’s social responsibility activities and it‘s business ethics commitment.
Human Rights	Reflects compliance with human rights conventions by the company.
Product Responsibility	Reflects the quality and reliability of the offered products.
Workforce	Reflects on the one hand the working conditions in the company and on the other the offered development opportunities.
CSR-strategy	Reflects company‘s the adoption, application, and reporting of the CSR-strategy.
Management	Reflects management’s compliance within the corporate governance guidelines.
Shareholders	Reflects the handling of shareholders and the prevention of takeovers.
Panel C:	
logFTE	Company size is approximated by the natural logarithm of full-time employees.
LR	Capital structure is considered as the ratio of total liabilities over total equity, i.e. the leverage ratio.
LoanRatio	Business model indicator which measures the loan exposures as total gross loans over total assets.
DepRatio	Business model indicators which measures the deposits exposures as total deposits over total assets.
ROE	Return on equity measures profitability. It is calculated as net income before taxes over total equity.
Panel D:	
Inflation	Rate of price change in the whole economy. Measured by annual growth rate of GDP implicit deflator. *Source: Worldbank*
GDP_{Cap}	Gross domestic product divided by midyear population. *Source: Worldbank*
GDP_{Cap}^{Growth}	Annual growth rate of GDP per capita. *Source: Worldbank*

Note: The table gives short descriptions of the variables used in this study. Panel A comprises the risk measures, Panel B comprises the ESG data, Panel C comprises the bank specific control variables, and Panel D comprises the country specific control variables.

Table 5.11: Correlation Metrics

	z-score	RD	ESG score	EnvPillar	SocPillar	GovPillar
z-score	1.00					
RD	-0.01	1.00				
ESG score	-0.11	-0.29	1.00			
EnvPillar	-0.13	-0.33	0.88	1.00		
SocPillar	-0.12	-0.23	0.88	0.72	1.00	
GovPillar	-0.03	-0.14	0.72	0.42	0.44	1.00

Note: The table shows pairwise correlation coefficients of the risk measures, the ESG score, and its pillars.

Table 5.12: Robustness: Winsorisation Level. Multivariate Robust FE Regressions of Risk on the ESG score

	(1)	(2)	(3)	(4)	(5)	(6)
	z-score	z-score	z-score	RD	RD	RD
	Coef./se	Coef./se	Coef./se	Coef./se	Coef./se	Coef./se
L.ESG score	1.2470***	0.9437***	0.7554***	-0.3249***	-0.1711**	-0.1977**
	(0.12)	(0.13)	(0.15)	(0.10)	(0.08)	(0.08)
L.logFTE		-13.3226*	-10.5866		14.1429	15.5211
		(7.81)	(7.79)		(10.95)	(10.82)
L.LR		0.0000	0.0000*		0.0000	0.0000
		(0.00)	(0.00)		(0.00)	(0.00)
L.LoanRatio		0.2007	0.1580		-0.2862*	-0.2791*
		(0.18)	(0.21)		(0.17)	(0.15)
L.DepRatio		1.5239***	1.3797***		-0.6572***	-0.6790***
		(0.25)	(0.25)		(0.13)	(0.13)
L.ROE		0.2869**	0.2178**		0.1798	0.1603
		(0.13)	(0.10)		(0.14)	(0.13)
L.Inflation			0.9130			0.5084*
			(0.57)			(0.27)
L.GDP_{Cap}^{Growth}			2.4507***			0.4935*
			(0.52)			(0.29)
L.GDP_{Cap}			0.0034**			0.0004
			(0.00)			(0.00)
Constant	-6.5554	-6.1129	-135.8365*	101.7768***	36.8341	12.04271
	(6.19)	(67.25)	(75.47)	(5.49)	(95.11)	(94.01)
N	3,949	3,200	3,117	2,904	2,674	2,635
R^2_{adj}	0.03863	0.1217	0.1485	0.01910	0.1321	0.1381

Note: The table shows the coefficients and standard errors (in parenthesis) of multivariate robust FE regressions. The dependent variables are the bank risk measures z-score and RD. The independent variables are the ESG score and bank and country specific control variables. The independent variables are 1 year lagged. Significance is denoted at the 10% (*), 5% (**), and 1% (***) significance level. Data is winsorised at the 5^{st} and the 95^{th} percentile.

Table 5.13: Robustness: Winsorisation Level. Multivariate Robust FE Regressions of Risk on the Environmental score

	(1)	(2)	(3)	(4)	(5)	(6)
	z-score	z-score	z-score	RD	RD	RD
	Coef./se	Coef./se	Coef./se	Coef./se	Coef./se	Coef./se
L.EnvPillar	0.8414***	0.6674***	0.5480***	-0.2973***	-0.2166***	-0.2390***
	(0.09)	(0.09)	(0.10)	(0.07)	(0.05)	(0.05)
L.logFTE		-13.1616*	-10.8003		15.5576	16.9864
		(7.61)	(7.58)		(11.00)	(10.90)
L.LR		0.0000	0.0000		0.0000	0.0000
		(0.00)	(0.00)		(0.00)	(0.00)
L.LoanRatio		0.1798	0.1303		-0.2520	-0.2475
		(0.18)	(0.21)		(0.17)	(0.15)
L.DepRatio		1.5579***	1.4059***		-0.6669***	-0.6930***
		(0.25)	(0.25)		(0.13)	(0.13)
L.ROE		0.2916**	0.2241**		0.1648	0.14435
		(0.13)	(0.10)		(0.14)	(0.12)
L.Inflation			0.8935			0.45077*
			(0.58)			(0.26)
L.GDP_{Cap}^{Growth}			2.3539***			0.5154*
			(0.53)			(0.29)
L.GDP_{Cap}			0.0035**			0.0005
			(0.00)			(0.00)
Constant	13.8755***	5.1654	-126.9003*	100.534***	25.1409	-2.3088
	(4.61)	(66.73)	(74.30)	(3.67)	(95.61)	(94.68)
N	3,949	3,200	3,117	2,904	2,674	2,635
R^2_{adj}	0.0356	0.1220	0.1498	0.0326	0.1418	0.1486

Note: The table shows the coefficients and standard errors (in parenthesis) of multivariate robust FE regressions. The dependent variables are the bank risk measures z-score and RD. The independent variables are the ESG environment pillar score and bank and country specific control variables. The independent variables are 1 year lagged. Significance is denoted at the 10% (*), 5% (**), and 1% (***) significance level. Data is winsorised at the 5^{st} and the 95^{th} percentile.

Table 5.14: Robustness: Winsorisation Level. Multivariate Robust FE Regressions of Risk on the Social score

	(1)	(2)	(3)	(4)	(5)	(6)
	z-score	z-score	z-score	RD	RD	RD
	Coef./se	Coef./se	Coef./se	Coef./se	Coef./se	Coef./se
L.SocPillar	0.8381***	0.5875***	0.4035***	-0.1452*	-0.0340	-0.0504
	(0.10)	(0.11)	(0.12)	(0.08)	(0.06)	(0.06)
L.logFTE		-10.0831	-7.3860		12.7165	13.9480
		(8.00)	(7.96)		(10.93)	(10.78)
L.LR		0.0000	0.0000		0.0000	0.0000
		(0.00)	(0.00)		(0.00)	(0.00)
L.LoanRatio		0.2696	0.2013		-0.3070*	-0.2920*
		(0.19)	(0.22)		(0.17)	(0.15)
L.DepRatio		1.5414***	1.3856***		-0.6658***	-0.6853***
		(0.25)	(0.25)		(0.13)	(0.13)
L.ROE		0.2699**	0.2023**		0.1861	0.1663
		(0.12)	(0.09)		(0.15)	(0.14)
L.Inflation			0.6410			0.5933**
			(0.56)			(0.27)
L.GDP_{Cap}^{Growth}			2.3818***			0.5064*
			(0.53)			(0.29)
L.GDP_{Cap}			0.0037**			0.0002
			(0.00)			(0.00)
Constant	14.5633***	-22.9463	-160.6256**	92.3738***	44.9294	24.7033
	(4.93)	(69.05)	(77.25)	(4.20)	(94.87)	(93.62)
N	3,949	3,200	3,117	2,904	2,674	2,635
R^2_{adj}	0.0242	0.1113	0.1408	0.0047	0.1281	0.1333

Note: The table shows the coefficients and standard errors (in parenthesis) of multivariate robust FE regressions. The dependent variables are the bank risk measures z-score and RD. The independent variables are the ESG social pillar score and bank and country specific control variables. The independent variables are 1 year lagged. Significance is denoted at the 10% (*), 5% (**), and 1% (***) significance level. Data is winsorised at the 5^{st} and the 95^{th} percentile.

Table 5.15: Robustness: Winsorisation Level. Multivariate Robust FE Regressions of Risk on the Governance score

	(1)	(2)	(3)	(4)	(5)	(6)
	z-score	z-score	z-score	RD	RD	RD
	Coef./se	Coef./se	Coef./se	Coef./se	Coef./se	Coef./se
L.GovPillar	0.4429***	0.2986***	0.2331***	-0.0948	-0.0046	-0.0067
	(0.08)	(0.08)	(0.08)	(0.07)	(0.06)	(0.07)
L.logFTE		-3.8763	-3.5309		12.2327	13.3483
		(8.01)	(7.85)		(10.83)	(10.70)
L.LR		0.0000	0.0000		0.0000	0.0000
		(0.00)	(0.00)		(0.00)	(0.00)
L.LoanRatio		0.3397*	0.2430		-0.3129*	-0.2971*
		(0.19)	(0.22)		(0.17)	(0.15)
L.DepRatio		1.5292***	1.3678***		-0.6648***	-0.6828***
		(0.25)	(0.25)		(0.13)	(0.13)
L.ROE		0.2328**	0.1768**		0.1885	0.1694
		(0.10)	(0.08)		(0.15)	(0.14)
L.Inflation			0.5368			0.6159**
			(0.57)			(0.27)
L.GDP_{Cap}^{Growth}			2.4503***			0.4994*
			(0.54)			(0.29)
L.GDP_{Cap}			0.0039**			0.0002
			(0.00)			(0.00)
Constant	34.5381***	-67.3896	-192.8314***	89.5592***	47.7339	29.0979
	(4.20)	(70.68)	(74.38)	(3.72)	(94.54)	(93.01)
N	3,949	3,200	3,117	2,904	2,674	2,635
R^2_{adj}	0.0090	0.1040	0.1384	0.0027	.1278047	0.1328

Note: The table shows the coefficients and standard errors (in parenthesis) of multivariate robust FE regressions. The dependent variables are the bank risk measures z-score and RD. The independent variables are the ESG governance pillar score and bank and country specific control variables. The independent variables are 1 year lagged. Significance is denoted at the 10% (*), 5% (**), and 1% (***) significance level. Data is winsorised at the 5^{st} and the 95^{th} percentile.

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